# Do Fin Rays Offer a Non-Lethal Approach for Assessing Life History Patterns Using Geochemical Analysis?

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# Outline

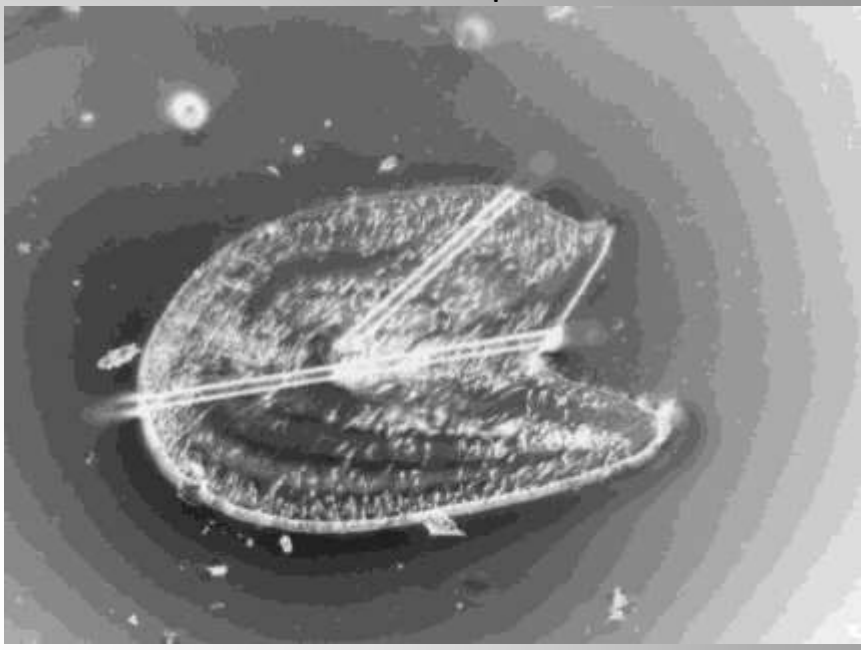
- Background & problem
- Alternative structures
  - Scales
  - Fin rays
- Impacts of fin ray removal
  - Lab
  - Field
- Fin ray & otolith relationships
- On-going efforts & next steps
- Summary

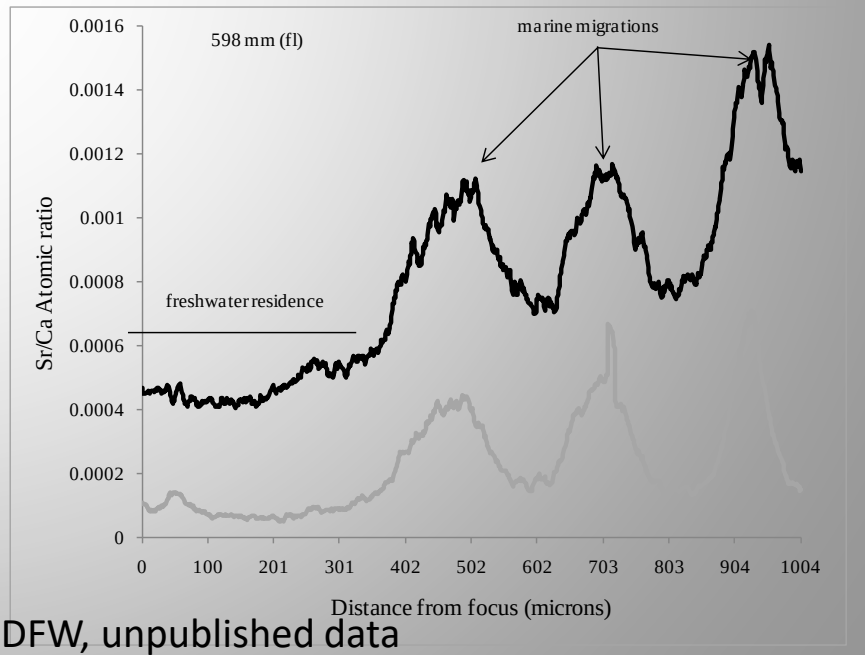
Photo: Lisa Wetzel, USGS

# Background & Problem

- Use of geochemical analysis
  - Connect nursery and rearing habitat in pelagic species
  - Assess spatial migration and life history patterns of marine and anadromous fish
  - ID natal origin
  - ID critical habitat
  - Etc.
- Problem
  - Otoliths extraction is lethal

Photo: Lance Campbell, WDFW

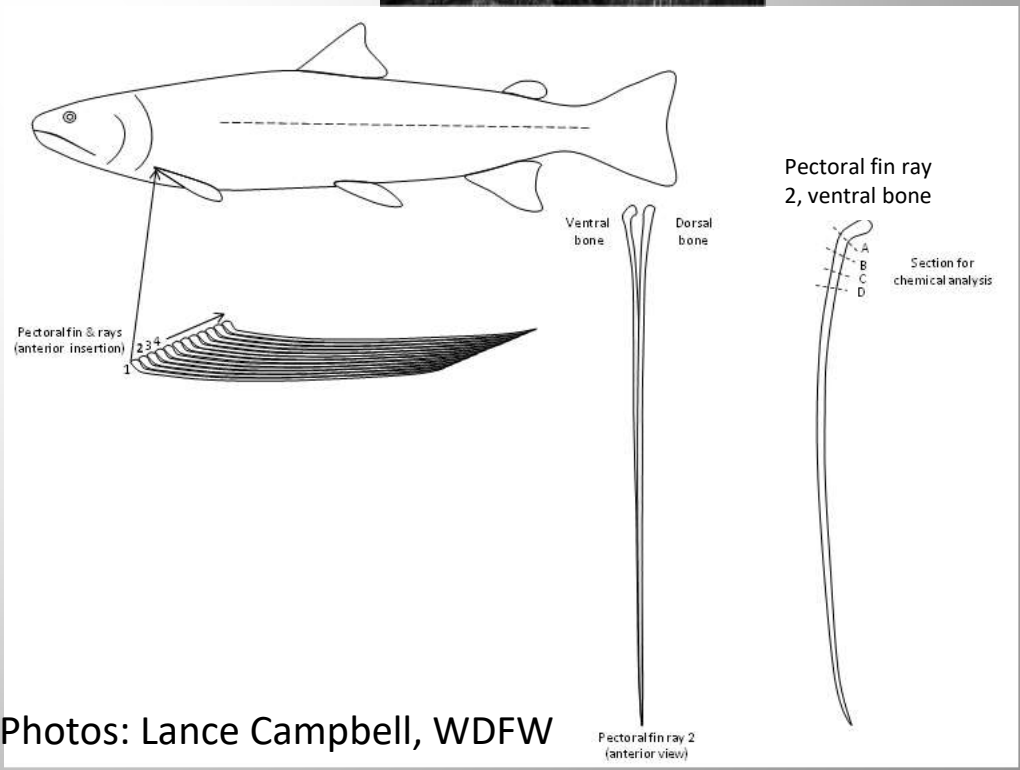





Campbell, WDFW, unpublished data

# Assessing Alternative Structures

- Approach
  - Bull trout with known otolith geochemistry (Brenkman et al. 2007)
  - Assess non-lethally sampled structures
    - Scales
    - Fin rays
  - Assess elemental ratios

