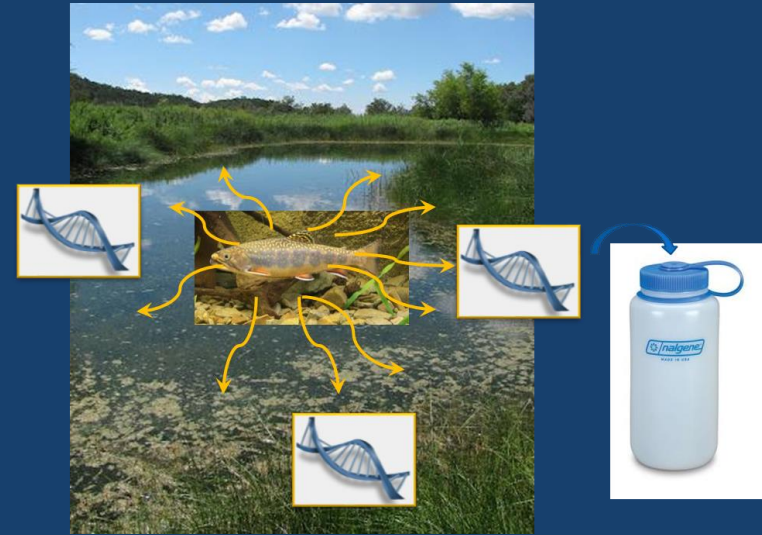
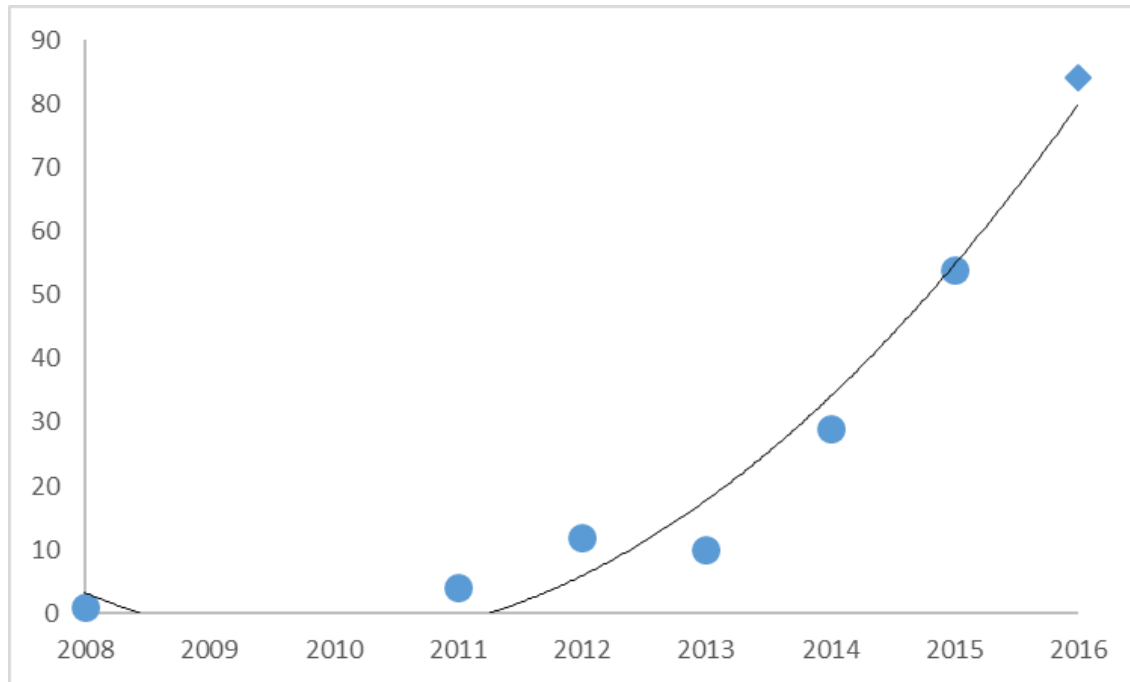


Environmental DNA detection of salmonids

Katherine Strickler
Caren Goldberg
Alexander Fremier



eDNA detection papers



biology *Biol. Lett.*
Conserv Genet
DOI 10.1007/s10592-015-0775-4

OPEN ACCESS Freely available online PLOS ONE

Estimation of Fish Biomass Using Environmental DNA
Teruhiko Takahara^{1,2*}, Toshifumi Minamoto¹, Hiroki Yamanaka³, Hideyuki Doi², Zen'ichiro Kawabata¹

Transport Distance of Invertebrate Environmental DNA in a Natural River
Matthew A. Baer¹, Kristy Deiner^{2*}, Florian Altermatt²

Environmental DNA Surveillance for Invertebrate Species: Advantages and Technical Limitations to Detect Invasive Crayfish *Procambarus clarkii* in Freshwater
Anne Trégouët¹, Tréguier Schlaepfer¹

