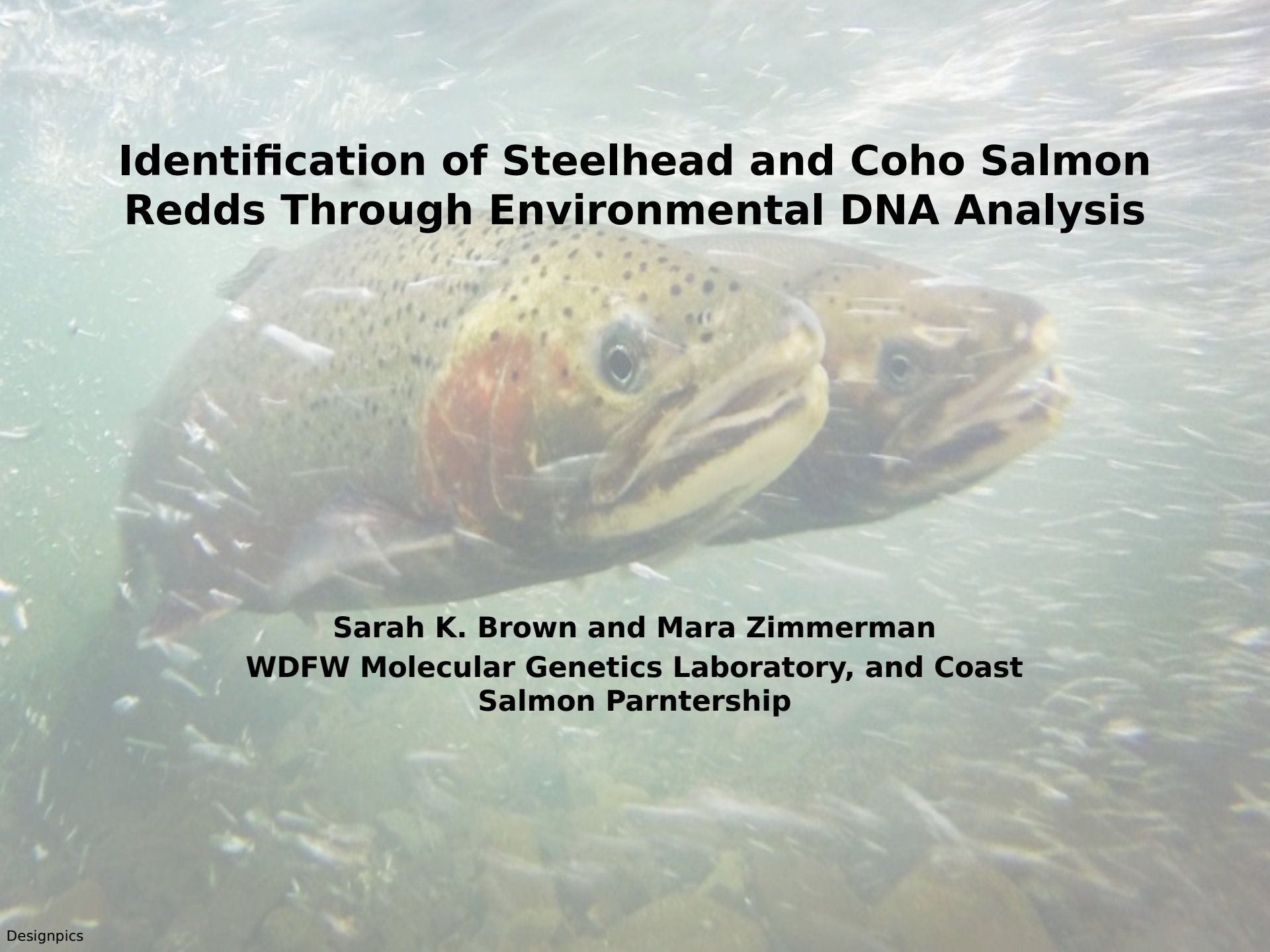
Identification of Steelhead and Coho Salmon Redds Through Environmental DNA Analysis



