Survival Estimates of Columbia River Summer Steelhead Caught and Released from Seines

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Background

- Since 1915 Columbia River fisheries have been regulated by the Columbia River Compact (States of OR & WA)
- Commercial harvest of Columbia River steelhead prohibited by WA in ~1930's and by OR in 1970's
- Purse, horse, hand, and beach seines were prohibited by OR & WA between 1922 and 1948
- Seine use was terminated due to user conflict

Policy Direction

- In 2012 a petition to eliminate gill nets from Columbia River was drafted as a ballot measure in OR
- Gov. Kitzhaber proposed a plan to phase out gill nets in the mainstem Columbia River in response to ballot measure.
- WDFW & ODFW Commissions adopted policies in this direction
- Seines were considered as an alternative to gill nets
- Pursue studies to estimate survival of salmon and steelhead released from seines

Project Goals

- Estimate post-release survival of salmon and steelhead released from purse and beach seines:
  - Short-term survival is from the seine fishery (above Washougal River) to Bonneville Dam (BON) (~15km)
  - Intermediate-term survival is from BON to McNary Dam (MCN) (240km) includes fisheries and tributary PIT tag detections (e.g. Deschutes, John Day, Klickitat, etc.)
  - Cumulative survival is from the seine fishery to MCN including tributary and fisheries detections

- Assess covariates in predicting post-release survival of salmon & steelhead caught and released from seines

Experimental Seine Fishery

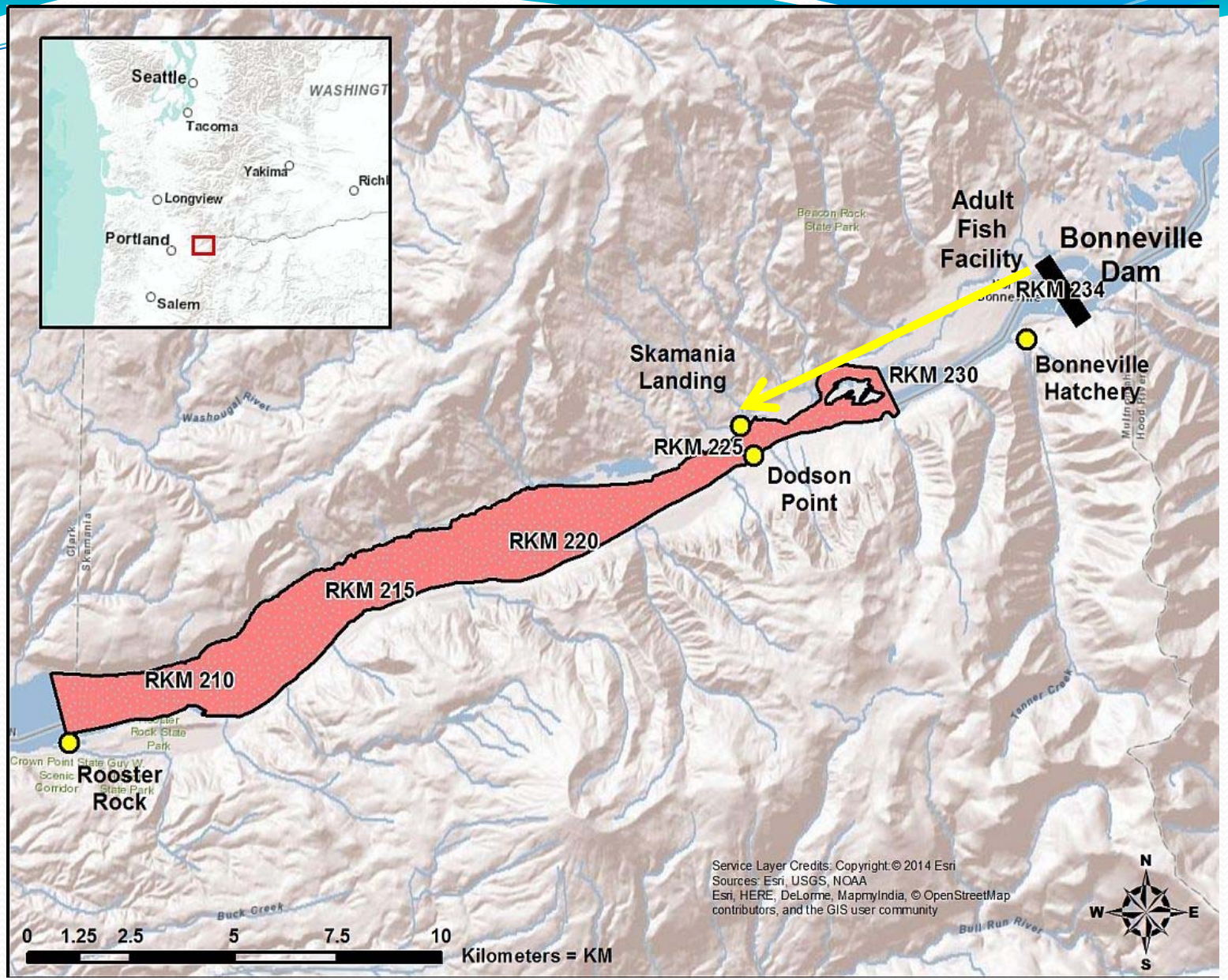
- Experimental seine fishery occurs in the fall (Aug-Oct) & targets Chinook and coho salmon
- Fishery was monitored from 2011-13 and each vessel had an observer and all caught fish were tagged with Passive Integrated Transponder (PIT) tags
- Mean salmon and steelhead catch per set was 11 and 1 fish, respectively
- Mean daily water temperature was 19.5°C (range 14.1 – 22.4 °C)
- Recover PIT tags through out the Columbia River including BON, MCN, tributary PIT tag interrogation sites and fishery sampling