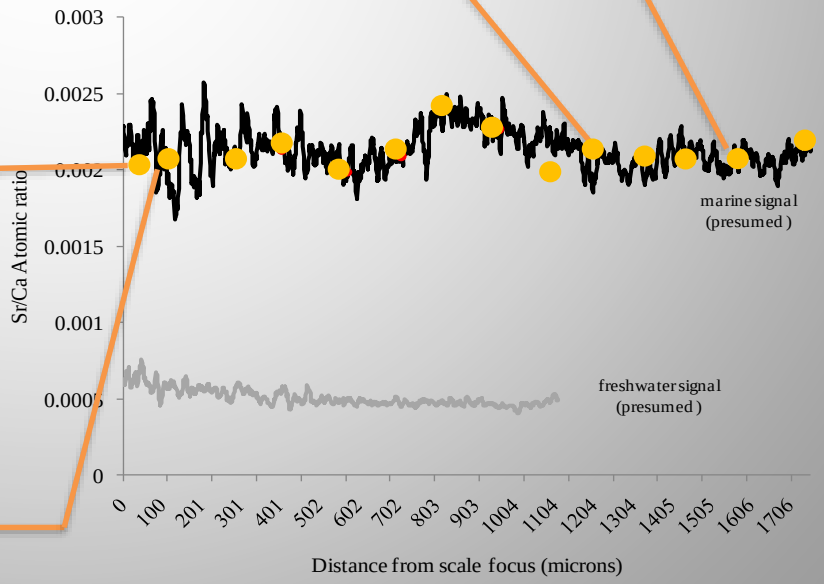



Photos: Lance Campbell, WDFW

# Assessing Alternative Structures

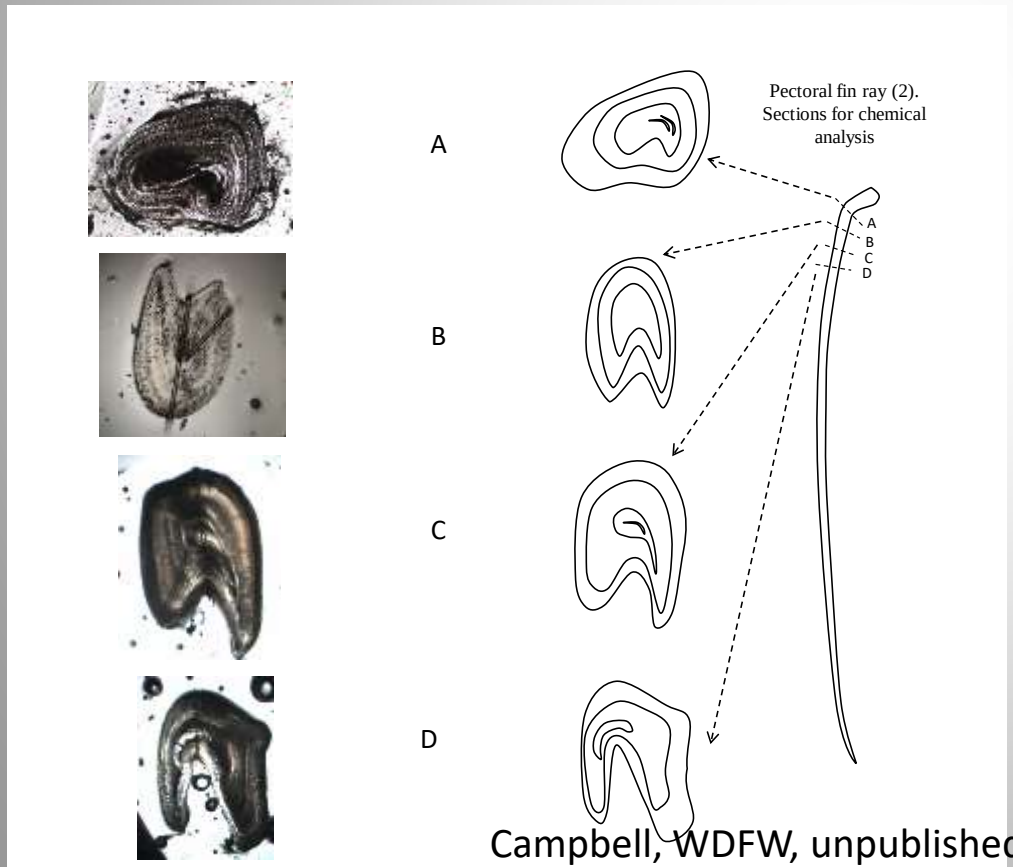
- Scales
  - Useful for anadromy
  - Do not show timing of migrations