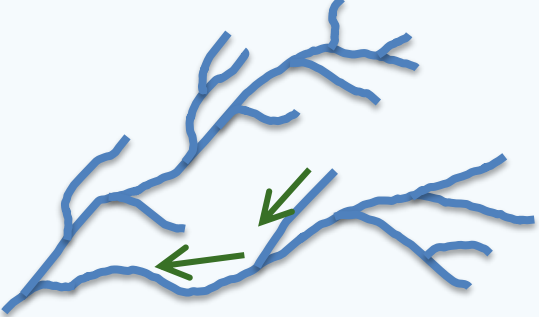
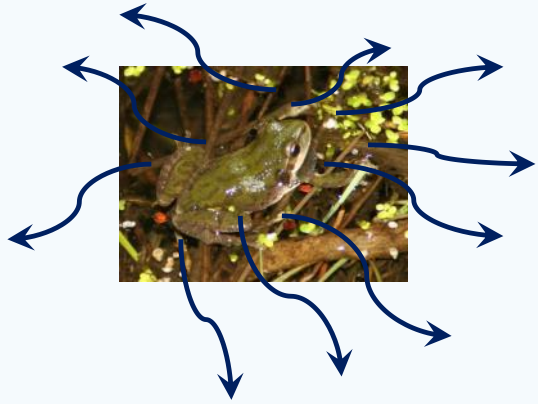
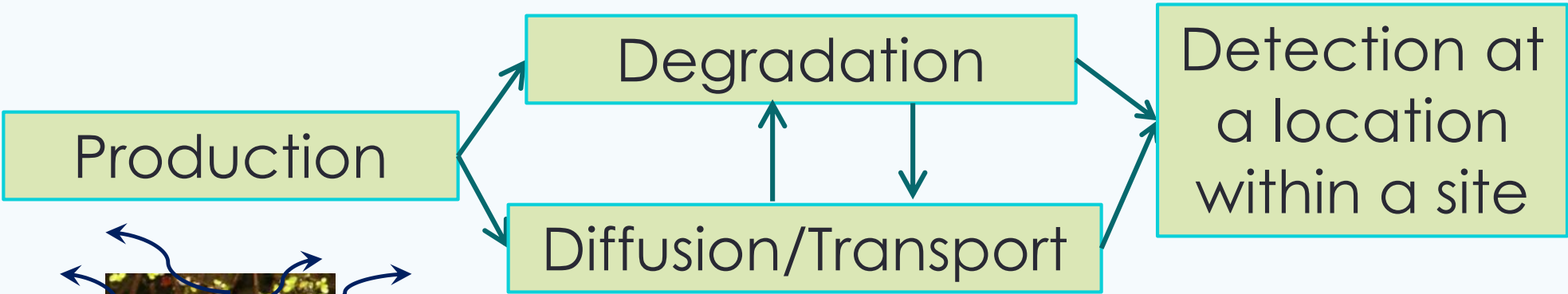
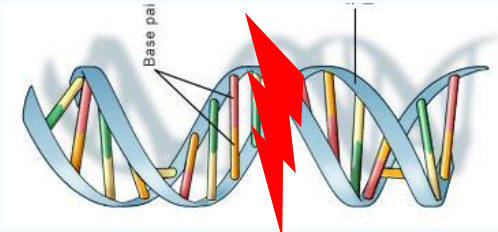
Investigating the Potential Use of Environmental DNA (eDNA) for Genetic Monitoring of Marine Mammals
Philip Francis Thomsen^{1,2,3}, Signe Sveegaard², Magnus Wahlberg^{3,4}, Jos Kielgast¹, Line A. Kyhn², Andreas B. Salling¹, Anders Galatius², Ludovic Orlando¹, M. Thomas P. Gilbert¹

PHILIP FRANCIS THOMSEN^{1,2,3}, SIGNE SVEEGAARD², MAGNUS WAHLBERG^{3,4}, JOS KIELGAST¹, LINE A. KYHN², ANDREAS B. SALLING¹, ANDERS GALATIUS², LUDOVIC ORLANDO¹, M. THOMAS P. GILBERT¹

OPEN ACCESS Freely available online PLOS ONE

Molecular Detection of Vertebrates in Stream Water: A Demonstration Using Rocky Mountain Tailed Frogs and Idaho Giant Salamanders
Caren S. Goldberg^{1*}, David S. Pilliod², Robert S. Arkle², Lisette P. Waits¹

Processes affecting eDNA detection





Our focus: understanding processes

- Degradation rates related to pH, UV, and temperature
- eDNA transport in streams
- Cross-sectional distribution of eDNA
- Longitudinal distribution of eDNA
- Detection of nuclear vs. mitochondrial DNA

Salmonid assays

- Bull trout - ITS1 (repeated nuclear gene)
- Brook trout - cyt b (mitochondrial)
 - Wilcox et al. (2013) assay
- Chinook – COI (mitochondrial)
 - Laramie et al. (2015) assay





Yakima Training Center

- 8 sites on Lmumma and Alkali Creeks (2012-2013)
- Ran assays for brook trout, bull trout, and Chinook





Yakima Training Center

- Brook trout detected at 1 site in Alkali Creek
- No other species detected





Brook Trout

- 64 surveys over 3 years (2013-2015) in Yakima and Idaho
- Ran brook trout assay for all samples
- Detections:
 - Upper Alkali Creek (YTC)
 - Lower Yakima River
 - American River
 - Union Creek
 - SF of the Tieton River (slightly positive in 1 samples at 1 site)





Bull Trout

- 62 surveys over 3 years (2013-2015) in Yakima and Idaho
- Detected eDNA at every site with redd counts
- Detected eDNA at 1 site that field crews didn't find redds
 - Lake Pend Oreille tributary
 - above a recent barrier