Purse Seine fishery

- Seine length ranged from 150 - 250 fathoms or 274-457 meters
- Seine depth is variable but generally > 12 meters
- Mesh size 8.9cm with purse seines having a 2.5cm bunt
- Set time (first cork out until last fish removed) for purse seines (mean = 71 minutes)

Beach Seine Fishery

- Same seine as purse seines except no bunt
- Set time less than purse seines (mean = 44 minutes)


Seattle
Tacoma
Yakima
Longview
Portland
Salem
Adult Fish Facility
Bonneville Dam
RKM 234
Bonneville Hatchery
Skamania Landing
RKM 230
RKM 225
Dodson Point
RKM 220
RKM 215
RKM 210
Rooster Rock
Washougal River
Beacon Rock State Park
Buck Creek
Tanner Creek
Bull Run River
Service Layer Credits: Copyright © 2014 Esri
Sources: Esri, USGS, NOAA
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
0 1.25 2.5 5 7.5 10
Kilometers = KM
N
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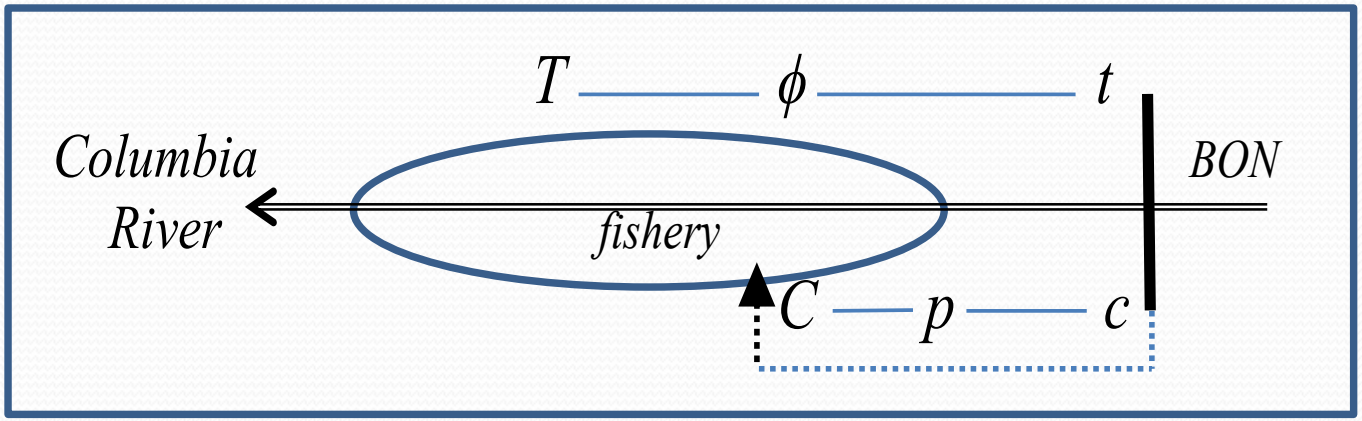
Ricker-Two-Release Study Design