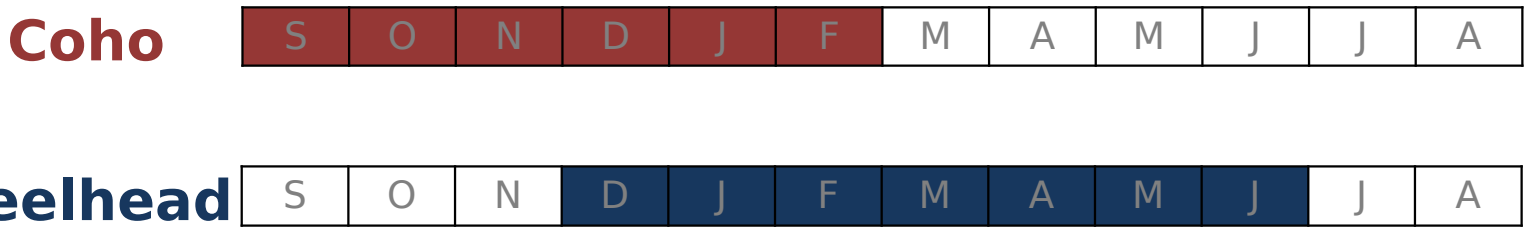
Sarah K. Brown and Mara Zimmerman

WDFW Molecular Genetics Laboratory, and Coast Salmon Parntership

Designpics

Problem: Salmon and Steelhead build redds in same time and place

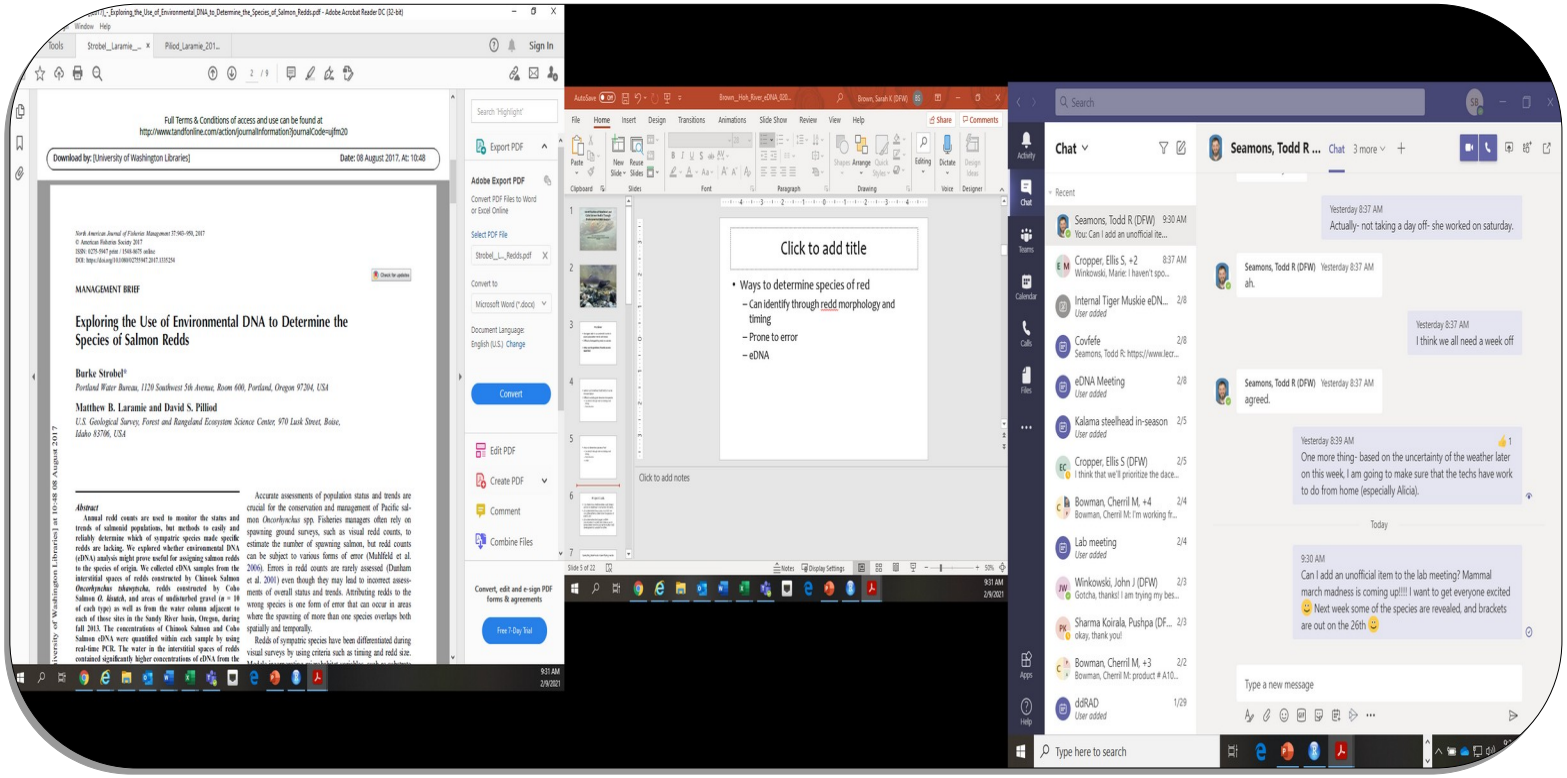
- Difficult to distinguish differences between the redds of the species
  - Overlap in spawning (spatial/temporal)
- Ways to determine species of redd
  - Can identify through redd morphology and timing
  - eDNA tool can test visual identification