North Fork of the Teanaway River

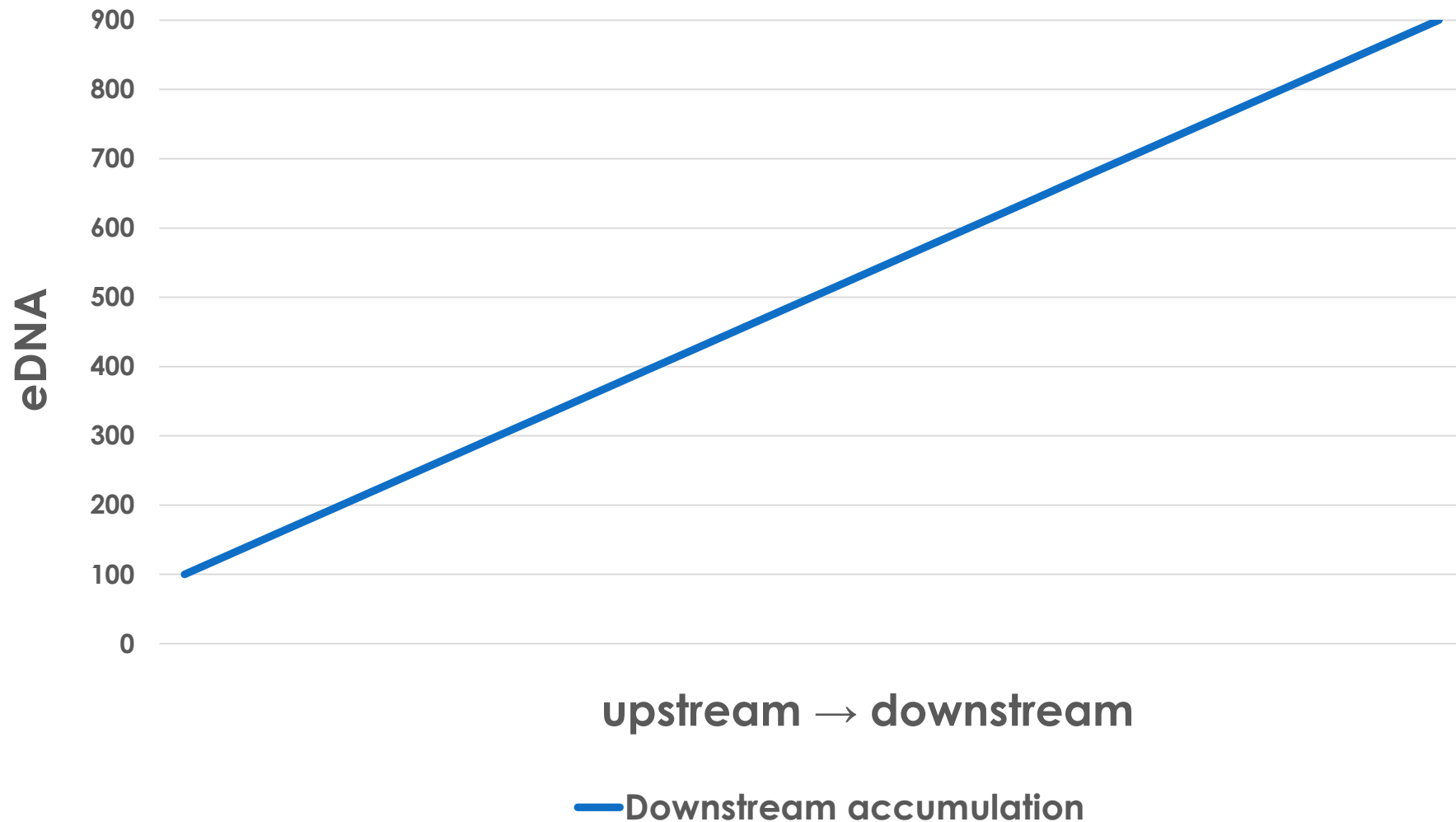
Bull trout eDNA sampling

- 2012: 2 sites
- 2013: 7 sites + 5 sites downstream from probable redd
- No detections



