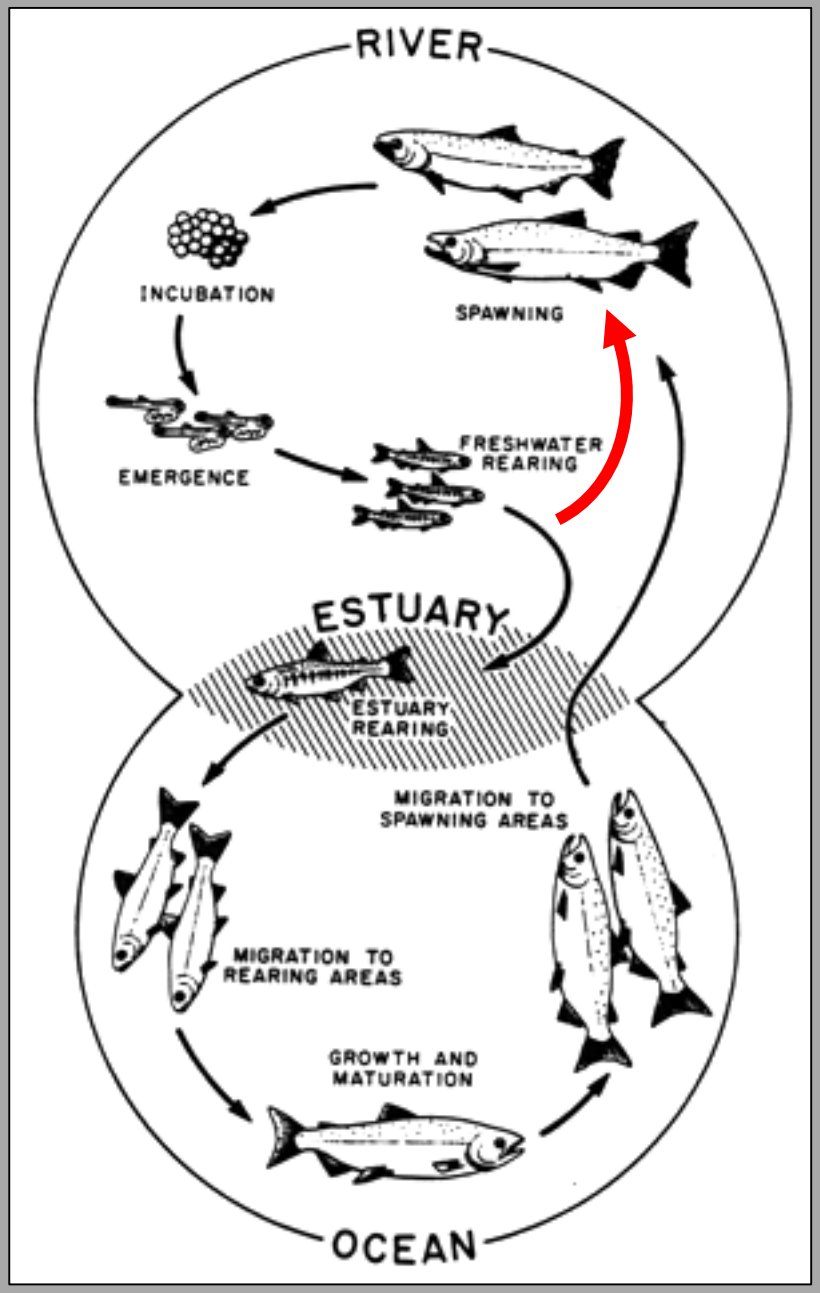
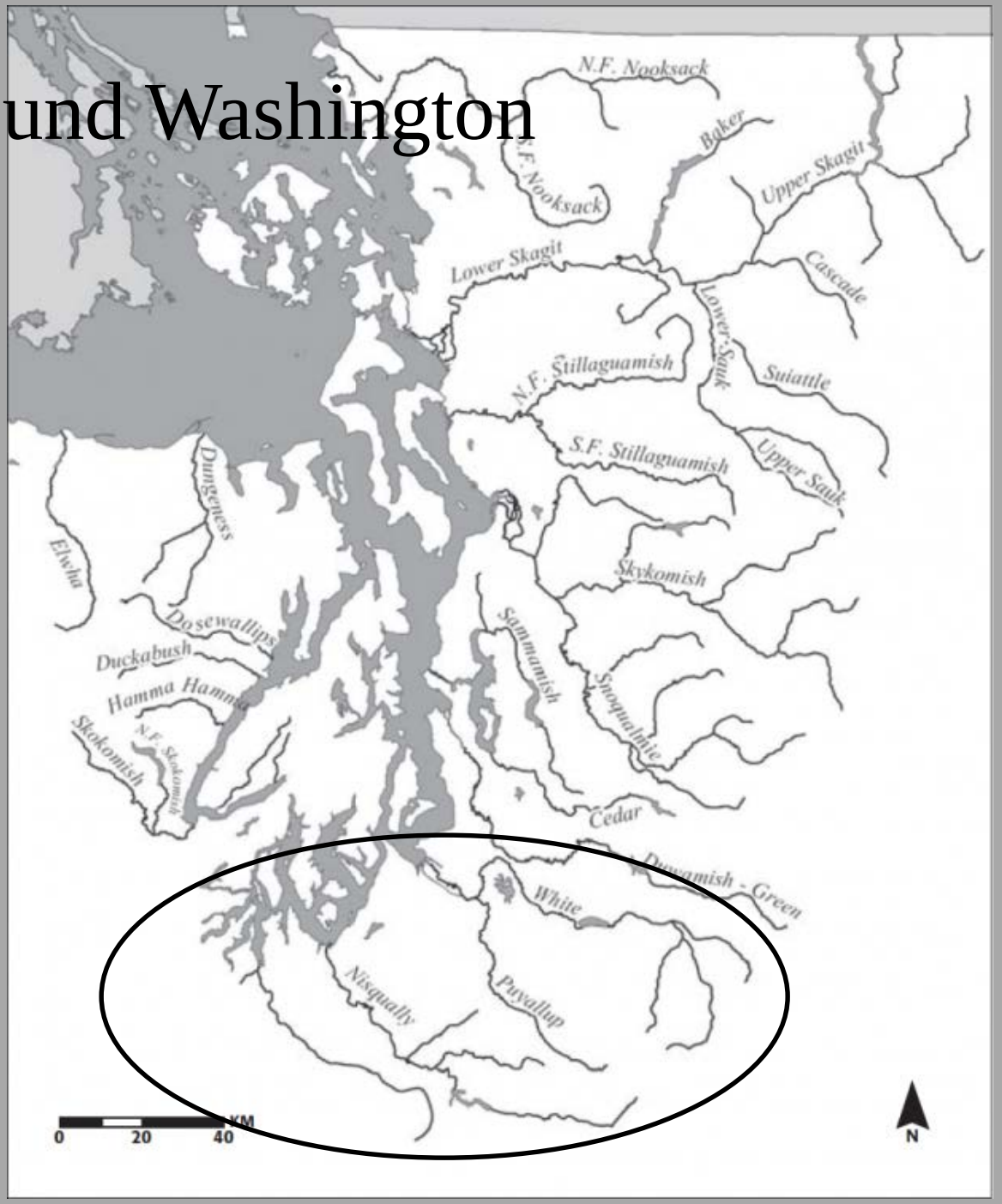
Managing ESA listed *O. mykiss* in the presence of multiple life history strategies

Joseph Anderson, Lance Campbell, Andrew Claiborne, Matt Klungle, James Losee, Larry Phillips