Environmental DNA: DNA that an organism released to the environment (water, soil, air)

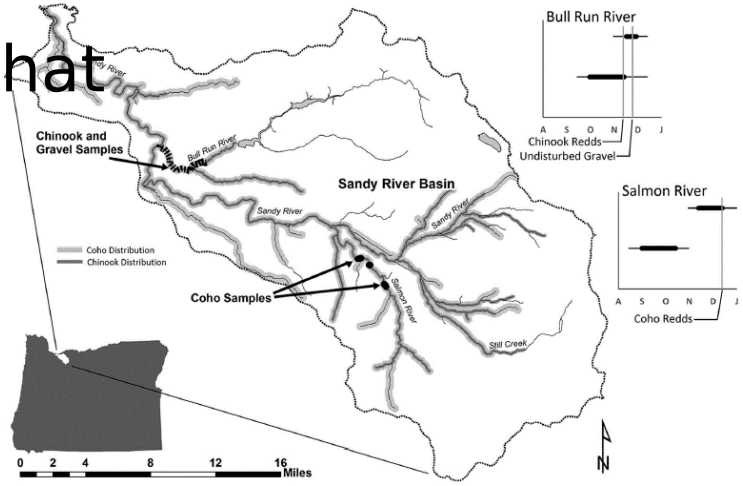
DNA Sources

- Sloughed cells
- Mucus
- Gametes
- Urine
- Fecal matter
- Shed hair
- Carcasses



Higher Concentration of the species that ade redd in:

- Redd compared to water column
- Than other species



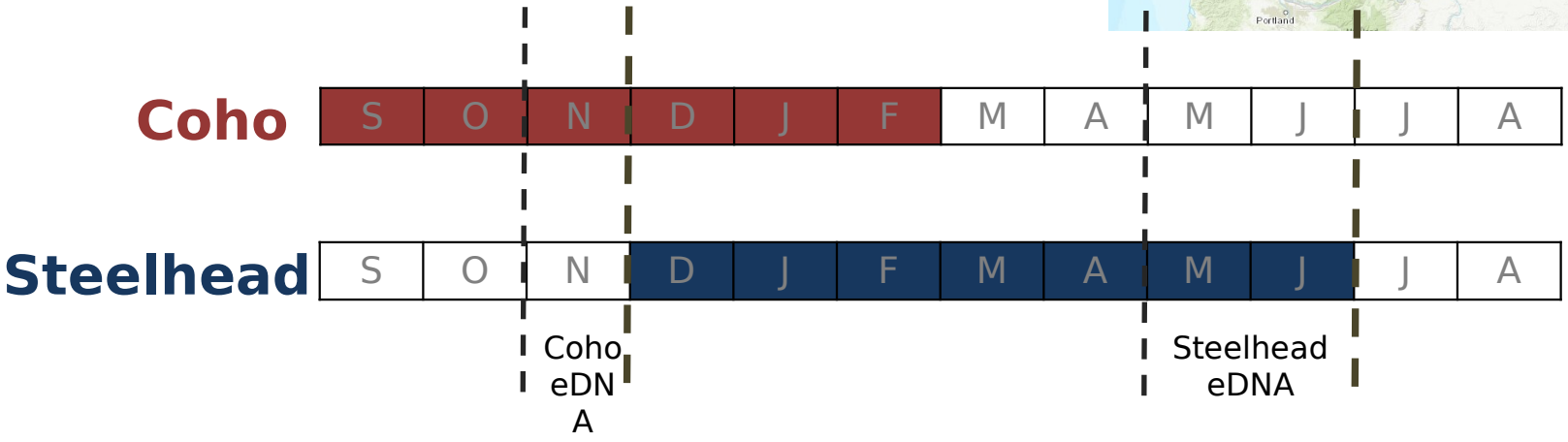
Project Goals

Hoh River as study system

1. eDNA use for species identification of steelhead vs. coho redds?
   a. Single eDNA sample
2. Determine change in eDNA concentration overtime?
   a. Repeated eDNA sample