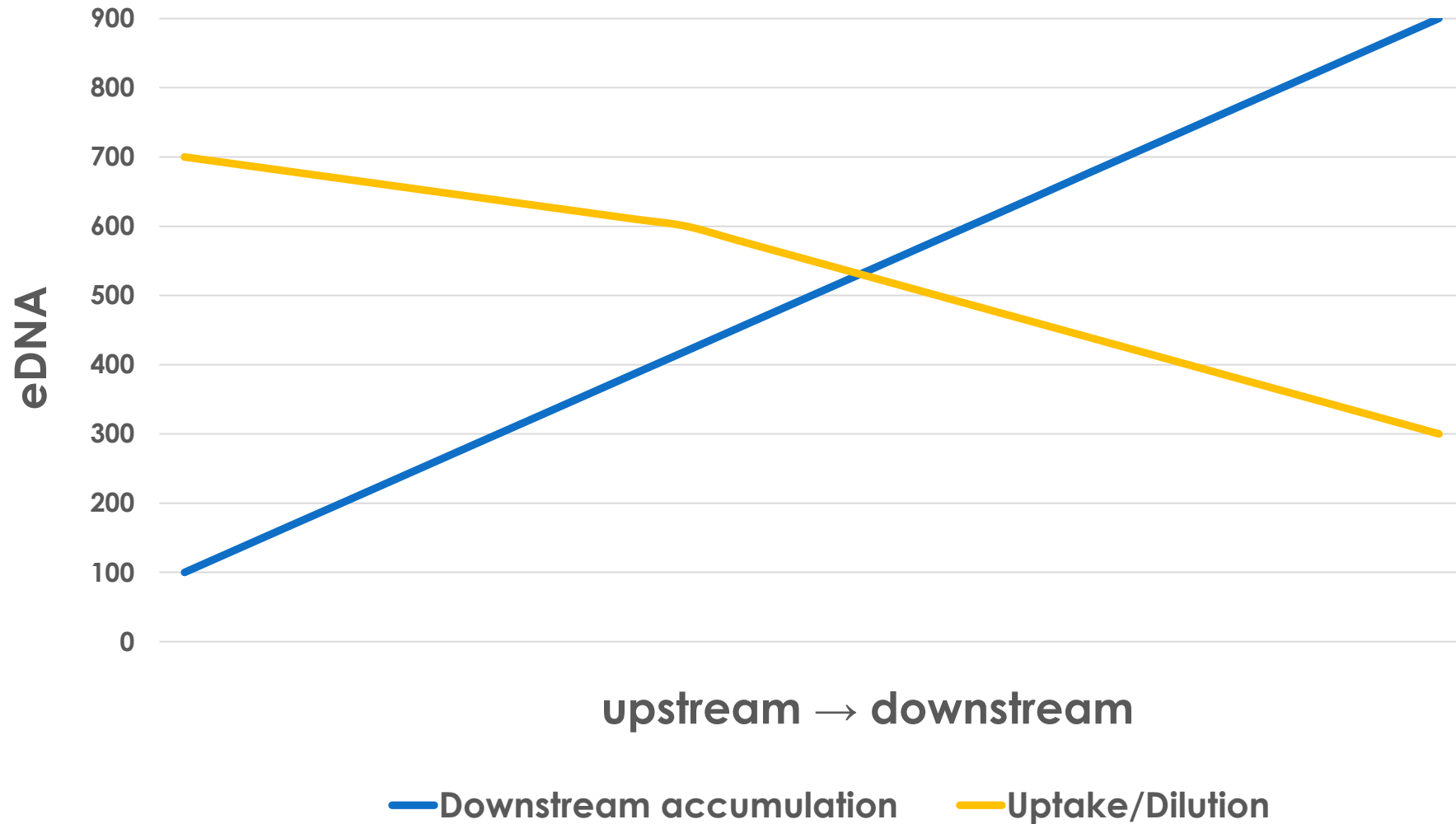


eDNA in streams: longitudinal



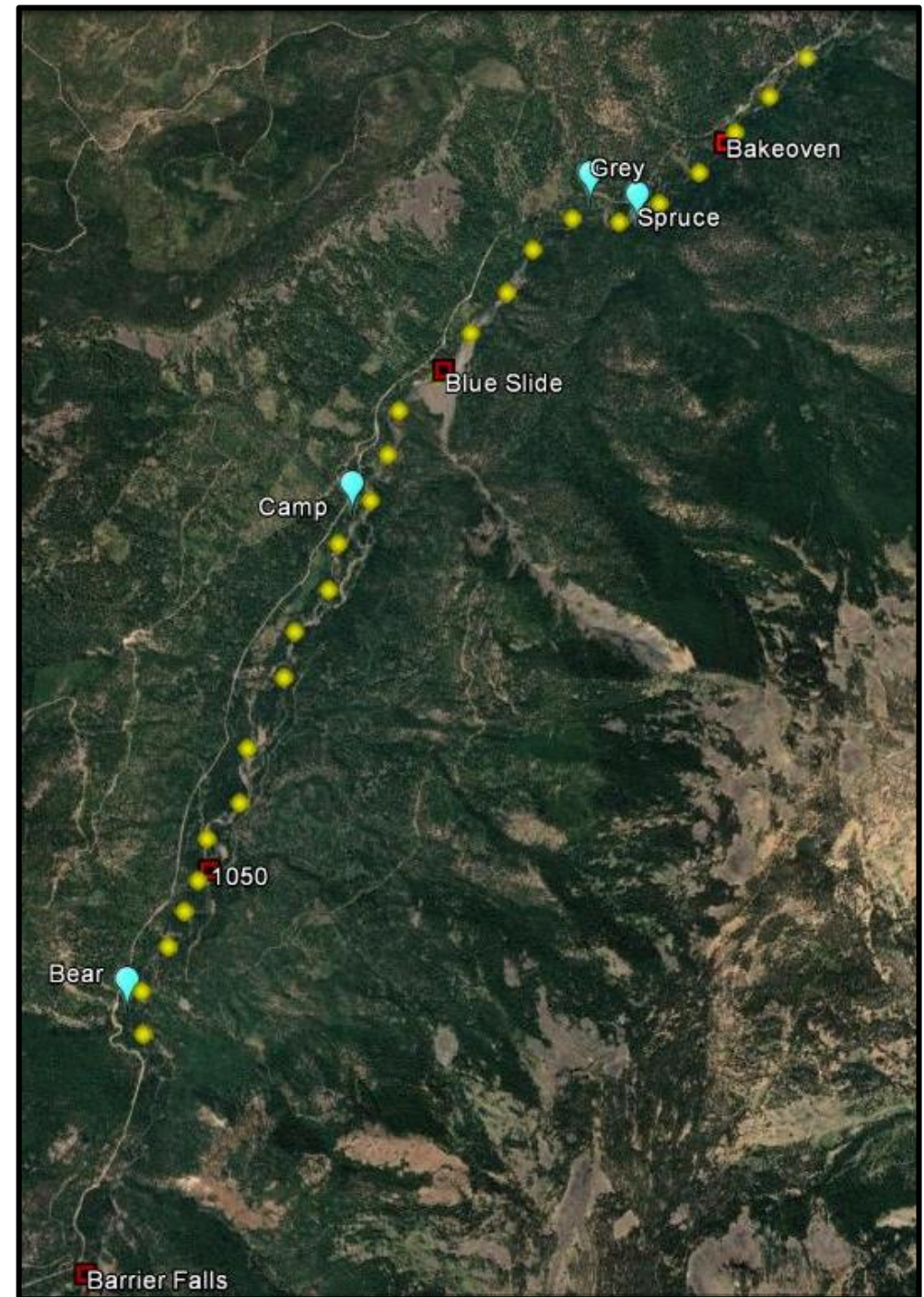


eDNA in streams: longitudinal