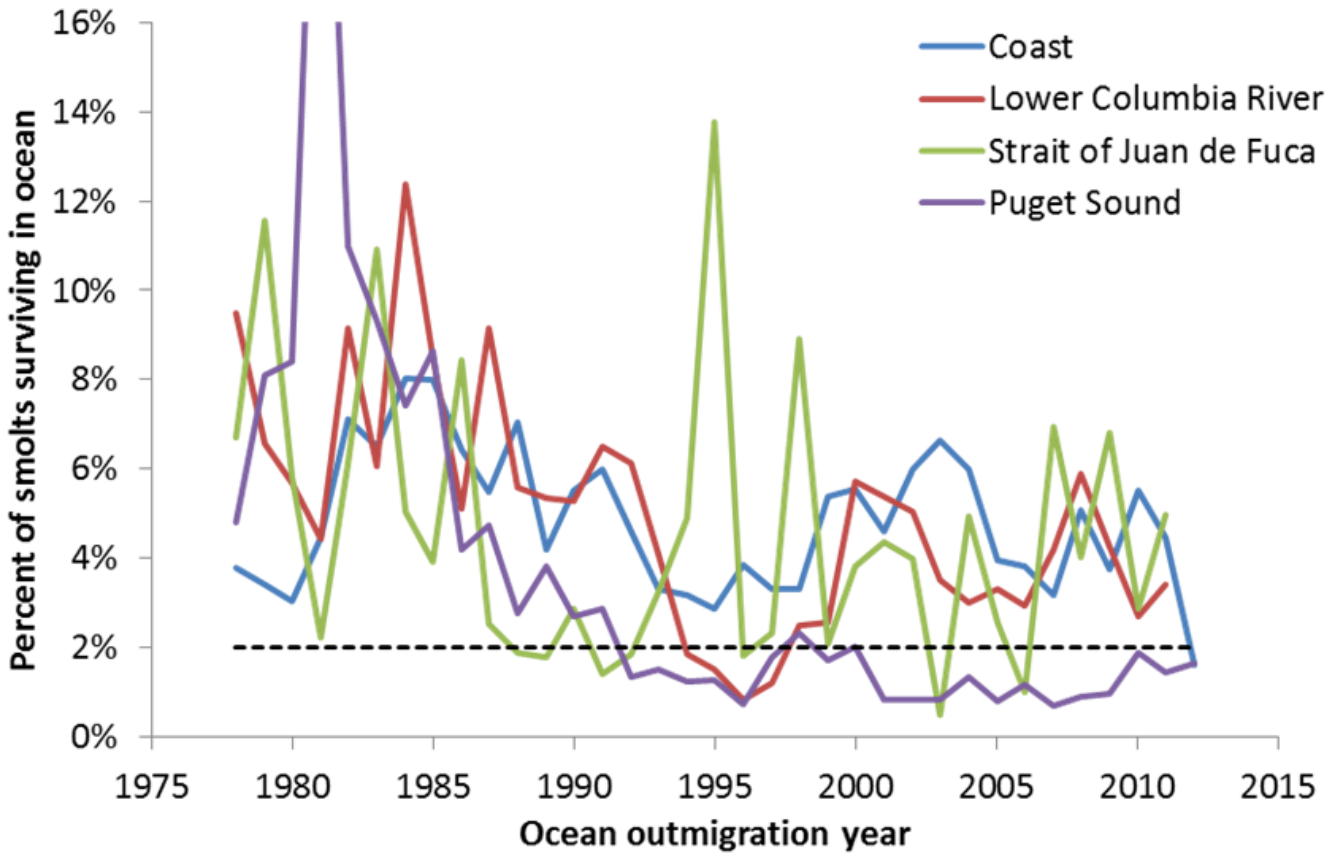
Washington Department of Fish and Wildlife


RIVER
INCUBATION
SPAWNING
EMERGENCE
FRESHWATER REARING
ESTUARY
ESTUARY REARING
MIGRATION TO SPAWNING AREAS
MIGRATION TO REARING AREAS
GROWTH AND MATURATION
OCEAN