://www.patagonia.com/stories/saving-one-river-hoh-steelhead-in-decline/story-73320.html

Sampling Methods: Location



Sampling Methods: Locations

- Lower Owl Creek (LOW)
- Upper Owl Creek (UOW)
- South Fork Hoh 0486 side channel (4SC)
- Ranger Station to Twin Creek (Hoh River) (RTW)
- Upper Big Flat (South Fork Hoh) (UBF)
- Upper Winfield Creek (UWI)
- Upper Lacey Seep (ULS)

- 21 Steelhead redds (single sample)
- 6 Steelhead redds (sampled every 3-4 days to detect [eDNA] change)
- Total of 27

- 15 Coho Redds

Sampling Methods: Select a redd

Mara Zimmerman and John Winkowski

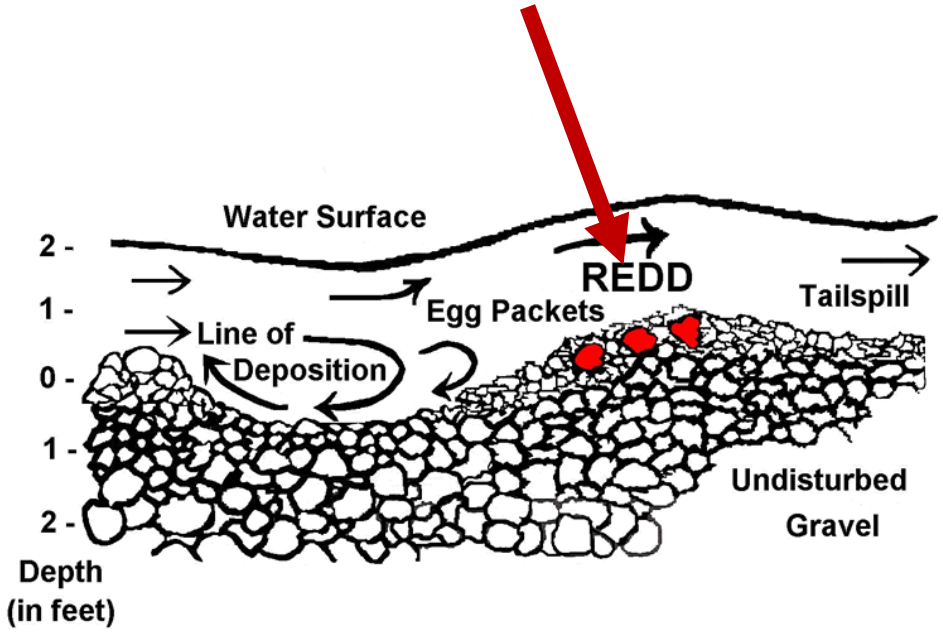
- Sampling in months to minimize overlap
- Surveyed reaches at 3-4 day intervals
- Sampling after coho/steelhead were observed constructing redd
- Field assigned species considered accurate

Sampling Methods: Collecting 90 ml from redds

Water Samples:

- Interstitial (from redd gravel)
- Adjacent water column
- Sterile H_20 (control)