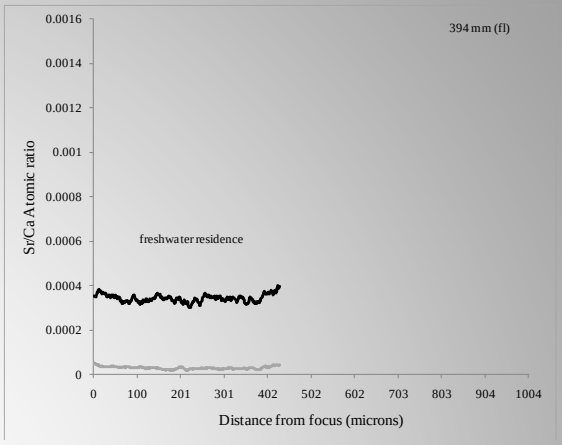
Campbell, WDFW, unpublished data

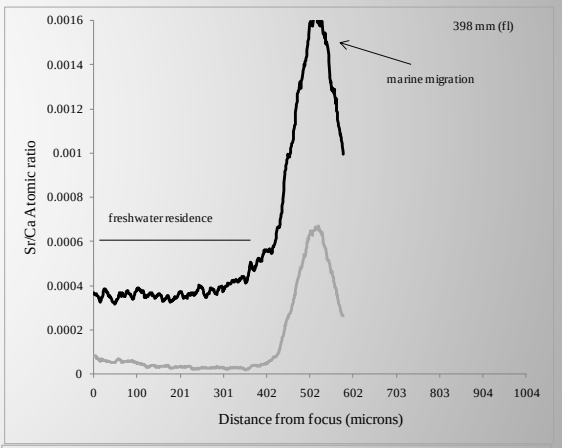


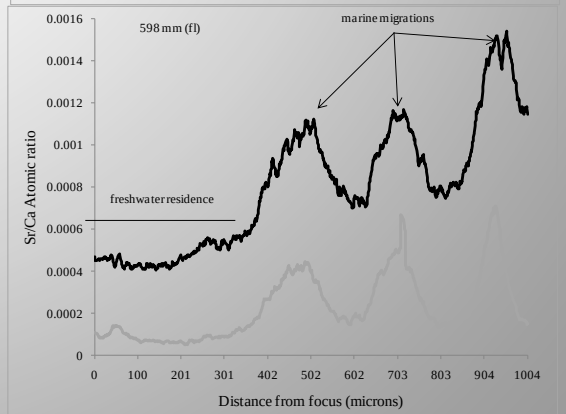
# Assessing Alternative Structures

- 2nd pectoral fin ray
  - Useful for anadromy
  - Shows migration timing



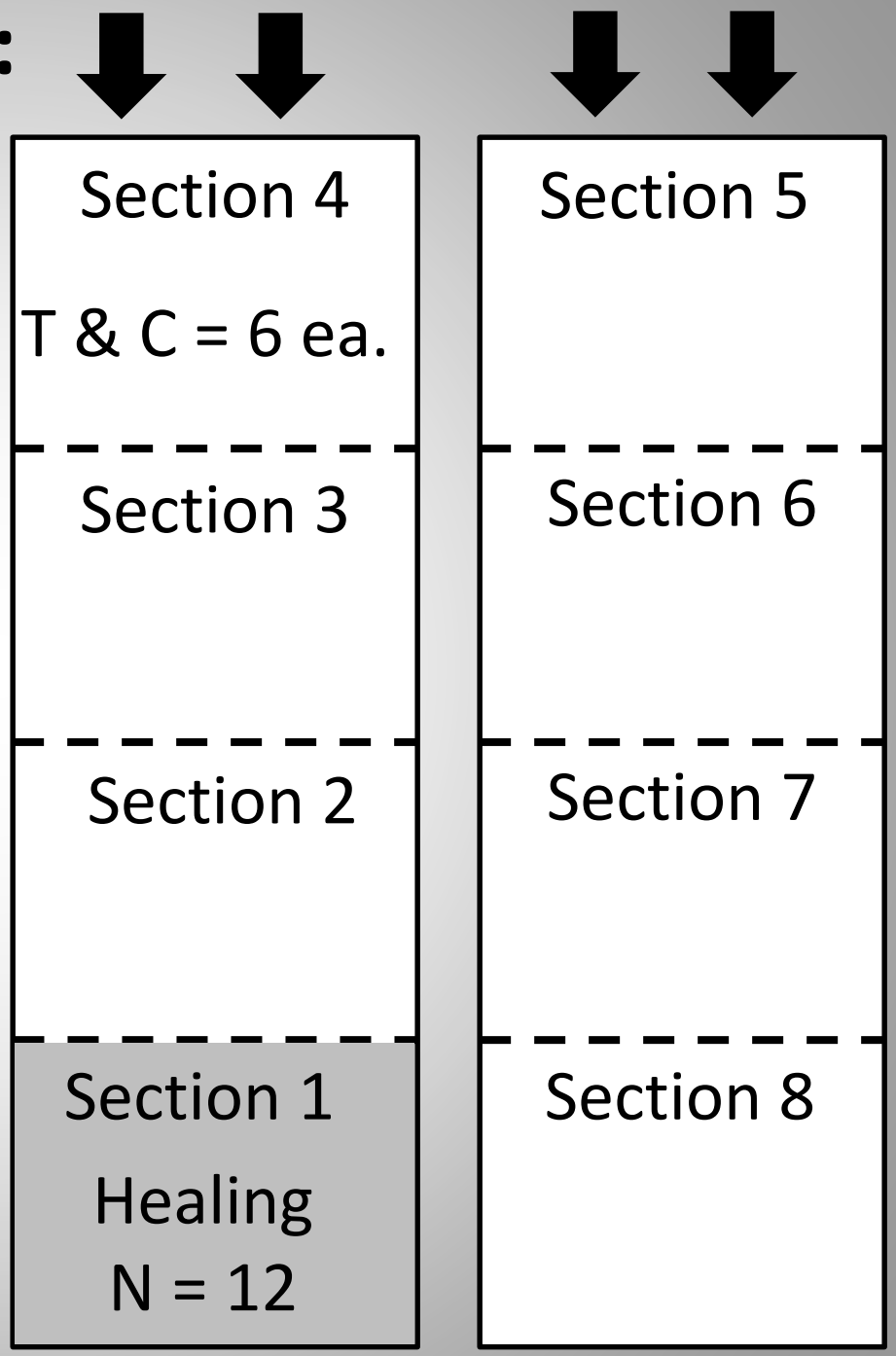




Campbell, WDFW, unpublished data

# Survival Assessment

- Can we remove the desired structure without impacting the fish?

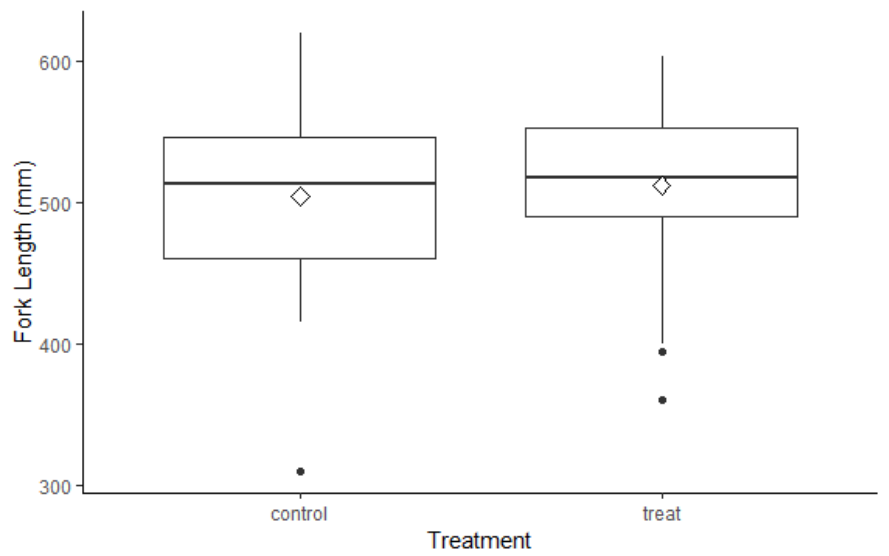

- **Removal assessment: Lab**
  - Hatchery rainbow trout
  - 7 Paired section in 2 raceways
    - 6 treatment fish
    - 6 control fish
  - 1 section to assess healing
    - N = 12
  - 71 day assessment
    - 2/9/2016 – 4/20/2016