Puget Sound Washington

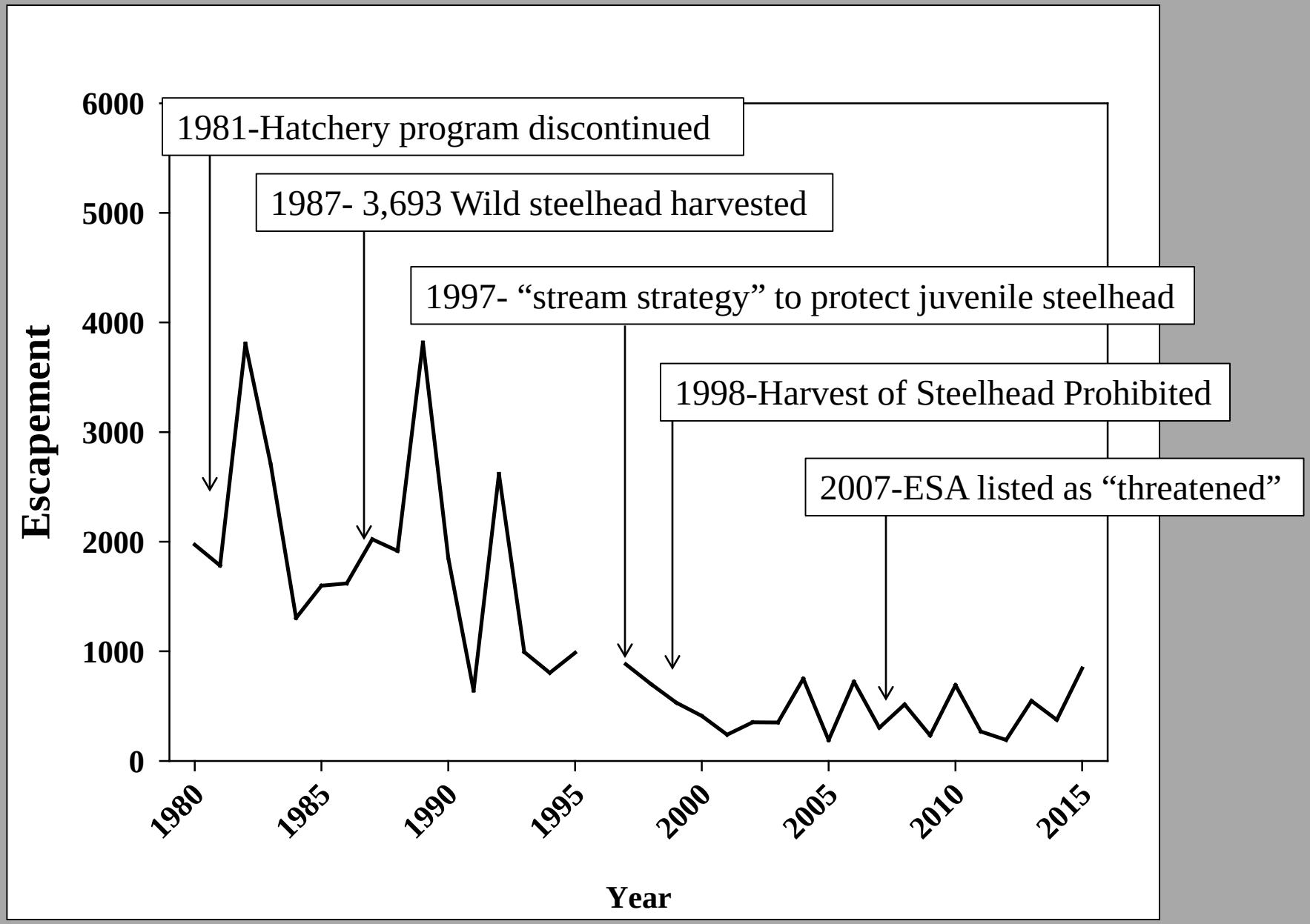


Steelhead-Marine Survival



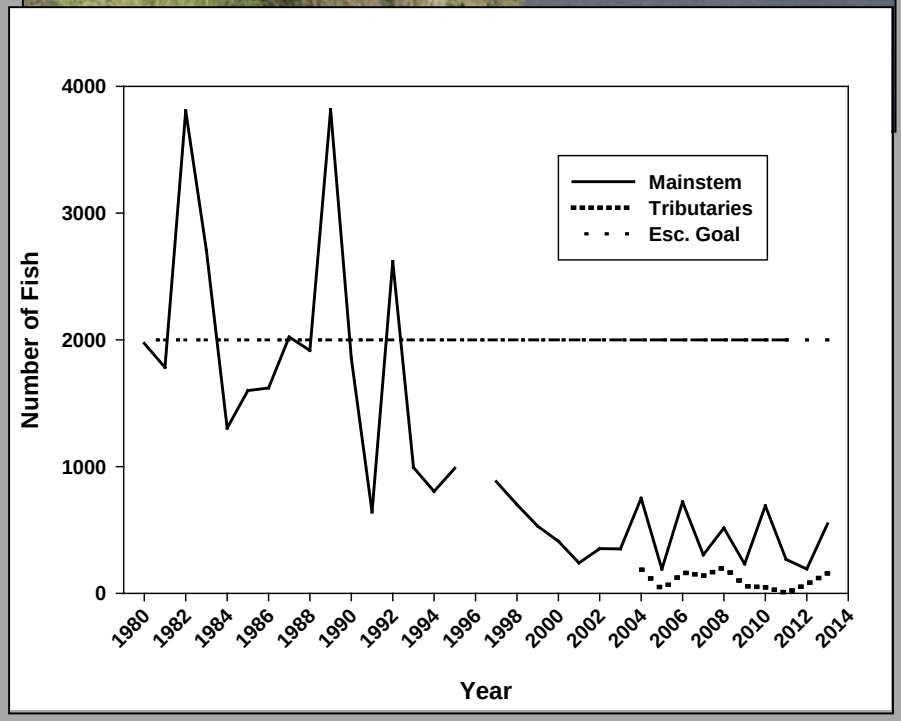
Kendall et al. *in prep*

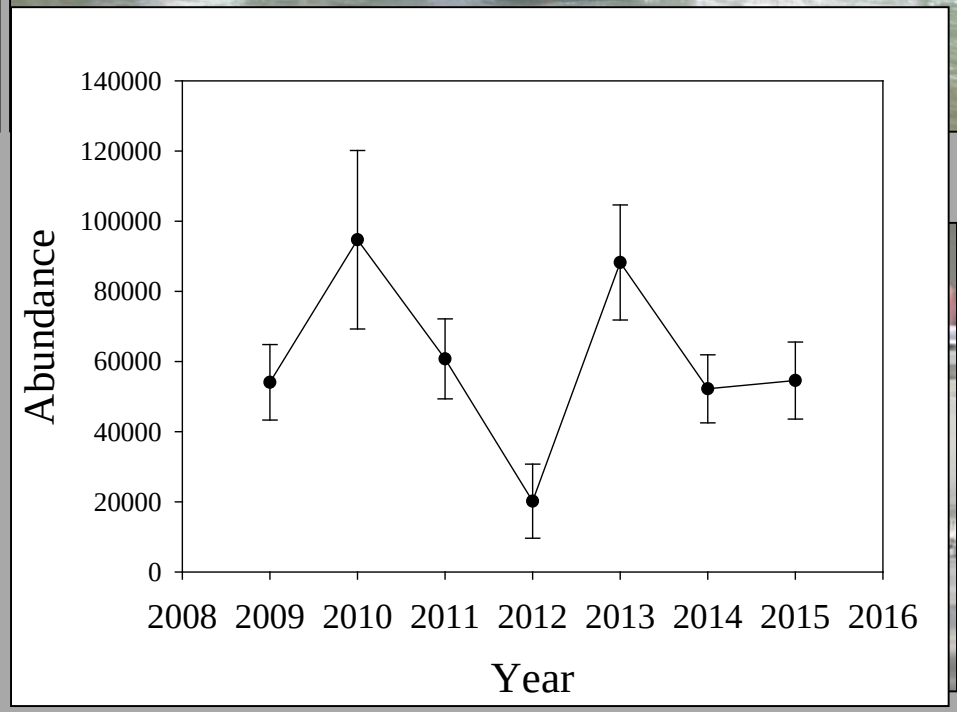
Management of Nisqually River Steelhead



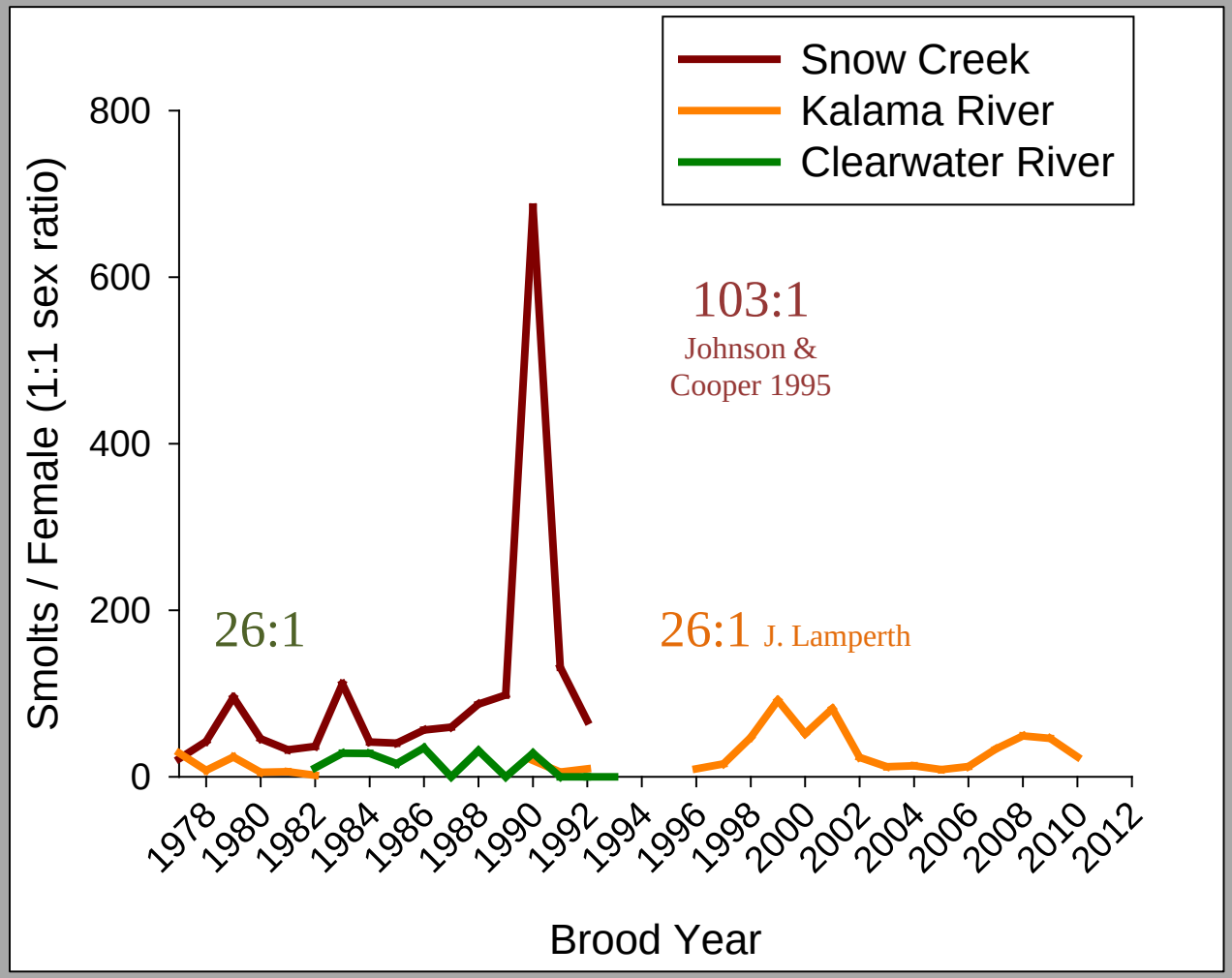
South Creek
Nisqually River
Tanwax Creek
Ohop Creek
Lynch Creek
Nisqually Watershed
Land Cover
Ice Mass
Lake or Pond
Developed, Moderately
Developed, Heavily
Shrub or Barren
Forested
Cultivated/Herbaceous
Wetland
N
W
E
S
Miles
0 1 2 3 4 5
0 1 2 3 4 8 12
Kilometers