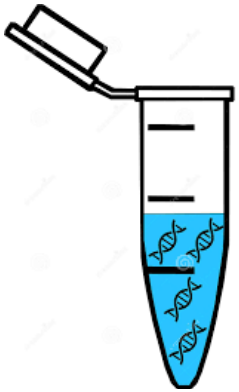
Nathan Rouche

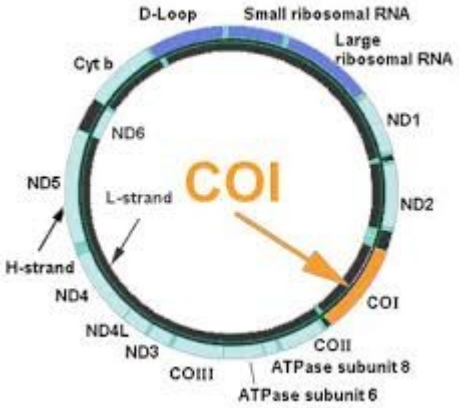


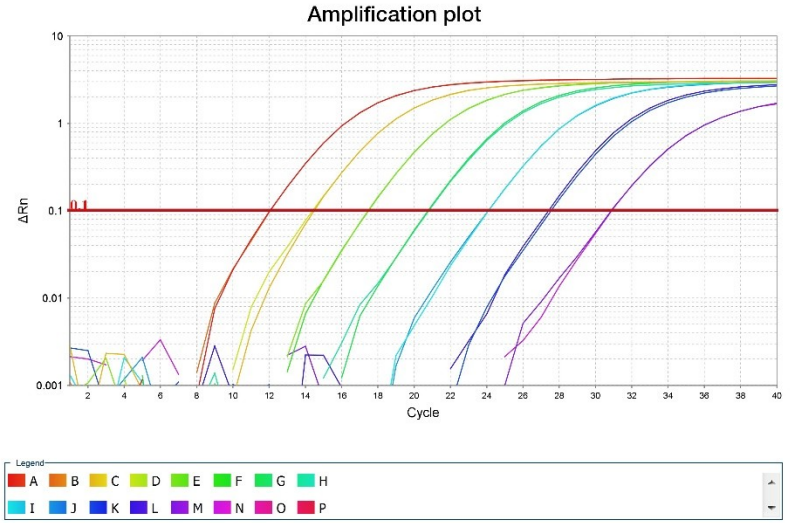
Sampling Methods: Filtering water

Lauren Bauernschmidt and David Low

Sampling Methods: Laboratory Analysis







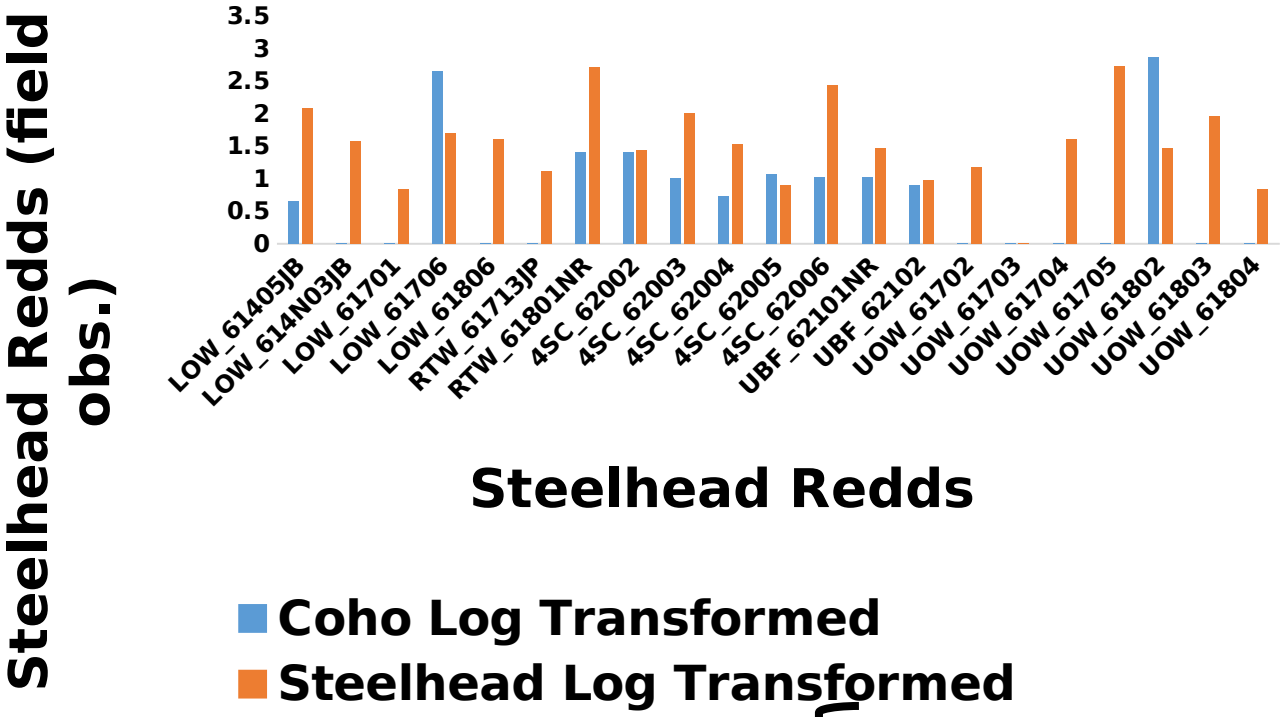
1) eDNA use for species detection of redds in Hoh River tributaries?

eDNA is detected in redds

	Steelhead Detected	**Coho Detected**	**Total**
Steelhead Redd	**16**	**4**	**20/21**
Coho Redd	**4**	**8**	**12/15**

1) eDNA use for species detection of redds in Hoh River tributaries?