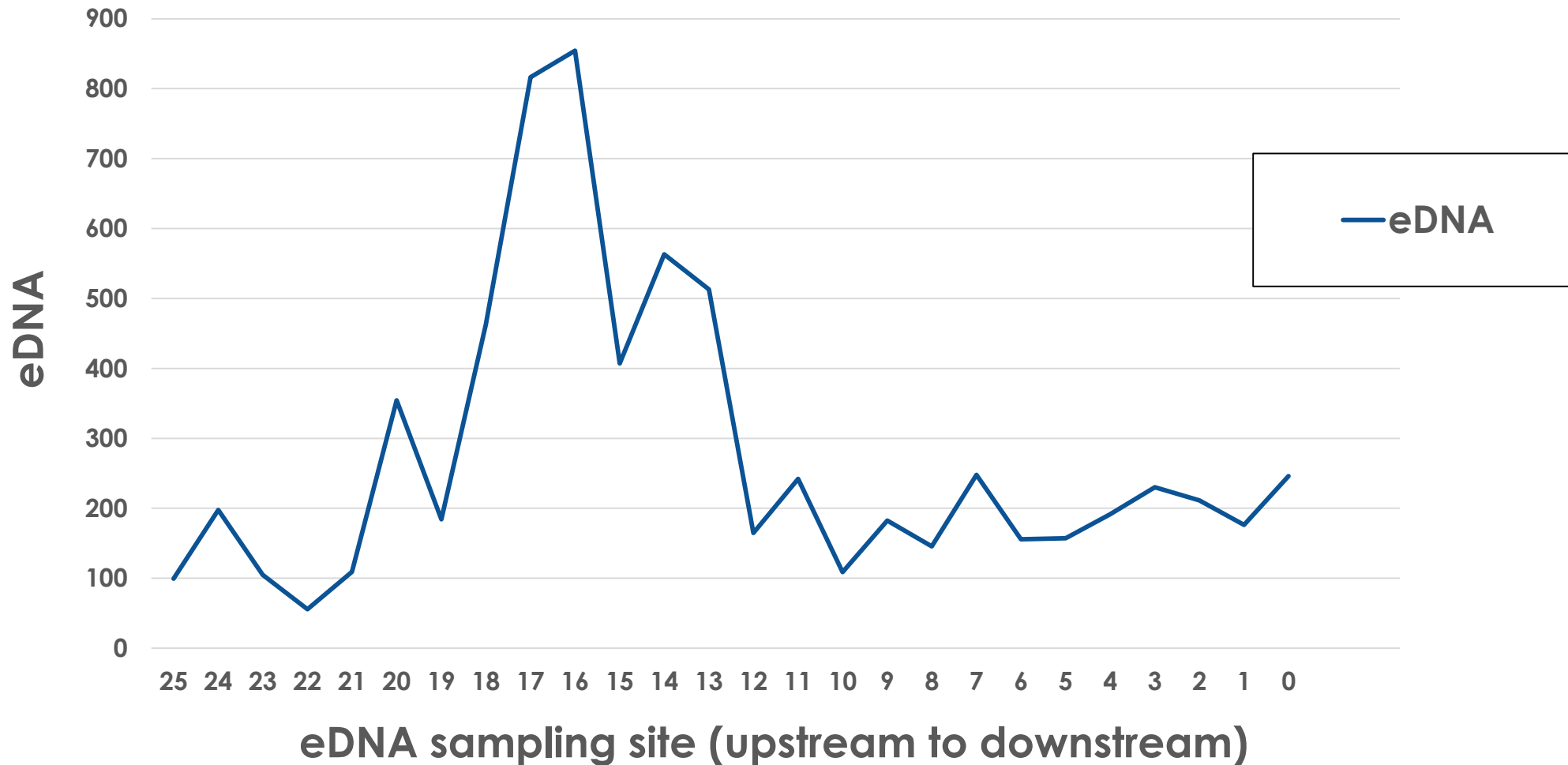
South Fork Tieton

- 26 mainstem sampling sites
 - 400 m segments
- 4 tributaries
- 4 samples/site (1 L samples)
- October 24-25, 2015