Stock Assessment Tools

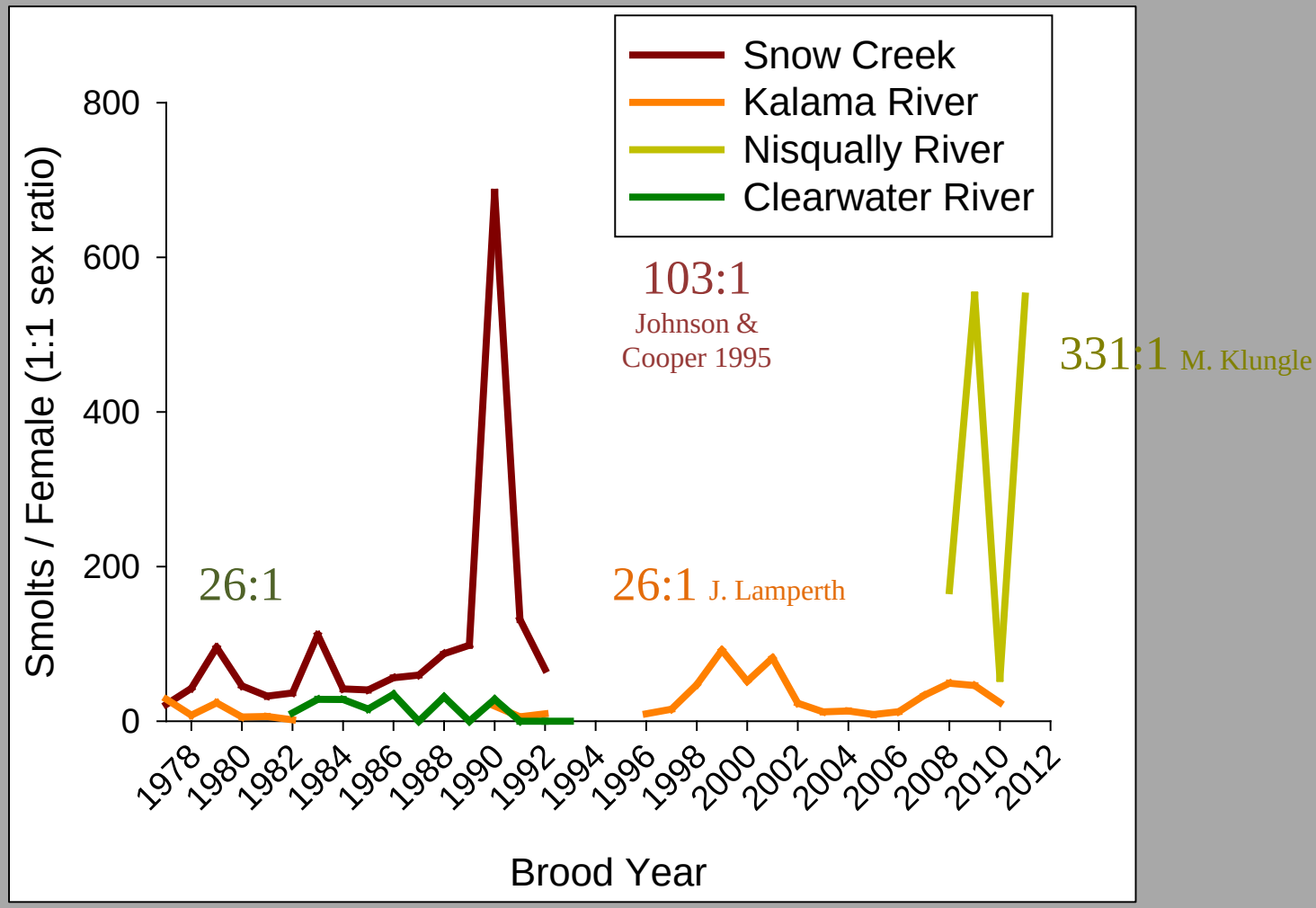




Smolt Trapping

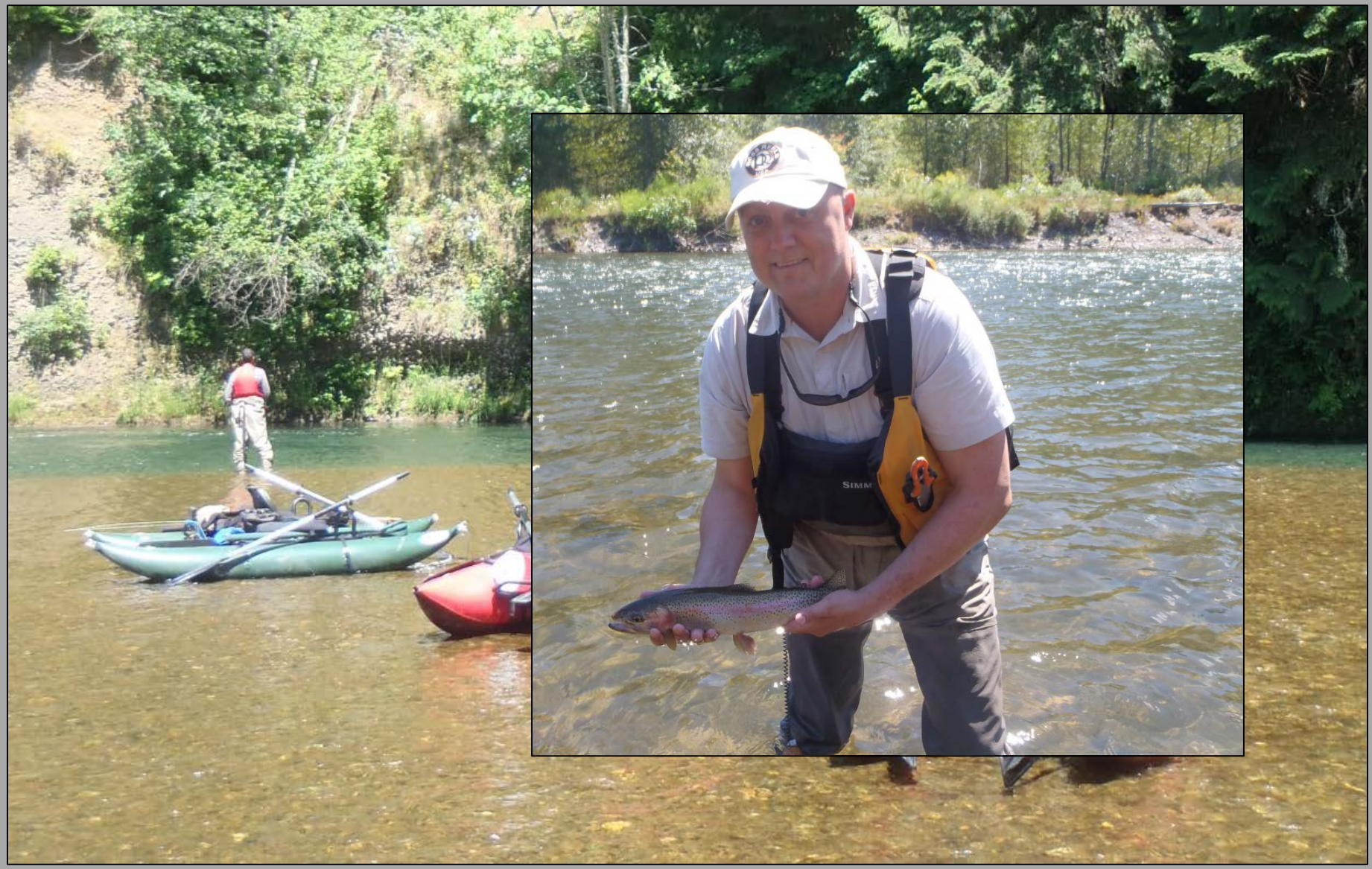


Smolt Trapping



Nisqually River Rainbow Trout

Nisqually River Rainbow Trout



What We Know . . .

- Higher than expected number of steelhead smolts outmigrating relative to estimate of spawning adult Steelhead.

- Potential Causes
  - Escapement estimate is way off?
  - Over estimation of juveniles (screw trapping)?
  - Nisqually River is very productive relative to other systems?
  - Contribution from resident rainbows?