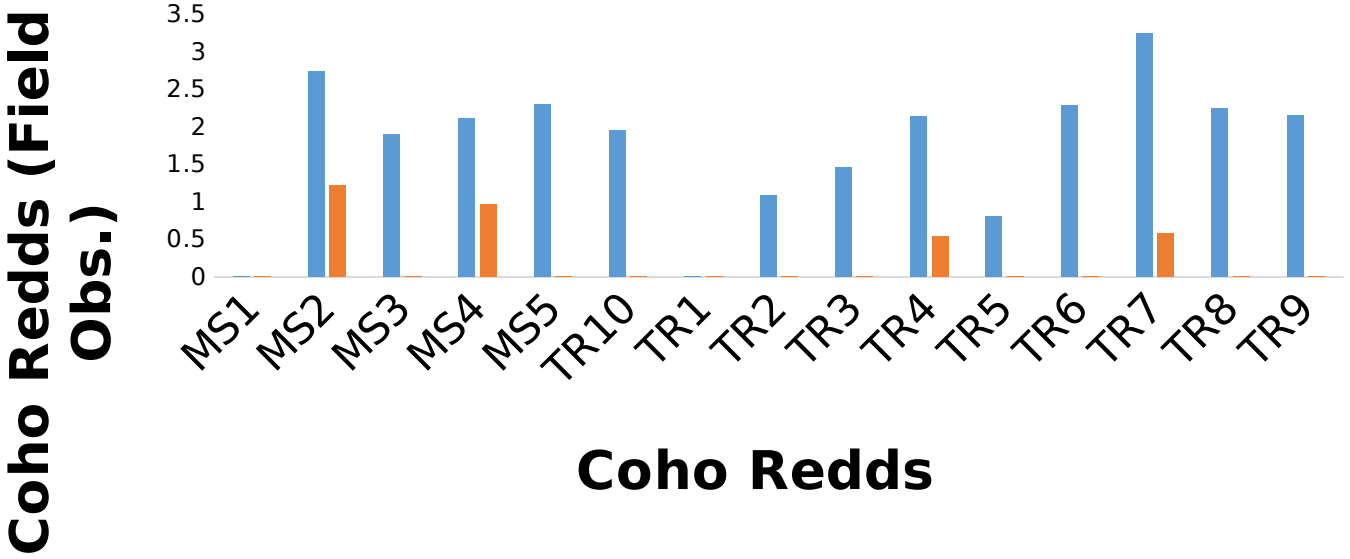
Steelhead redd samples: eDNA concentration useful (but not perfect) for redd identification



Success	Steelhead only	9/21
	Steelhead >Coho	6/21
Problematic	Coho >Steelhead	3/21
	Equal	2/21
	No detection	1/21

1) eDNA use for species detection of redds in Hoh River tributaries?