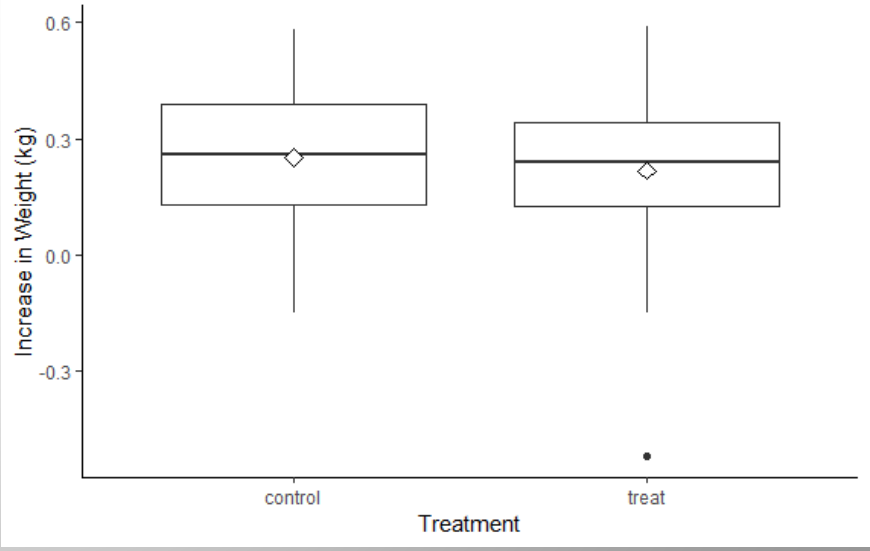
- **Removal assessment: Lab**

- No mortality
- No statistical difference
  - Length or weight
    - Beginning or end
  - Growth
    - Length or weight