Preliminary Question

1. What contribution are resident *O. mykiss* making to the Nisqually Steelhead population?

Study Area

Steelhead early-marine, N=50

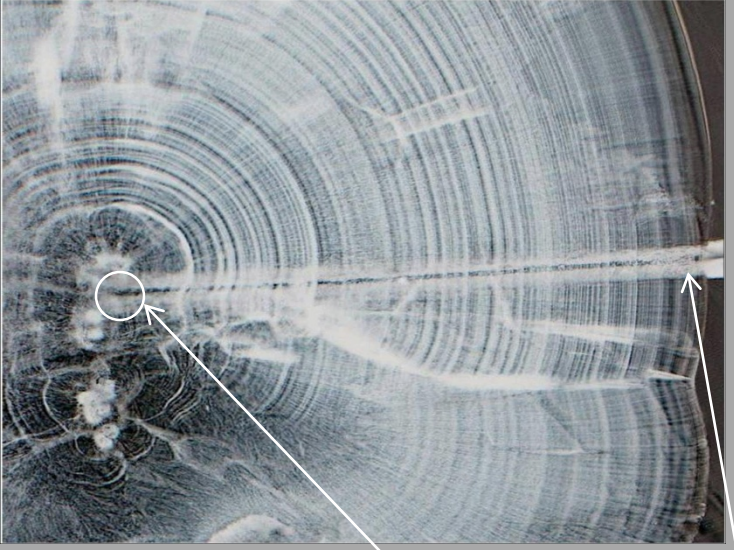
Photo: Chris Ellings

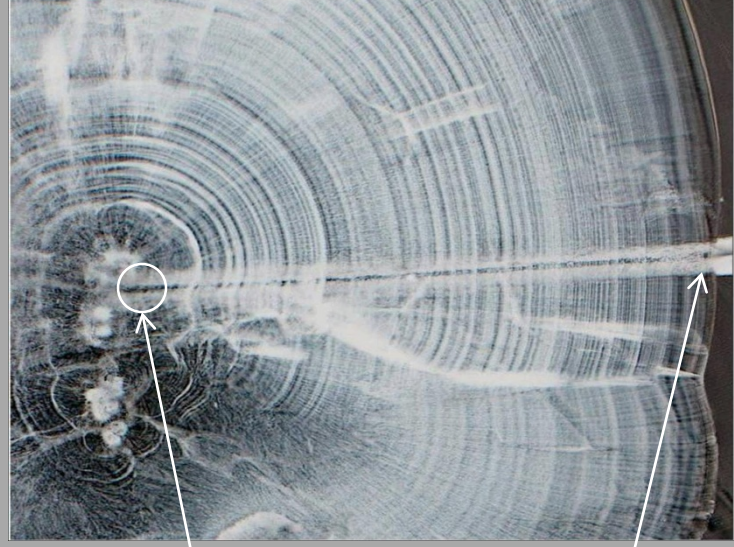
In-river *O.mykiss*

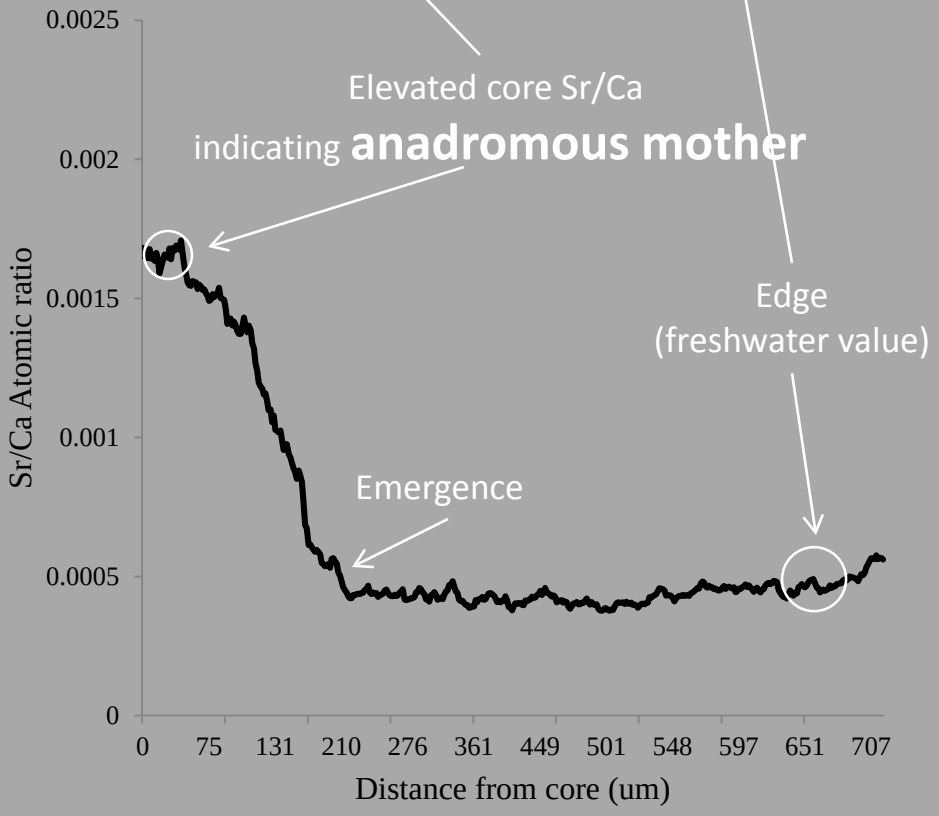
Mainstem, N=60

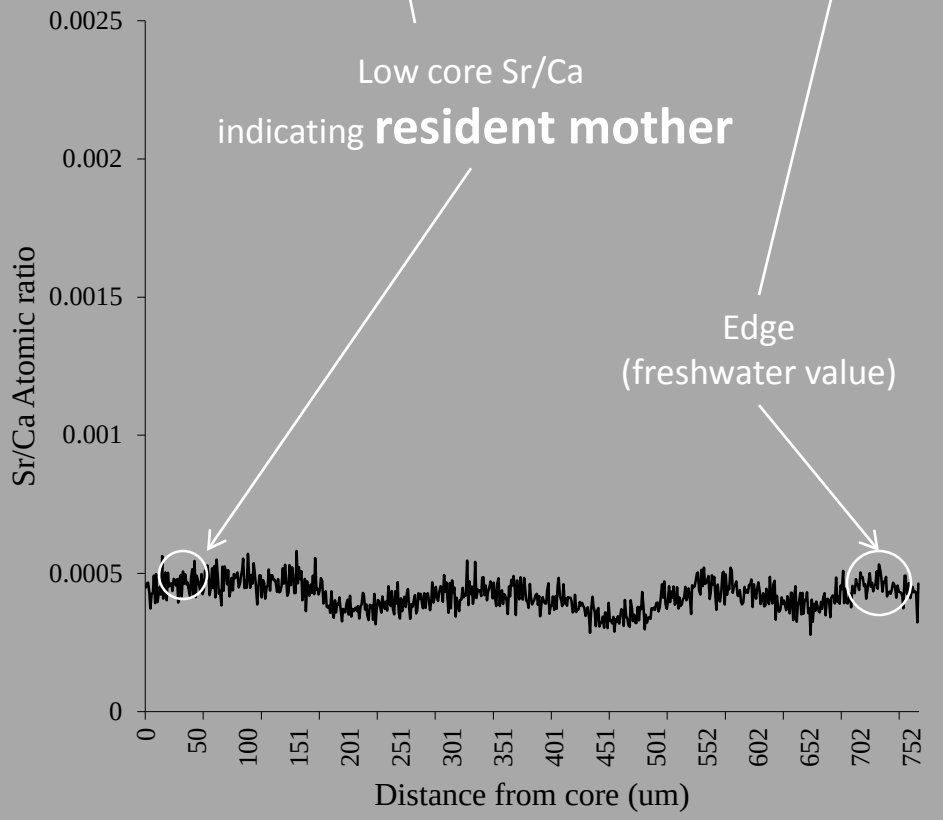
Mashel River, N=45

Steelhead Smolts, N=43





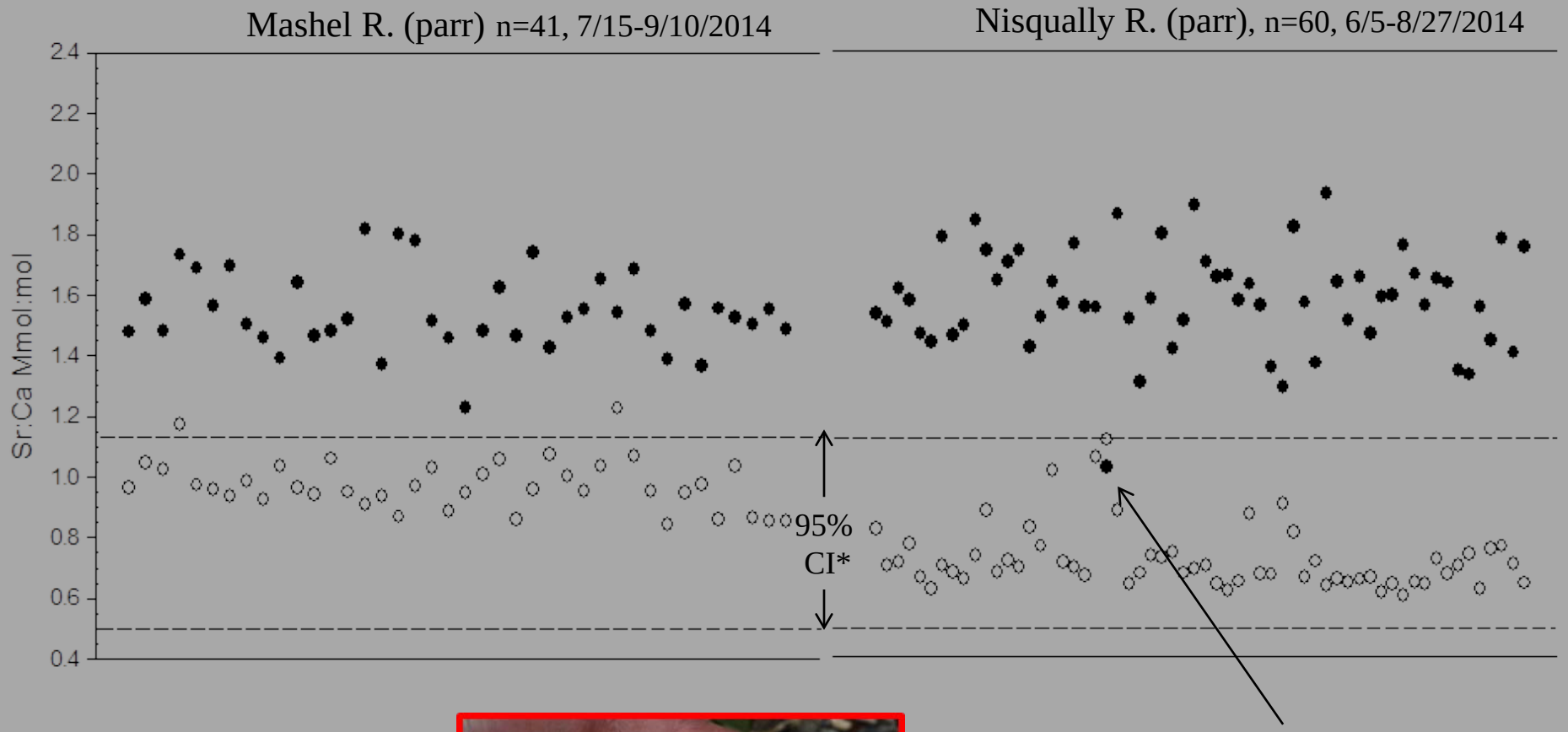

Elevated core Sr/Ca
indicating anadromous mother
Edge
(freshwater value)
Emergence
Sr/Ca Atomic ratio
0.0025
0.002
0.0015
0.001
0.0005
0
0
75
131
210
276
361
449
501
548
597
651
707
Distance from core (um)


Low core Sr/Ca
indicating resident mother
Edge
(freshwater value)
Sr/Ca Atomic ratio
0.0025
0.002
0.0015
0.001
0.0005
0
0
50
100
151
201
251
301
351
401
451
501
552
602
652