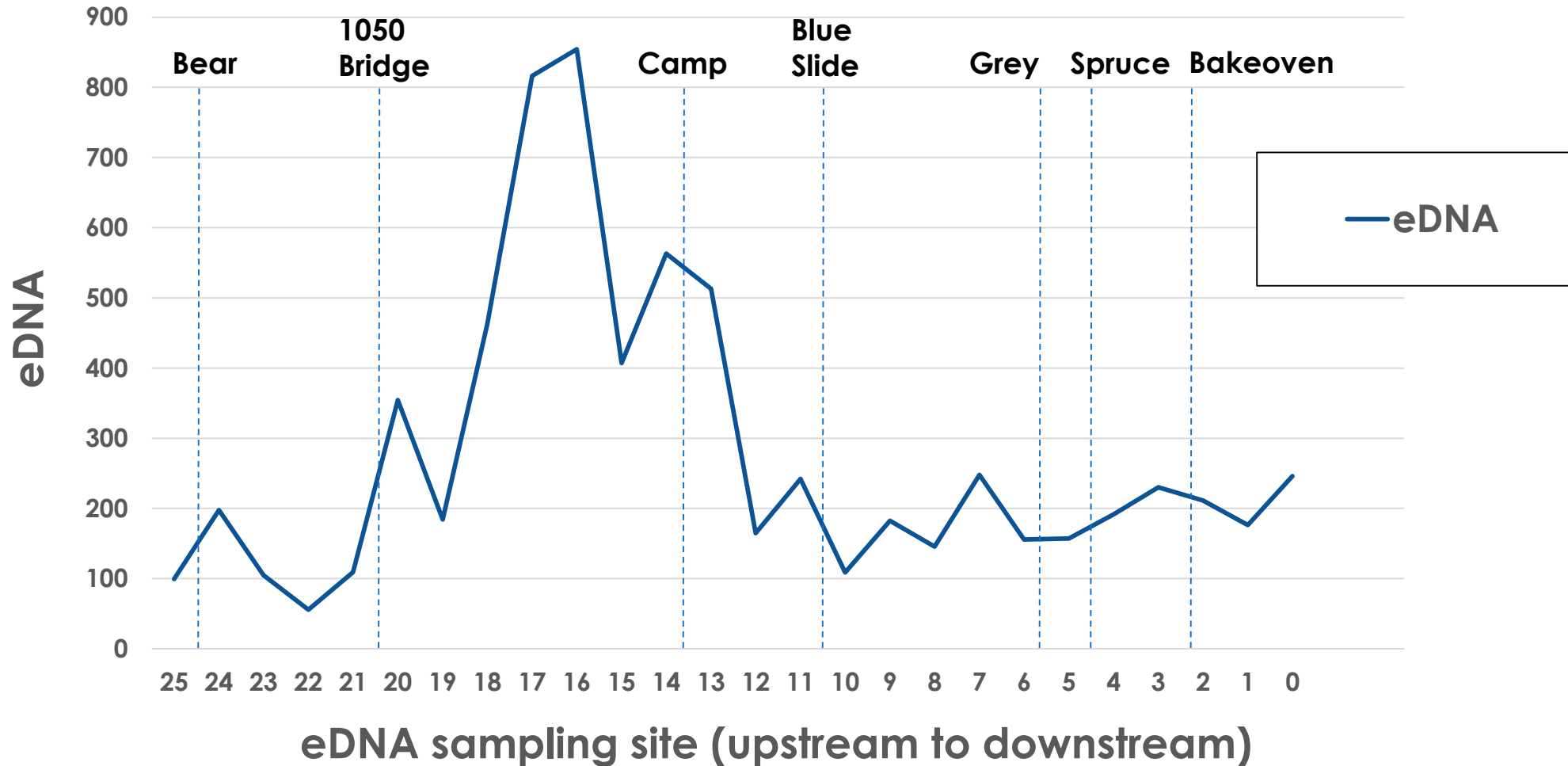


South Fork Tieton



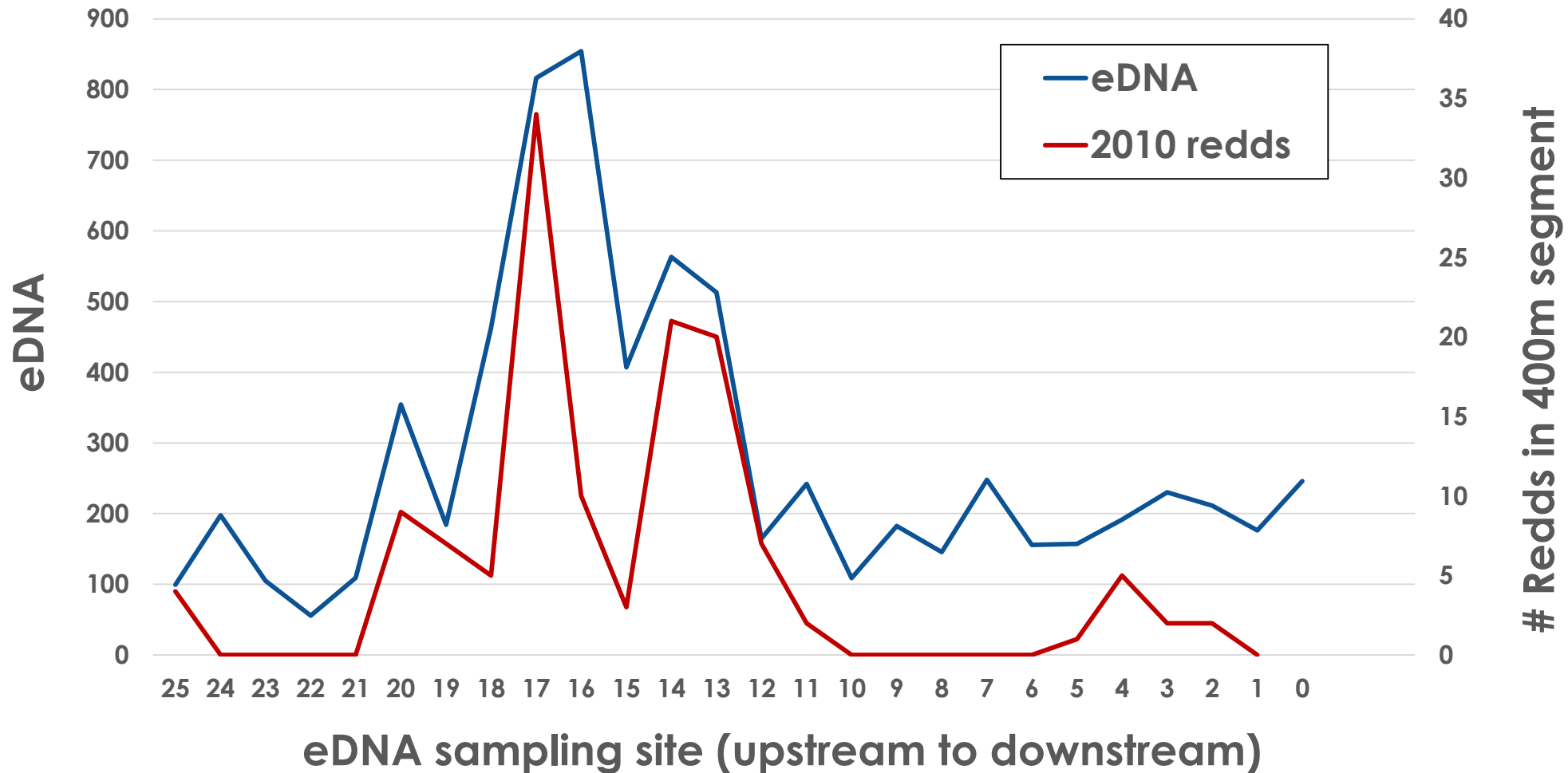


South Fork Tieton



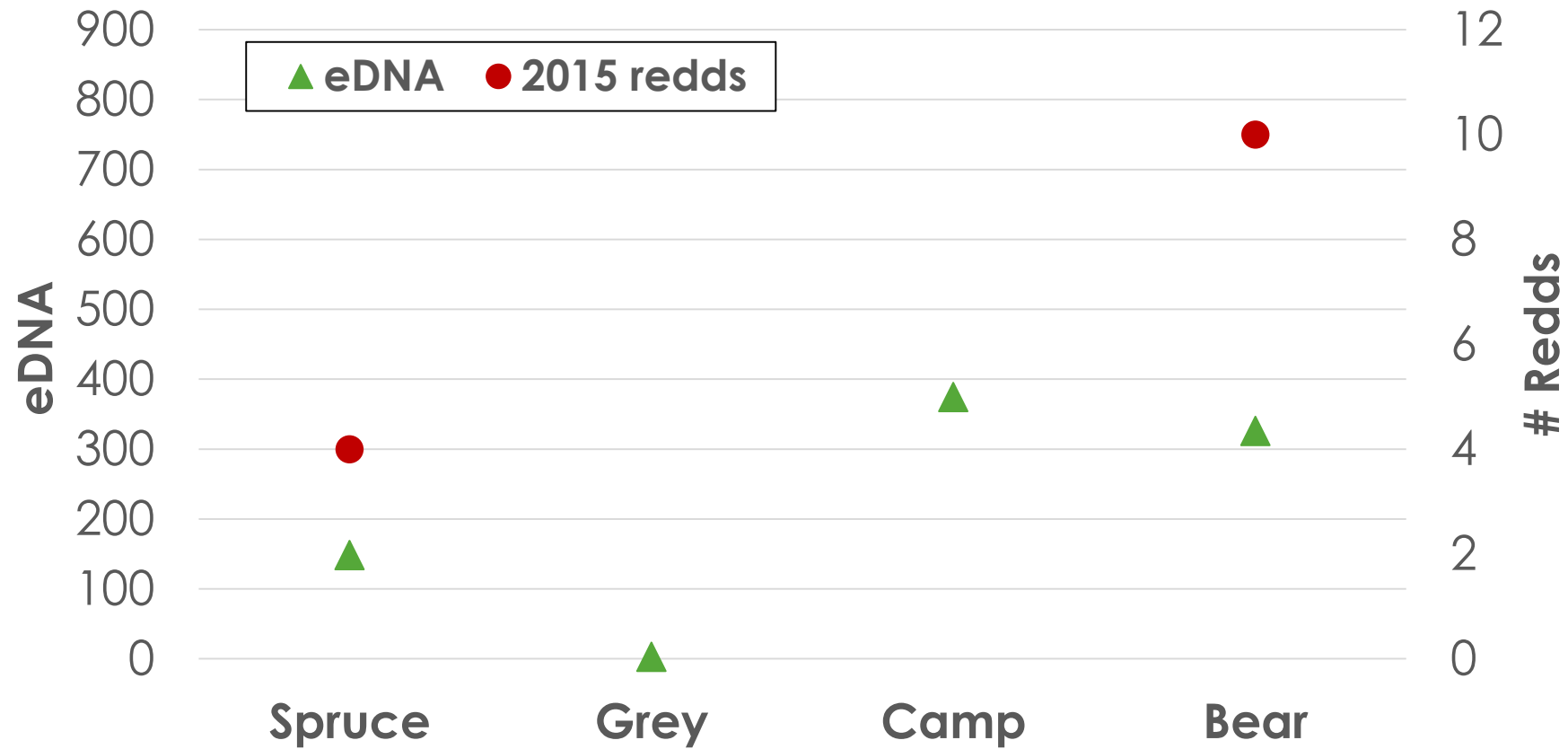


South Fork Tieton





South Fork Tieton

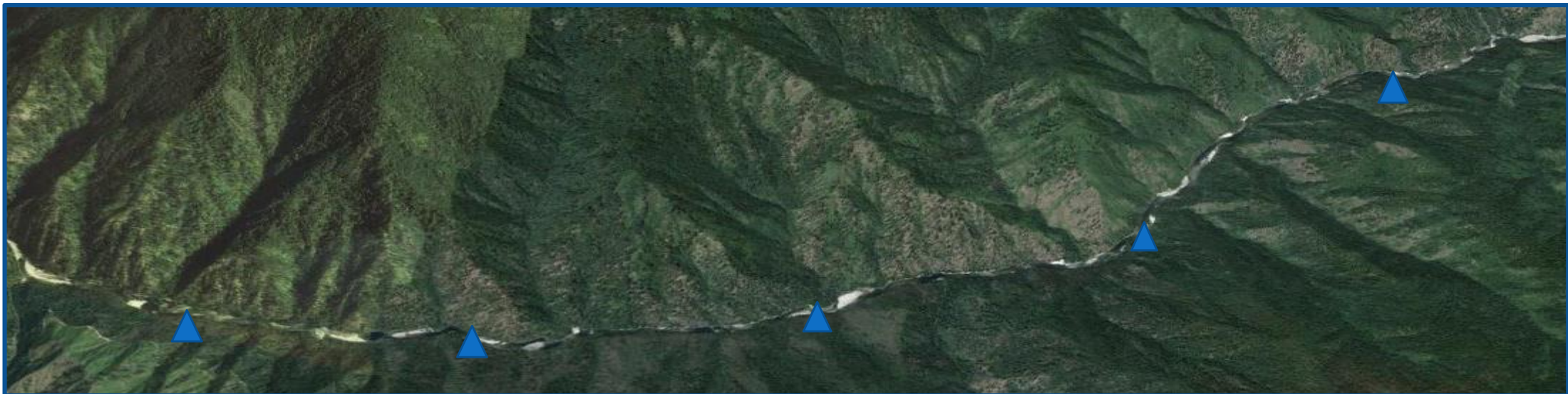




eDNA in streams: cross-section

Where to sample?

- High density sampling:
- 3 bull trout streams, 5 transects per stream