Length beginning




Growth in Weight

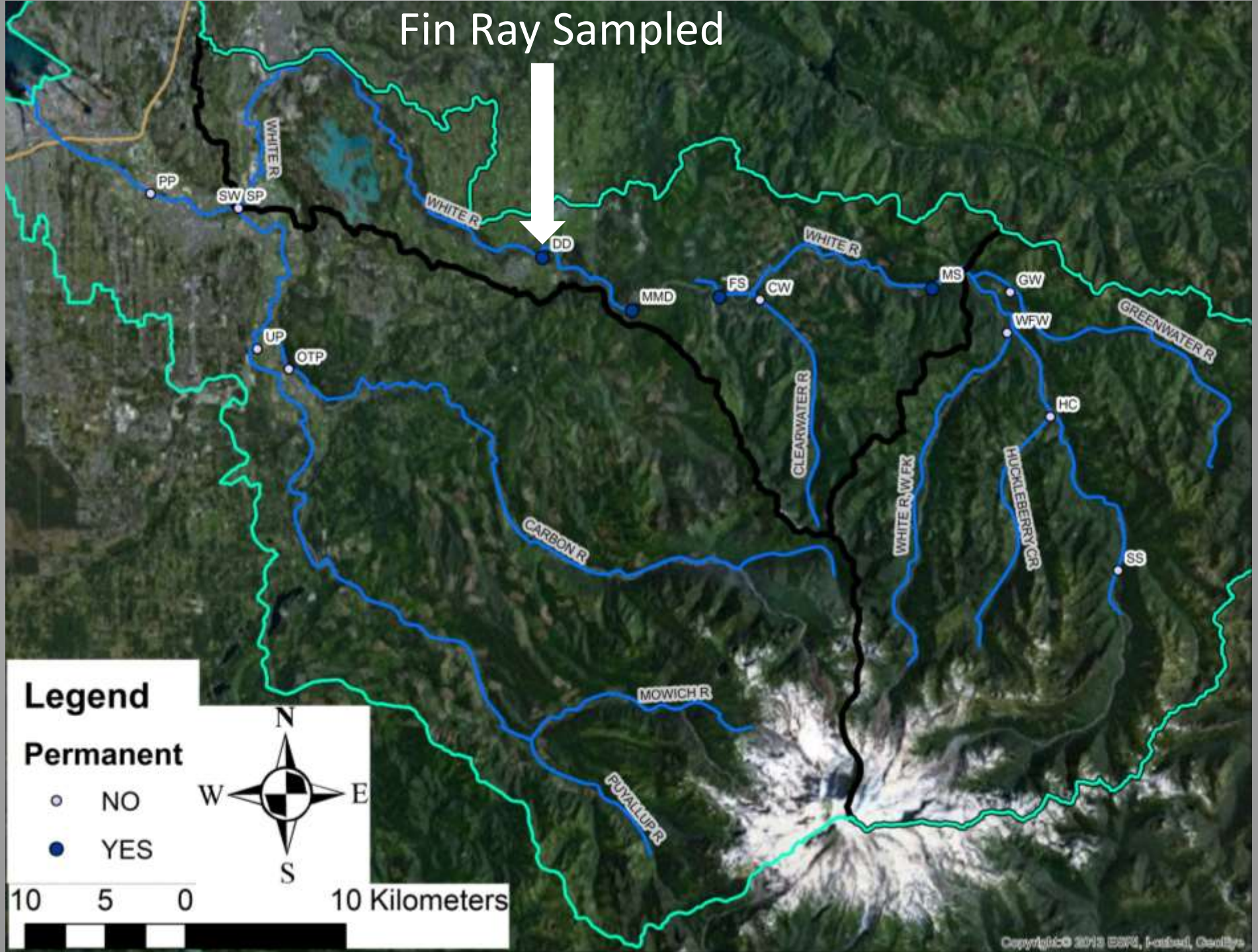


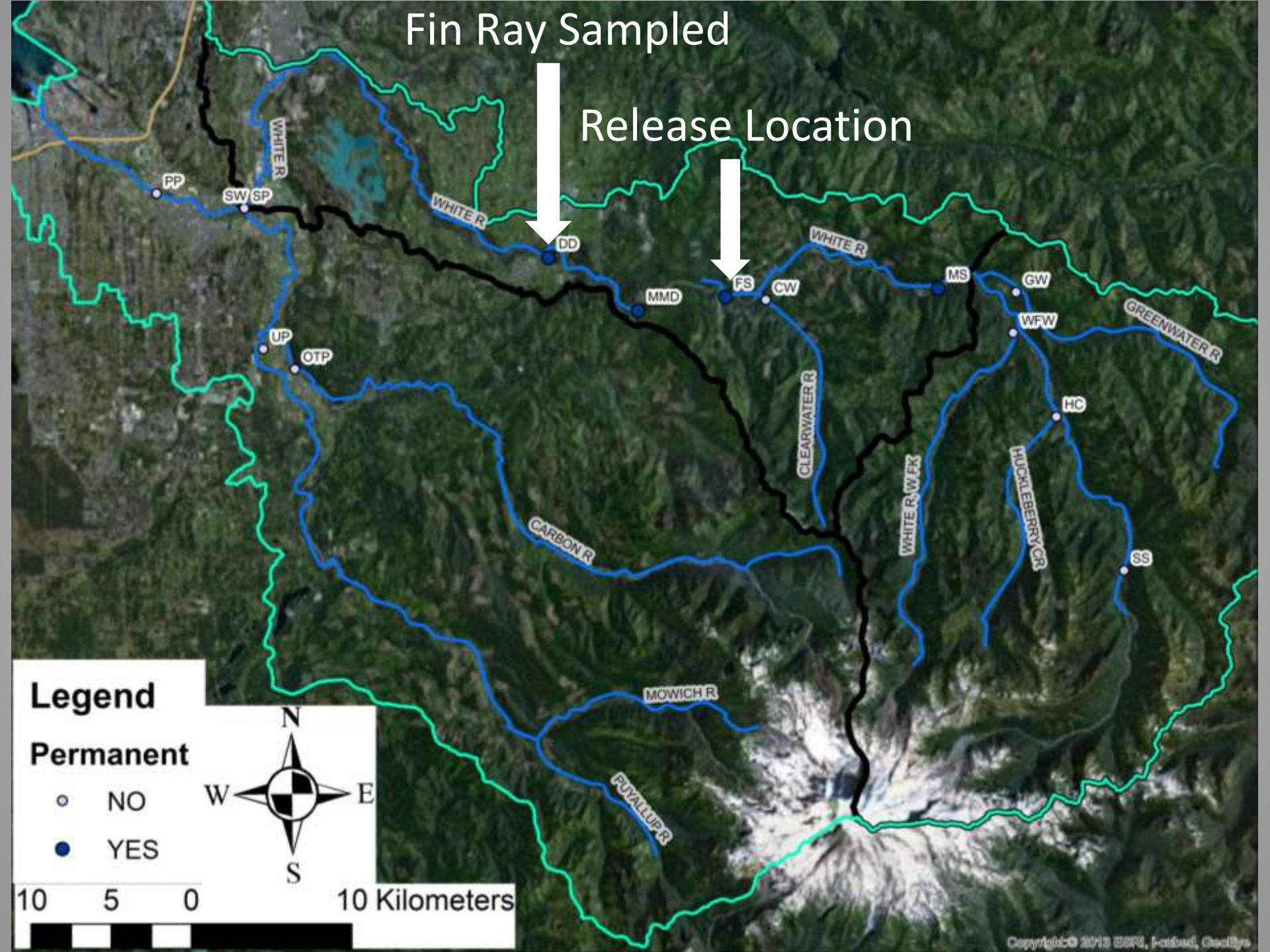
# Removal assessment: Healing

- ~85% of the wounds classified as covered scare after 10 weeks


# Removal assessment: Healing Methods

- Remove fin rays at Buckley Diversion – all fish PIT tagged
- Compare survival, migration rate, and growth
  - ‘Recaptures’ at upstream PIT arrays and Buckley Diversion
- Paired study design
  - Equal number of control and treatment fish each day


Fin Ray Sampled
WHITE R
PP
SW
SP
WHITE R
DD
MMD
WHITE R
FS
CW
MS
GW
WFW
GREENWATER R
UP
OTP
CLEARWATER R
HC
WHITE R W FK
HUCKLEBERRY CR
CARBON R
SS
MOWICH R
PUYALLUP R
Legend
Permanent
NO
YES
N
W
E
S
10 5 0 10 Kilometers