702
752
Distance from core (um)

Summer Parr Samples

○ Sr:Ca otolith edge (freshwater signal)

● Sr:Ca otolith core (maternal signal)



*95% CI of freshwater otolith values (Mashel &Nisqually)

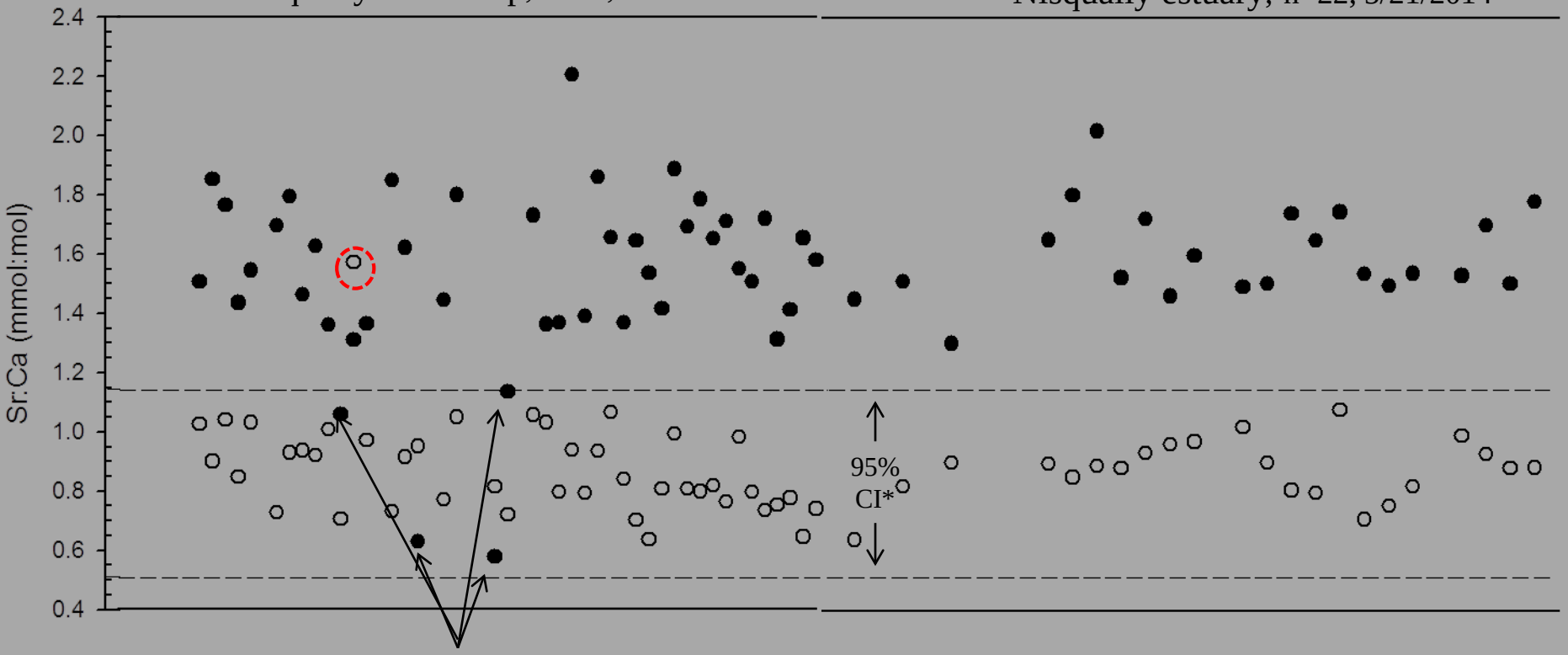
Spring Smolt Samples

○ Sr:Ca otolith edge (freshwater signal)

● Sr:Ca otolith core (maternal signal)

Nisqually smolt trap, n=43, 5/8-6/5/2014

Nisqually estuary, n=22, 5/21/2014



progeny from resident mothers*

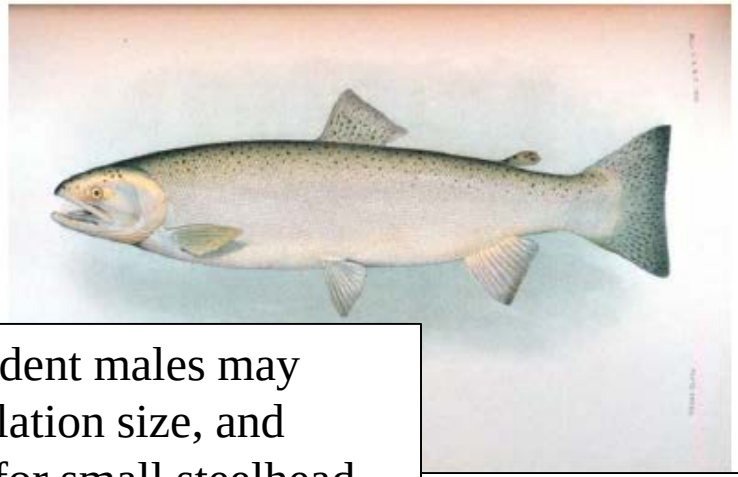
◌ One individual that apparently moved from the estuary back into freshwater

*95% CI of freshwater otolith values (Mashel &Nisqually)

Preliminary Question

1. What contribution are resident *O. mykiss* making to the Nisqually Steelhead population?
    - Majority (>90%) of summer parr and spring smolt collections were the product of anadromous mothers.