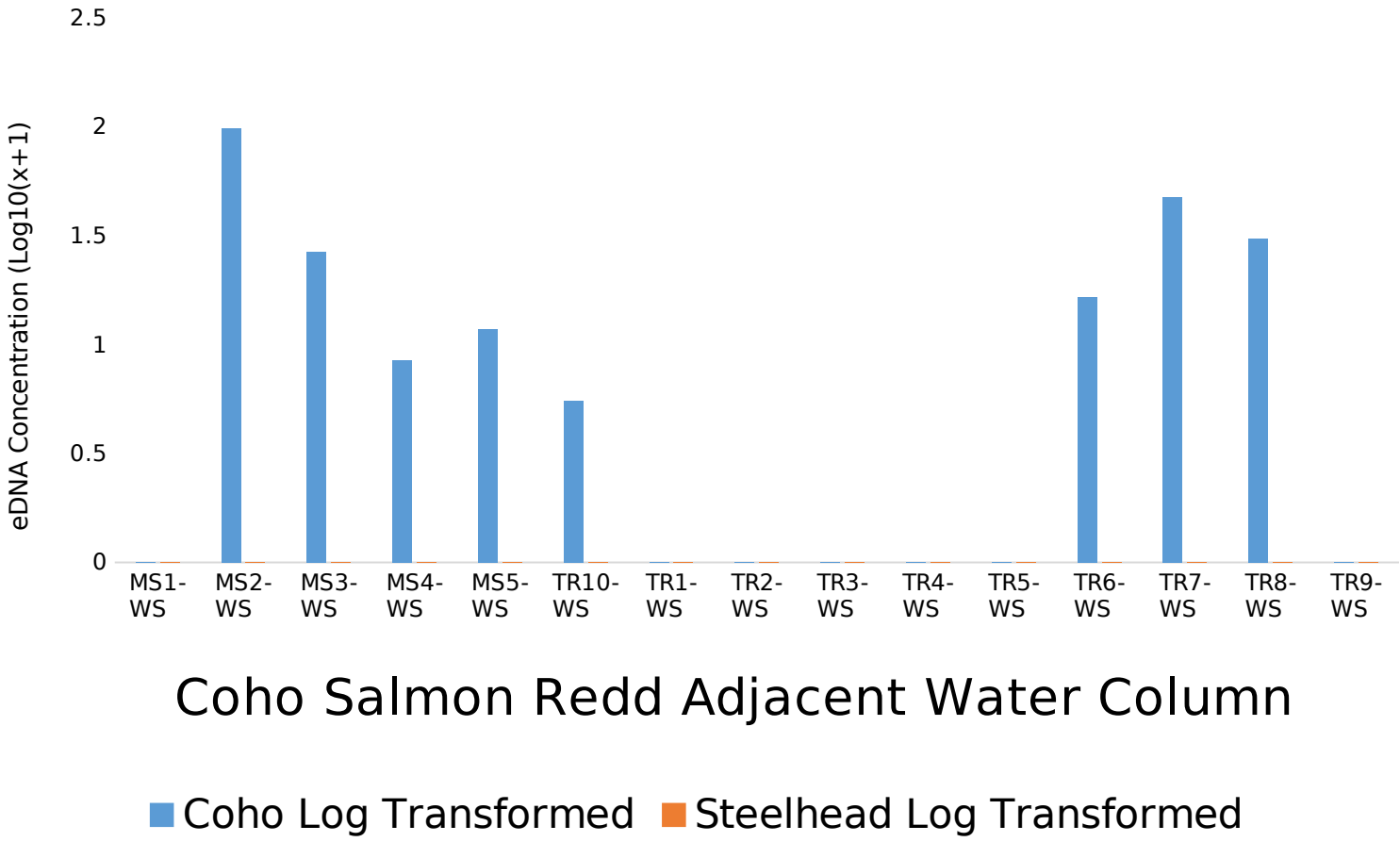
Coho redd samples: eDNA concentration useful (but not perfect) for redd identification



Success	Coho only	9/15
	Coho >Steelhead	4/15
Problematic	Steelhead >Coho	0/15
	Equal	0/15
	No detection	2/15

1) eDNA use for species detection of redds in Hoh River tributaries?

Water column samples: only coho eDNA detected



1) eDNA use for species detection of redds in Hoh River tributaries?

eDNA concentration higher in redds than water column

Group	Species (eDNA analysis)	*P*- Value	Description
Coho Salmon redds	Coho Salmon	**0.0017**	Coho in redd > Coho in water column