Fin Ray Sampled
Release Location
WHITE R
PP
SW
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WHITE R
DD
MMD
WHITE R
FS
CW
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GW
WFW
GREENWATER R
UP
OTP
CLEARWATER R
HC
WHITE R W FK
HUCKLEBERRY CR
CARBON R
SS
MOWICH R
PUYALLUP R
Legend
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NO
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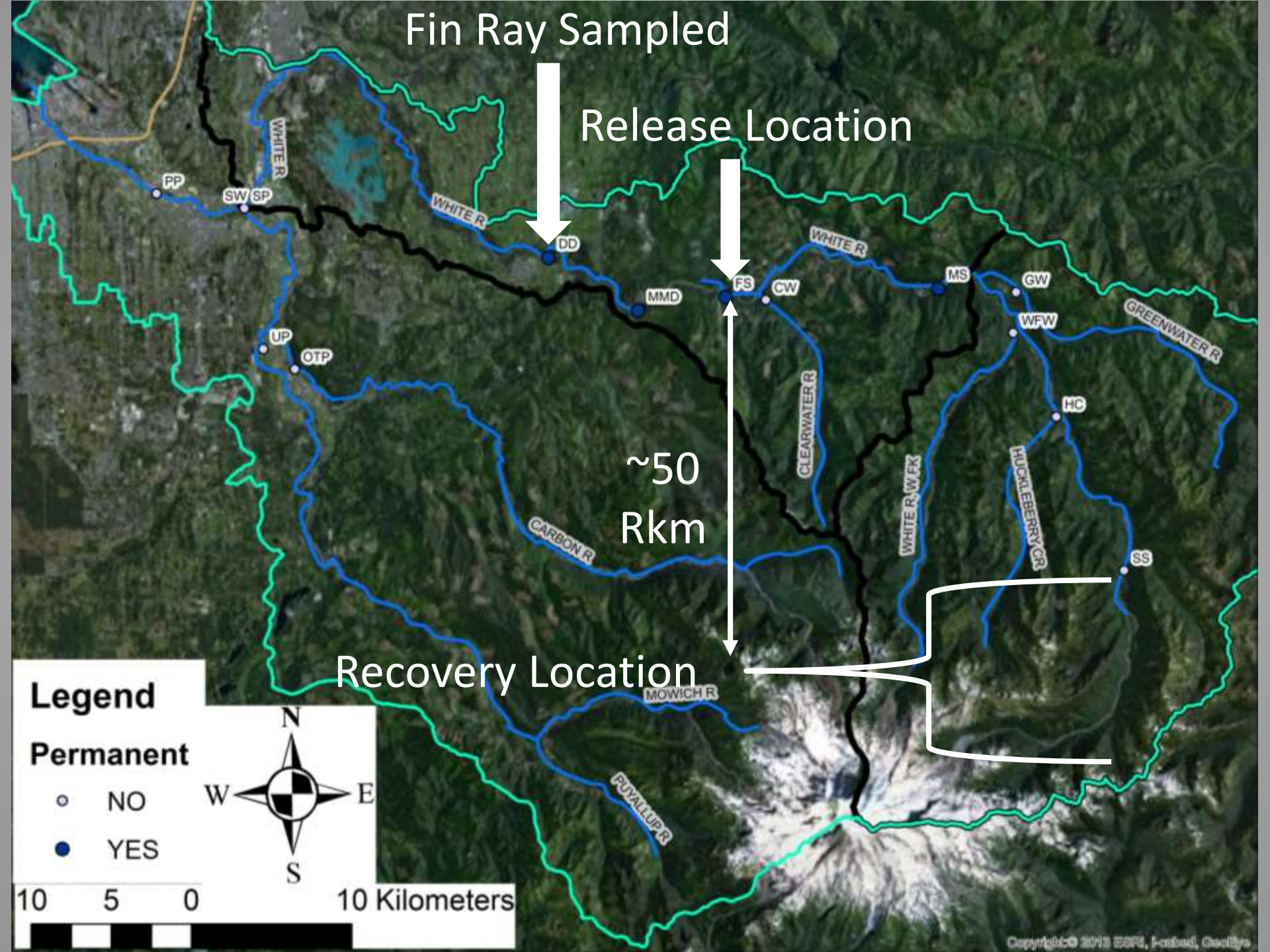
Fin Ray Sampled
Release Location
~50
Rkm
Recovery Location
WHITE R
PP
SW
SP
DD
MMD
FS
CW
MS
GW
WFW
GREENWATER R
UP
OTP
CLEARWATER R
HC
WHITE R W FK
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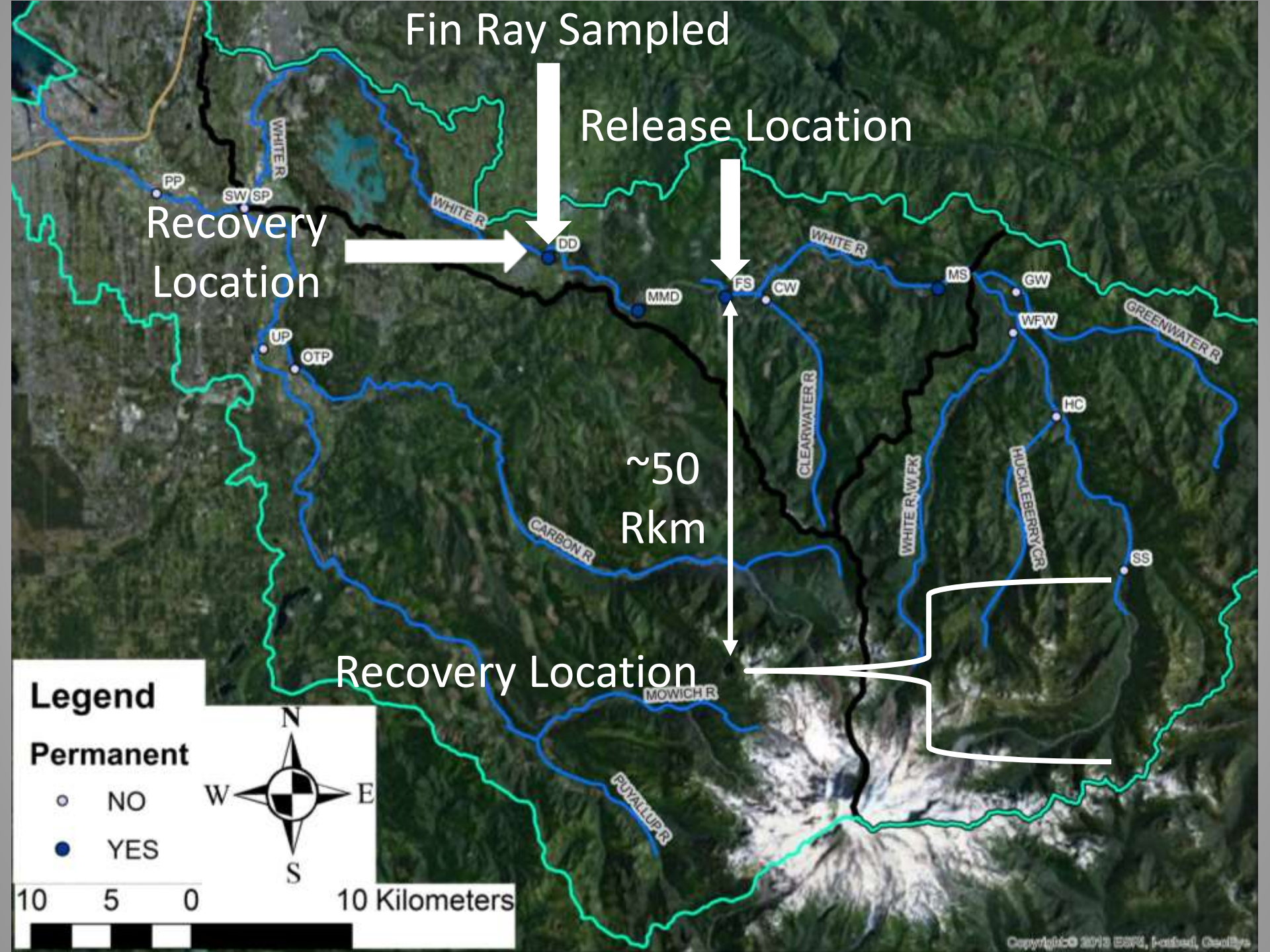
Fin Ray Sampled
Release Location
Recovery Location
~50 Rkm
Recovery Location
WHITE R
PP
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GREENWATER R
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WHITE R W FK
HUCKLEBERRY CR
SS
CARBON R
MOWICH R
PUYALLUP R
Legend
Permanent
NO
YES
N
W
E
S
10 5 0 10 Kilometers