Steelhead Policy



. . . results suggest that resident males may increase the effective population size, and probability of persistence, for small steelhead populations (Seamons et al. 2004).

Implement monitoring, evaluation and adapt
decisions to protect the abundance, diversity,
and the habitats they rely on.

Statewide Policies, Str

(1) Pristine populations of steelhead should be expected to exhibit partial anadromy; and (2) that managing anadromous and resident individuals separately without demonstrating reproductive isolation is biologically unsound (Mcphee et al. 2007).

Actions:
10). . .for populations identified to have a potential conservation concern, broaden the analysis to evaluate the contribution of rainbow trout to population viability . . .

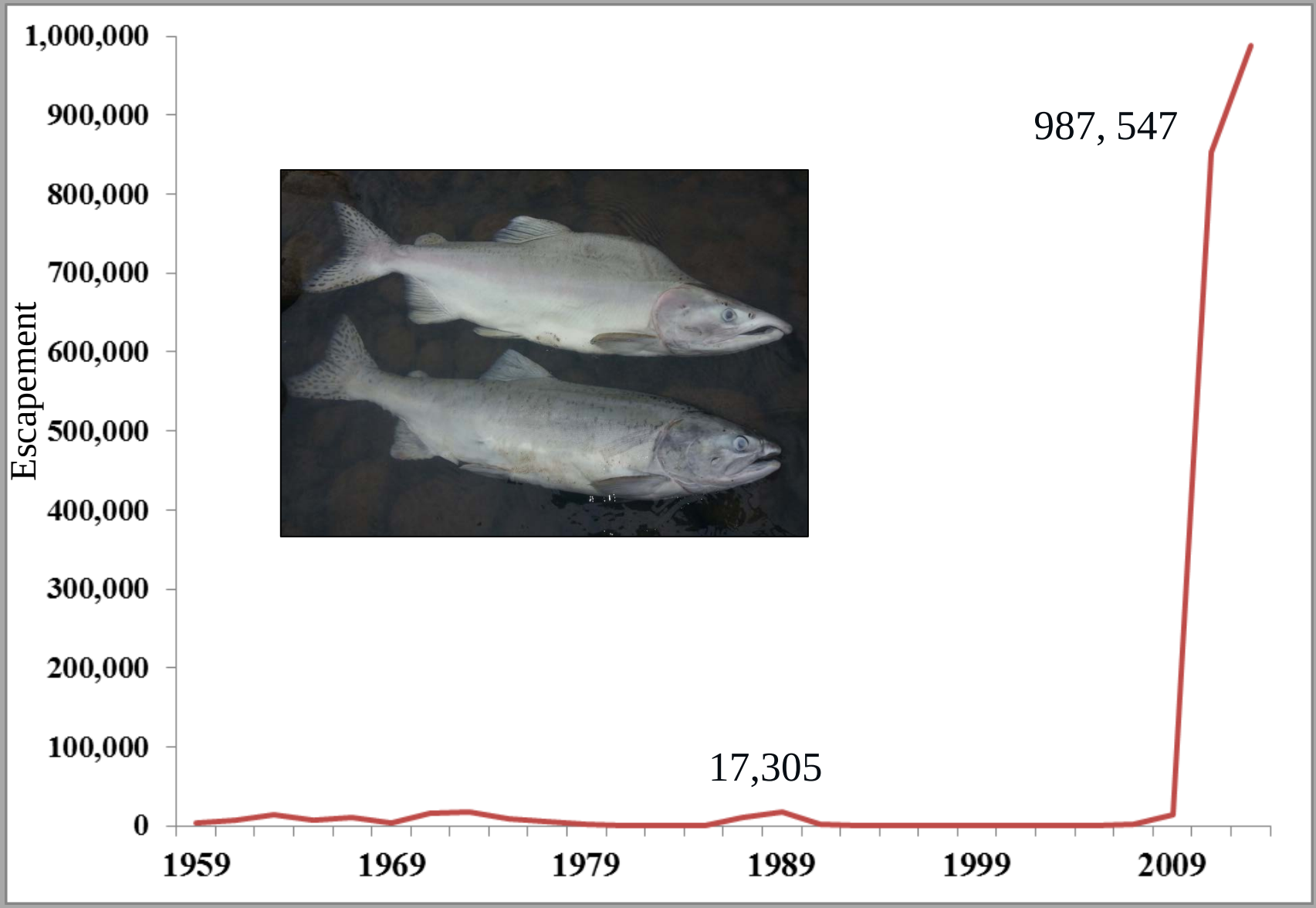
Acknowledgements

- Nisqually Indian Tribe: Chris Ellings, Sayre Hodgson, Jed Moore.

- WDFW: Bob Leland, Neala Kendall, Thomas Buehrens, Kelly Cunningham, Bill Evans, John Rohr, Riley Freeman, Clayton Kinsel, Kenny Behen, Anna Hildebrandt, Dale Gombert.

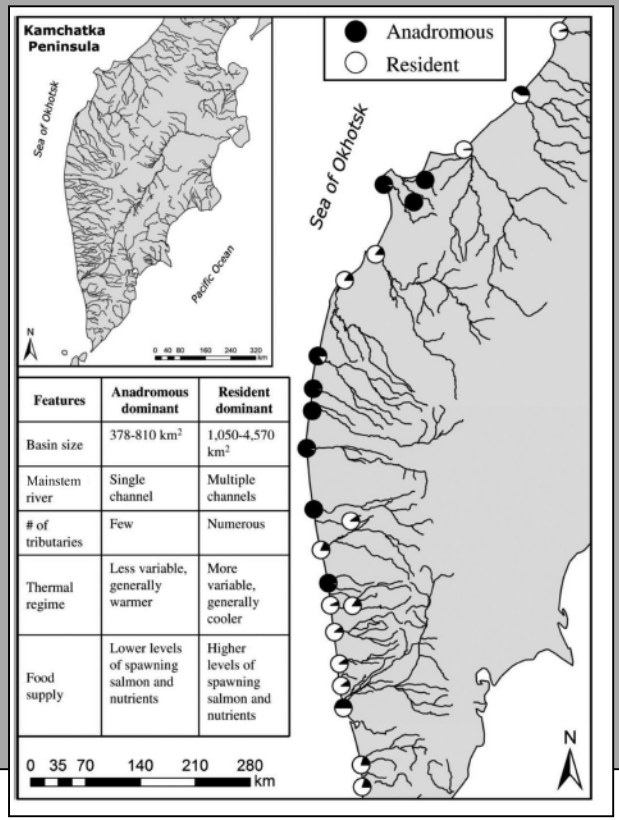
Questions?