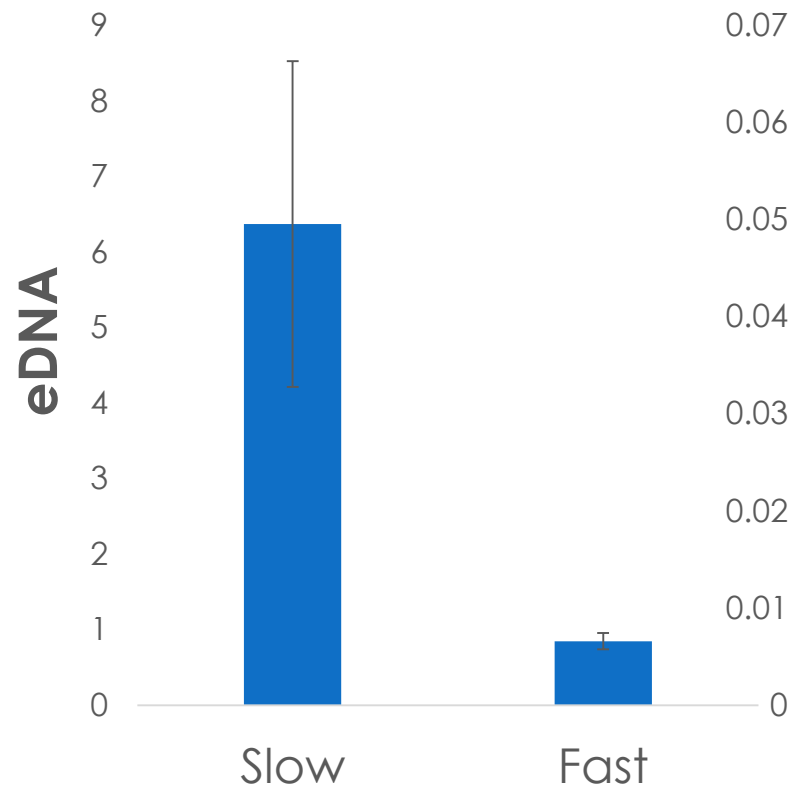
eDNA in streams: cross-section

Where to sample?

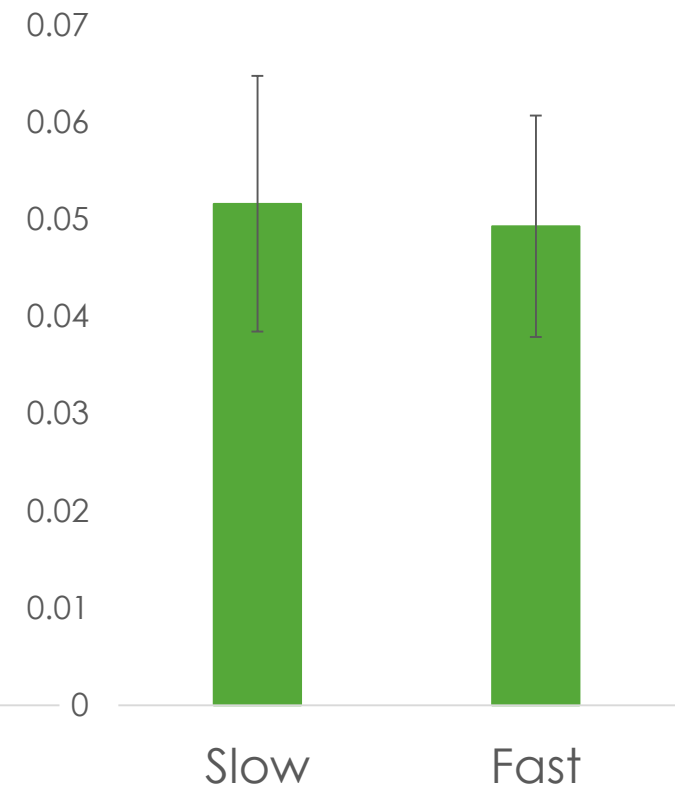
► Thalweg vs. pools



Bull trout



Tailed Frog





Fall vs. spring run analysis

- Some taxa do not have genetic fixed differences, instead varying by frequency

Fixed difference:



Taxon 1

Taxon 2

Frequency-based difference:



Taxon 1

Taxon 2

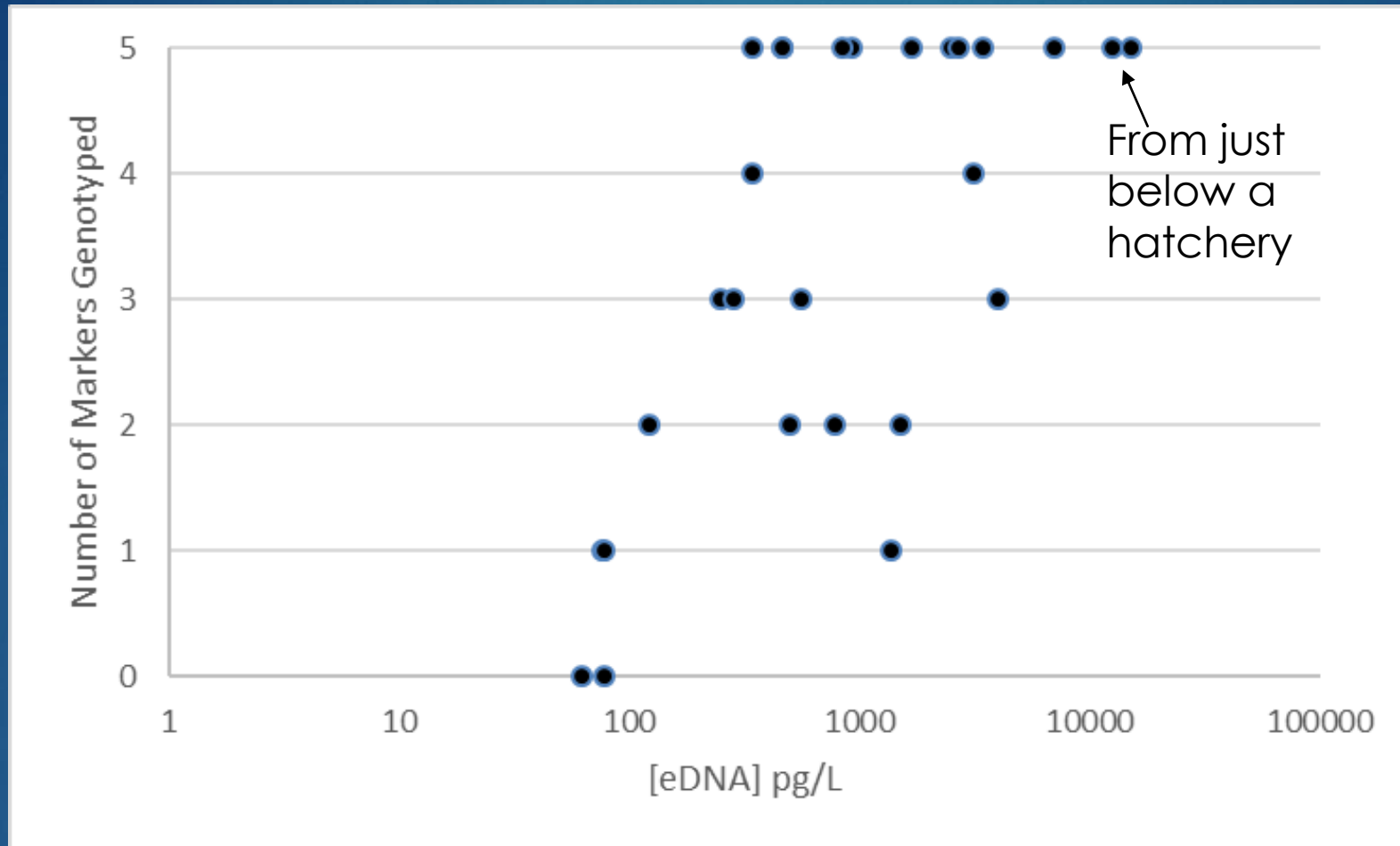
These are a challenge for eDNA assays because we need information from nuclear genes (much more rare than mitochondria)



Fall vs. spring run analysis

- Through collaboration with CRITFC (Shawn Narum), we identified 5 SNPs that only amplified Chinook DNA
- Statistically, an assignment to fall or spring run can be made with 4 of these SNPs
- However, if both alleles (A/G) are present but we only pick up one, that will give a false signal.
- How much Chinook eDNA do we need to correctly assign a run?

Chinook SNPs from eDNA samples



Empirical minimum

Minimum for run identification by probability

From just below a hatchery

Sample contribution from Matt Laramie

Figure 5-5. Relationship between Chinook eDNA concentration in sample replicate and the number of single nucleotide polymorphism markers that generated data for run-specific analysis. A minimum of 4 markers was required for run identification.



Summary

- eDNA concentration is related to where fish are (longitudinally and cross sectionally)
 - Laramie et al. 2015: longitudinal sampling in Methow
 - no accumulation, localized concentrations
 - Strobel et al. in press: Chinook and Coho redds
 - More eDNA of the species that made the redd, but mixed in water column
- New approaches for ESUs



eDNA online resource center


- Knowledge base
 - Intro to eDNA
 - Project profiles
 - Lessons learned
 - Links to research and commercial labs
- Guidance
 - Protocols
 - Technical details
- Community hub
 - Information exchange
 - Emerging technology

<https://labs.wsu.edu/edna>



EDNA Resources
A hub of eDNA technology and testing information

All About eDNA



All About eDNA
New to Environmental DNA? Looking to learn more about Environmental DNA testing protocols, tips, and latest research? You've come to the right place. eDNA technology is constantly changing and improving, and this resource site is a community collection that keeps

Intro to eDNA
Test content: Introduction to eDNA Environmental DNA is a field-to-lab testing methodology that can facilitate rapid identification of species within aquatic systems—from ponds and streams to deep bodies of water. It has proven to be extremely useful in some scenarios.

Project Profile: Bullfrog Eradication
Using eDNA with species management strategies: Invasive species detection Impact: Threatens livelihood of at-risk species Role of eDNA: can be used to detect bullfrog presence and assist with ongoing monitoring of water systems Lorem ipsum dolor sit amet, consectetur

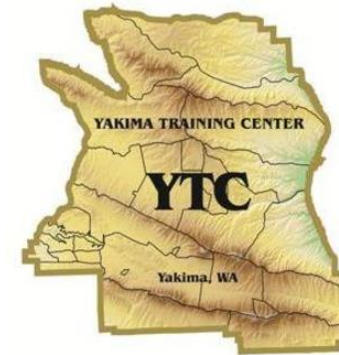
Watch instructional videos
Recorded webinars, workshops, and protocol videos to help you quickly get up to speed on how eDNA technology can best be used.

View media

Guidance Materials
Learn more about eDNA in the latest and most significant findings in research reference material.

@eDNAresources

Thank You



University of Idaho