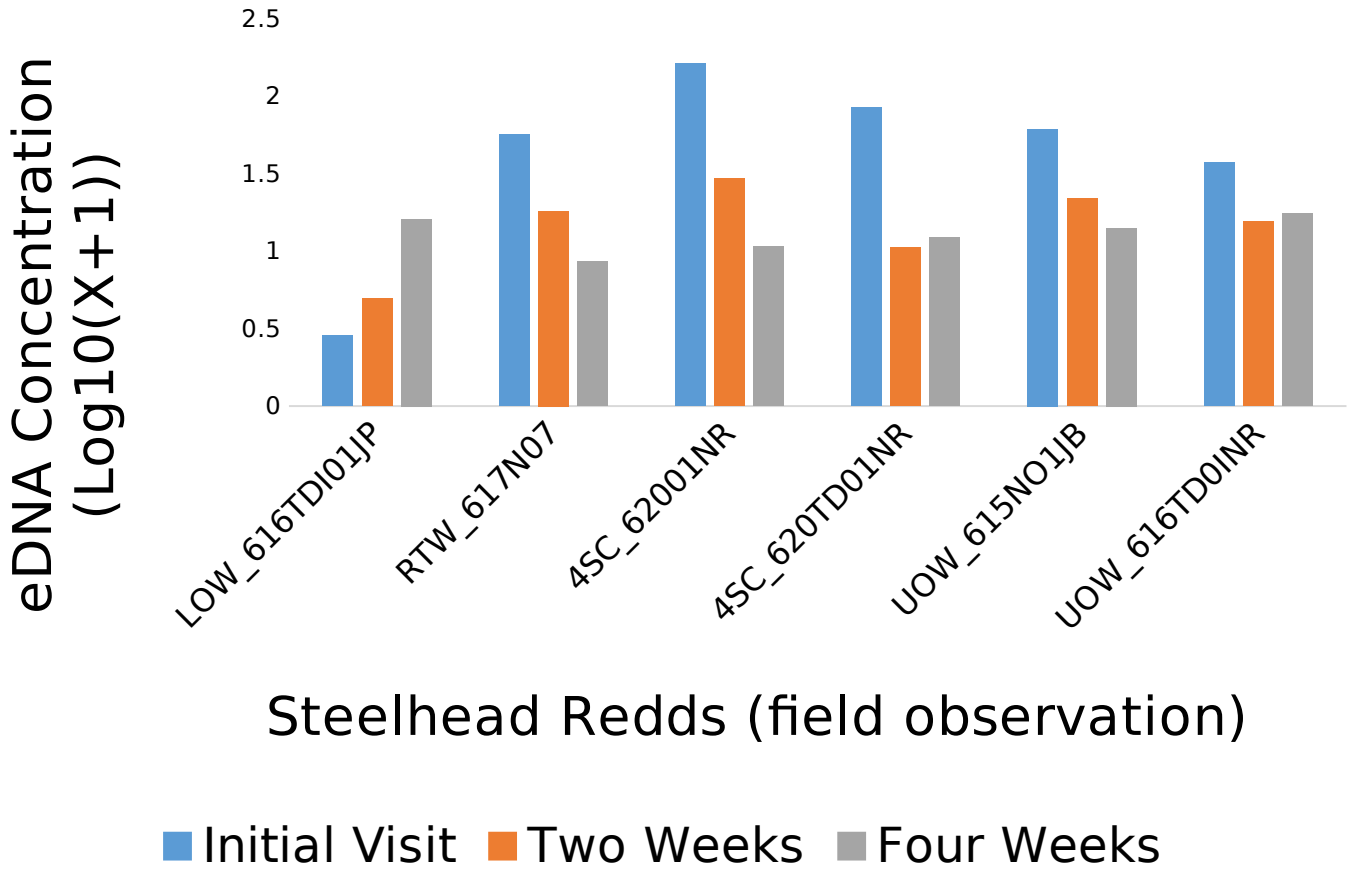
1) eDNA use for species detection of redds in Hoh River tributaries?

eDNA concentration higher in respective species redds

Group	Species (eDNA analysis)	*P*- Value	Description
Steelhead redds	Coho Salmon vs. Steelhead	**0.0165**	[Steelhead] > [Coho]
Coho Salmon redds	Coho Salmon vs. Steelhead	**0.0017**	[Coho] > [Steelhead

2) Is there a change in eDNA concentration over time?

Steelhead redds: eDNA concentration detectable after four weeks



Conclusions

- *1) eDNA use for species detection of redds in Hoh River tributaries?*
  - 88% of STHD and 100% of Coho redds were correctly assigned
  - Mean [eDNA] highest of field ID species
  - More mixed DNA in STHD redds than Coho
    - Coho carcasses in system when STHD are spawning?
    - Coho juveniles?
- *2) Is there a change in eDNA concentration over time?*
  - *Slight decrease over time*
  - Wide window of detection (>28 days)

Future work

- Conduct steelhead sampling with adjacent water column filtered on site
  - Gravel samples
- Identify systems where this methodology will be most useful to inform uncertainties in population monitoring
  - e.g., late coho runs overlap with early winter steelhead in southwestern Washington

Thank you

- Nathan Rouche- WDFW
- Joe Boucher- WDFW
- John Winkowski
- Trout Unlimited
- Mitch Kissler- Laboratory Technician

- 5 STHD redds with observation of STHD on redds
  - 3 definite STHD
  - 2 had mixed species
- 2 Coho redds with observation of Coho on red
  - 1 coho in pool next to red (mixed results)
  - 1 steelhead and coho nearby, coho pair were nearby