Nisqually River Pink Salmon

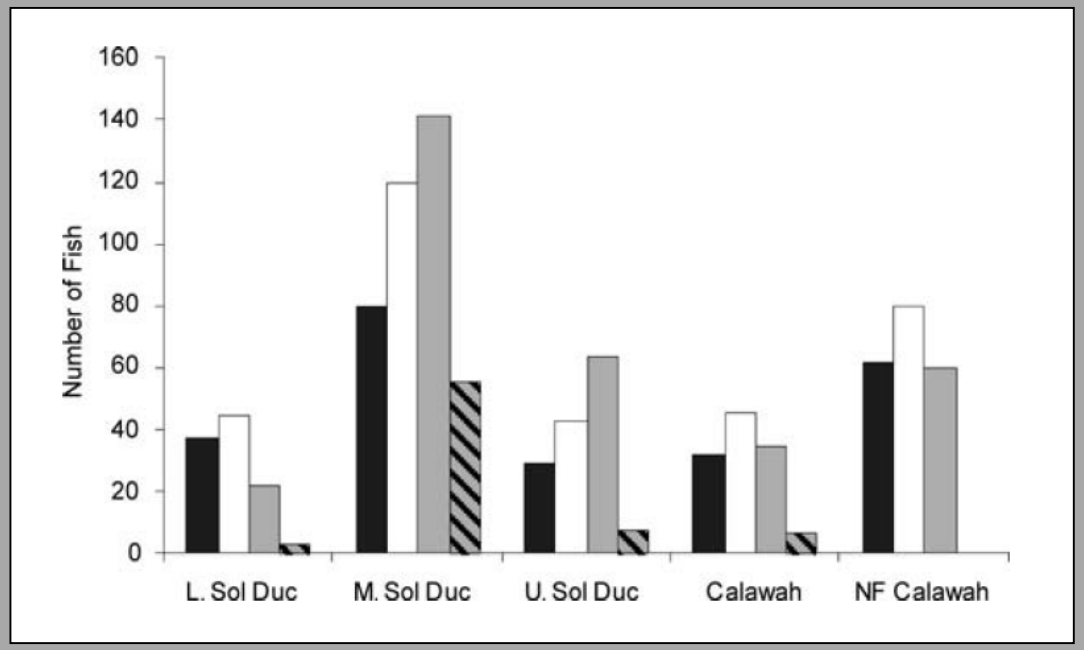


Life History Diversity and Management

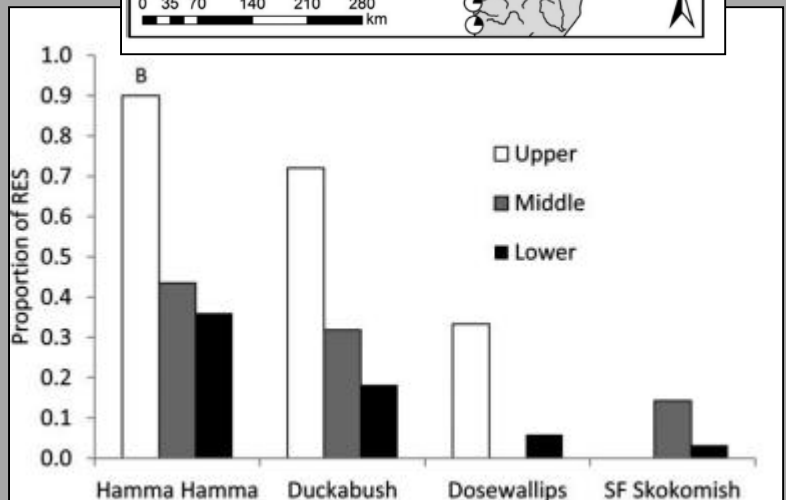
Pavlov et al. 2008



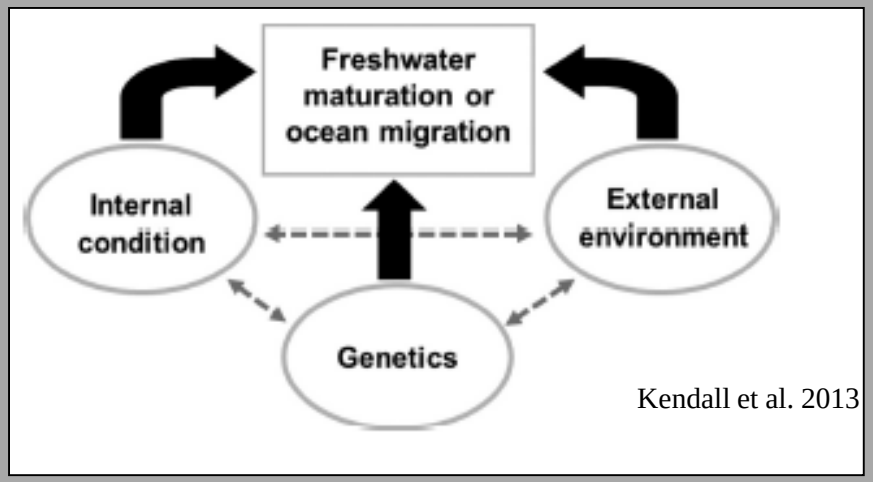
Features	Anadromous dominant	Resident dominant
Basin size	378-810 km^2	1,050-4,570 km^2
Mainstem river	Single channel	Multiple channels
# of tributaries	Few	Numerous
Thermal regime	Less variable, generally warmer	More variable, generally cooler
Food supply	Lower levels of spawning salmon and nutrients	Higher levels of spawning salmon and nutrients



McMillan et al. 2007



Berjekian et al. 2013



Kendall et al. 2013

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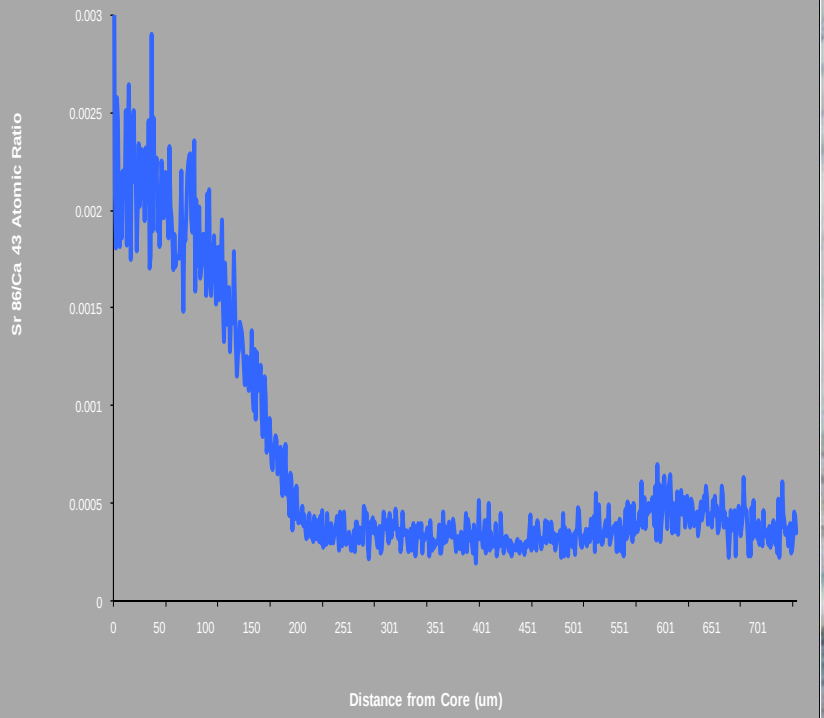
Otolith microchemistry to determine anadromy through a maternal strontium (Sr) signal using (LA-ICPMS)

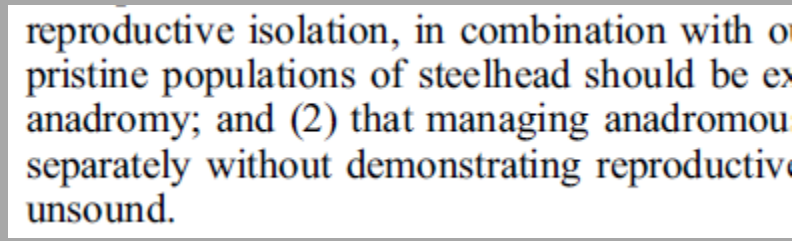


Notes

- During this study only eight PIT-tagged progeny from our breeding crosses were subsequently detected at adult observation sites on Columbia and Snake river dams (Table 3). Of these, it is likely that the two detections in 1998 at Lower Granite Dam were from fish that had outmigrated no farther than downstream of Lower Granite Dam, otherwise these fish would probably have been recorded at the Bonneville and/or McNary dam adult detection sites. Of the six remaining adults detected, each came from crosses using female steelhead.
- Summer steelhead, redband
- Ruzycki et al. 2009

stated that an explanation for this observed pattern may
be a proportional increase in reproductive success of resident males when few anadromous males occur (see also Ardren and Kapuscinski 2003). These results suggest that resident males may increase the effective population size, and probability of persistence, for small steelhead populations (Seamons et al. 2004). Seamons et al. 2004

Mcphee et al. 2007


reproductive isolation, in combination with o
pristine populations of steelhead should be ex
anadromy; and (2) that managing anadromou
separately without demonstrating reproductive
unsound.