# Removal assessment:

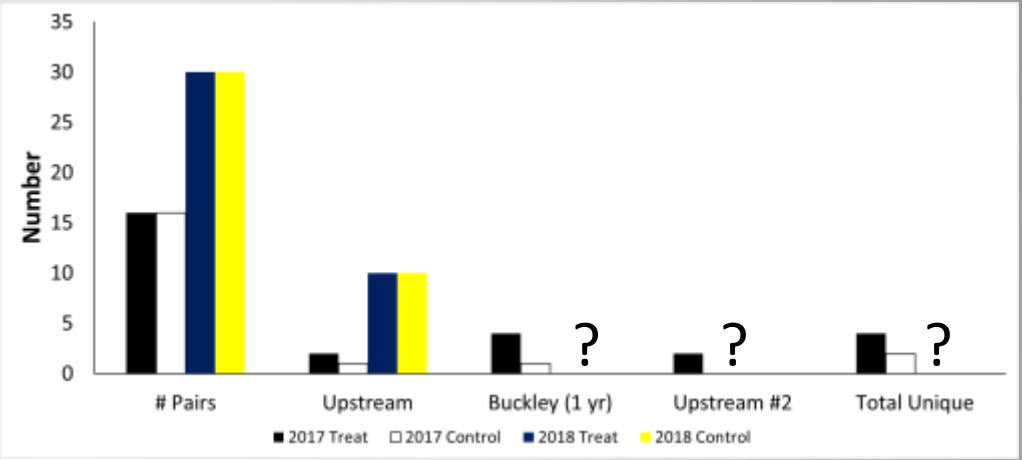
# Field

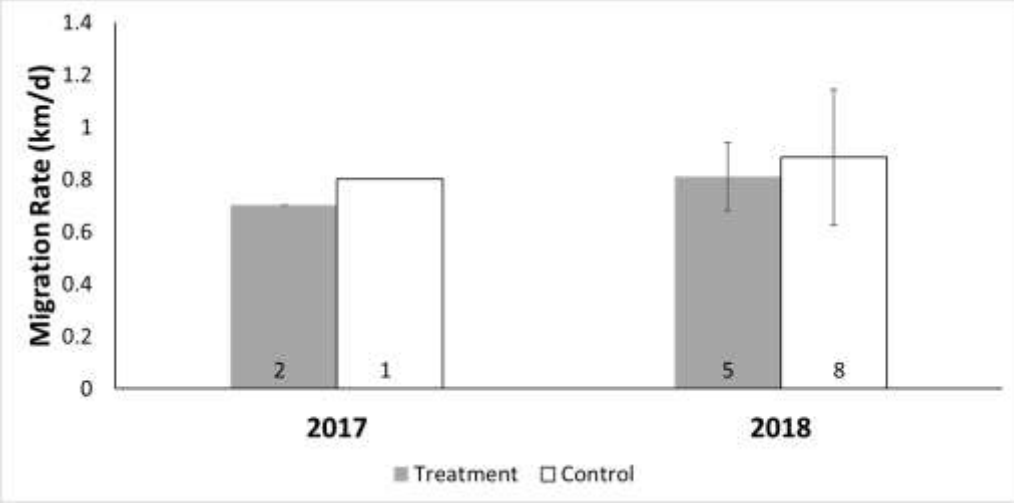
- Sampled 2017, 2018
- 2017
  - 16 paired fish
  - 6 days, June 9 – July 3
    - 1-4 pairs/day
- 2018
  - 30 paired fish
  - 14 days, June 4 – July 25
    - 1-6 pairs/day

# Removal assessment:

# Field

- Recoveries similar
  - 1st upstream
  - Return to Buckley
  - 2nd upstream
  - Total unique
- Migration rate similar
- Growth similar
  - Low samples size (n=3)



# Otolith, Fin Ray Relationship

- Purpose
  - Assess relationships between otoliths, pectoral, and anal fin rays
    - Continue testing assumptions
    - Size
      - Relationship between otoliths and fin rays
      - ID the best structure
    - Assess element concentration through time
    - Assess presence of maternal mark

Photo: Lisa Wetzel, USGS

# Otolith, Fin Ray Relationship

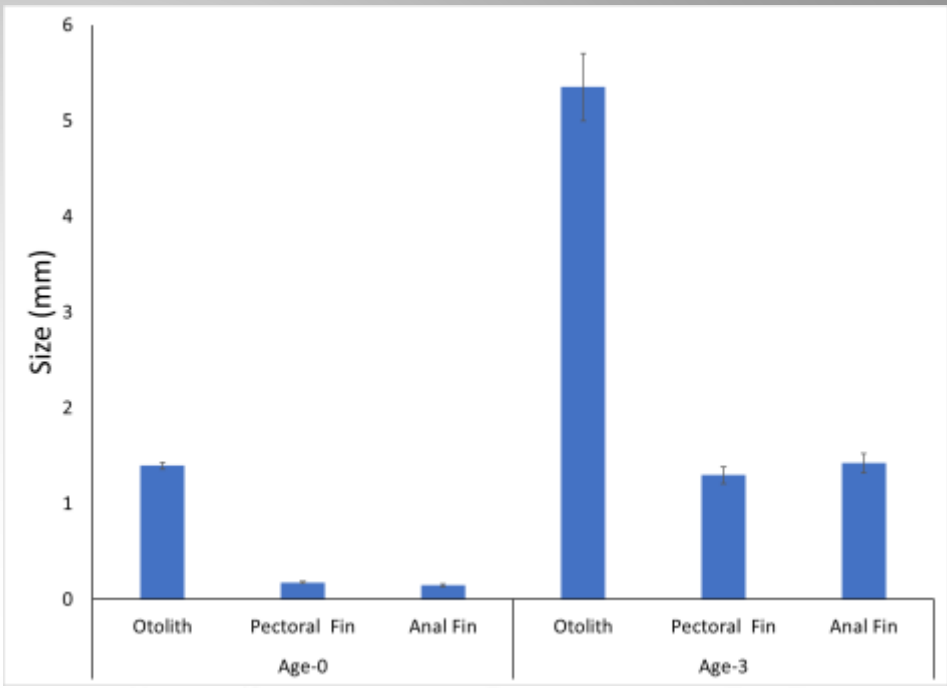
- Method
  - Hatchery rainbow trout age 0-3+
  - Apply a strontium chloride mark
  - Bull trout morts (n=4) – no SrCl mark
  - Compare otolith and fin ray sizes
  - Compare mark location and concentration
  - Assess maternal mark
    - Progeny of FW captive brood & traditional hatchery steelhead

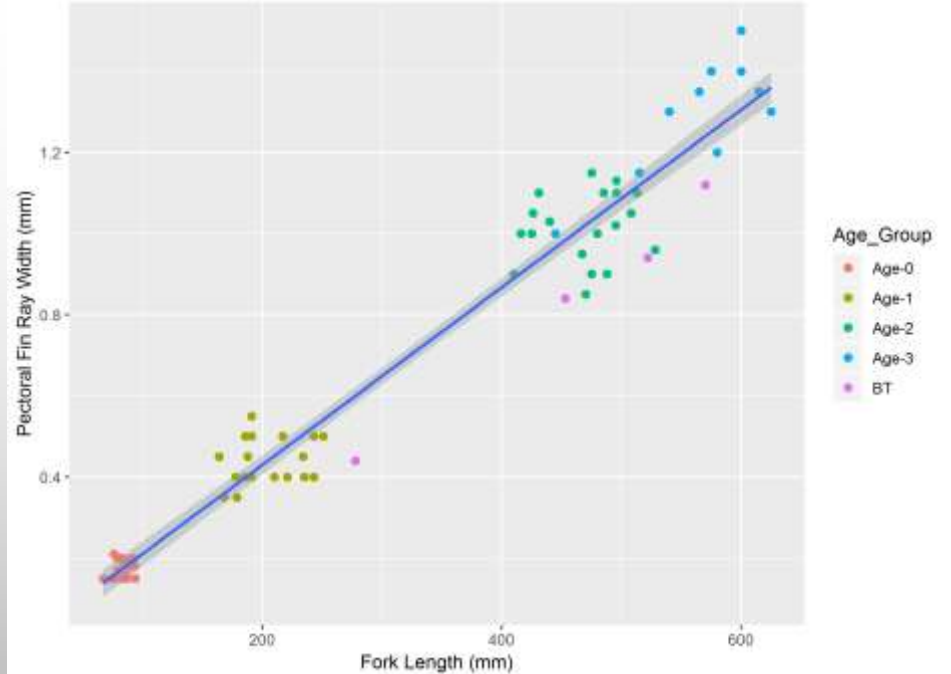
Photo: Lisa Wetzel, USGS

# Otolith, Fin Ray Relationship

- Size
  - Otolith > Rays
  - Pectoral = Anal fin rays
- Structures correlated with fork length (age)
  - Bull trout structures < rainbow trout
- Fin ray diameter correlated with otolith length

Kim Larsen, Lisa Wetzel, USGS, unpublished data

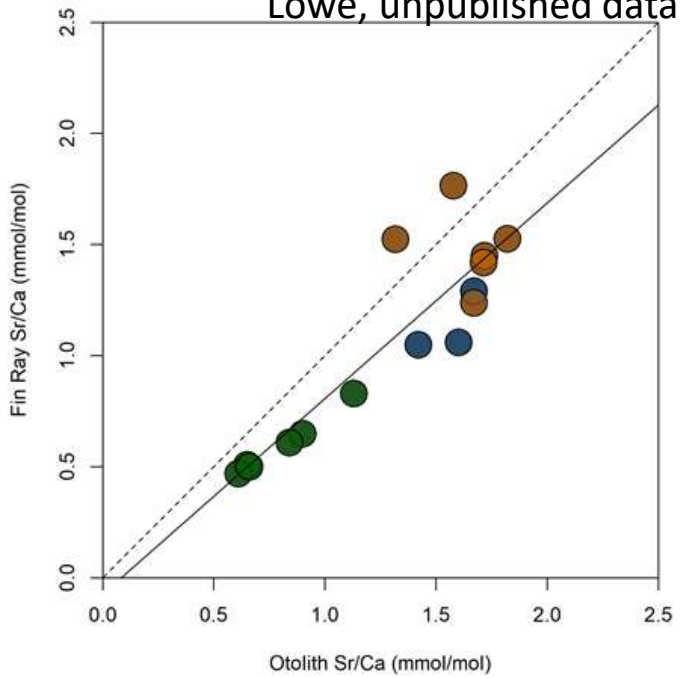


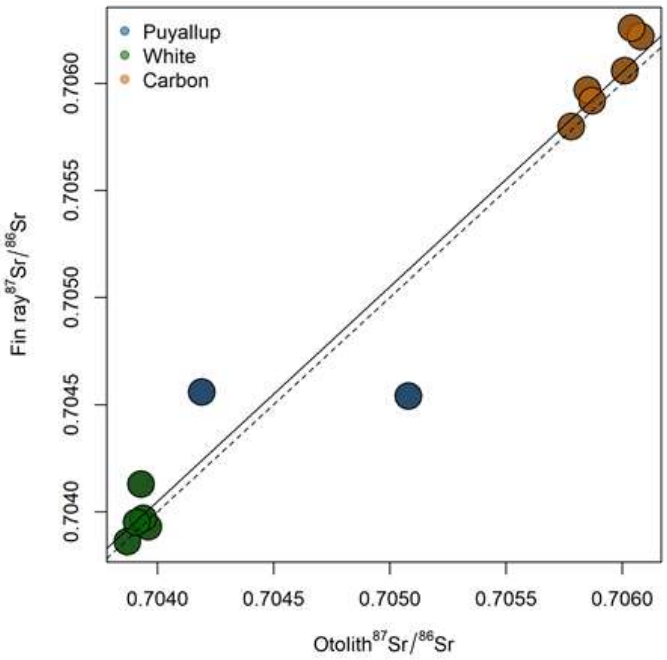



# On-Going Efforts & Next Steps

- Different species – cottids (Lowe, UW)
- Potential use of isotopes (Lowe, UW)
- Determine migratory patterns of bull trout in the Puyallup basin (Lowe, UW)

Lowe, unpublished data



# On-Going Efforts & Next Steps

- Age bull trout (Larsen & Wetzel, USGS)
- Test basic assumption
  - Concentrations stable over time
  - Represent environment
  - ID influential factors
  - Etc.

Photo: Lisa Wetzel, USGS

# Summary

- Alternative structures
  - Scales - no temporal resolution
  - Fin rays – similar to otoliths
- Removal assessment
  - Survival, growth, migration rate not impacted
- Otolith fin ray relationship
  - Size related, rays smaller
  - Bull trout < rainbow
- Fin rays useful across species (n=2)
- Several assumptions still need testing

# Questions