- T = # C & R in fishery by seines (Treatment Group)
- C = # C & R @ BON released < BON (Control Group)
- t = # of Treatment Group captured at BON
- c = # of Control Group captured at BON
- $\phi = \frac{t/T}{c/C} = \frac{\rho_t}{\rho_c}$
- Survival estimate is the recapture of treatment relative to controls

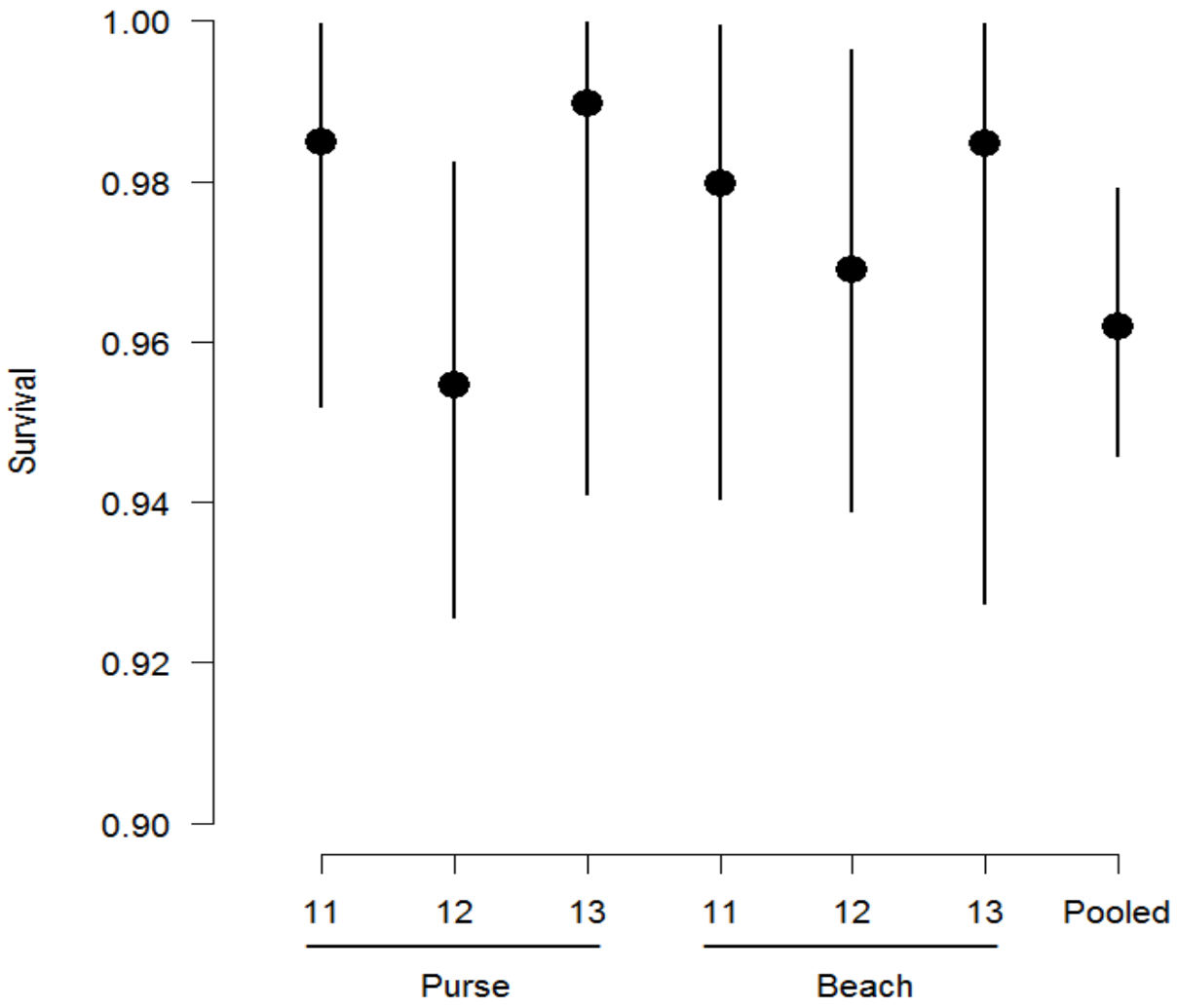
Ricker-Two-Release Design

- Previous slide was short-term survival (fishery to BON)
- Same design was repeated for control and treatment fish detected at BON to estimate intermediate-term survival (BON to MCN including fisheries and tributaries)
- Cumulative survival is the product of short-term and intermediate survival
- Key assumption is the control & treatment group are from the same population (e.g. they have the same proportion of individuals that originated above Bonneville Dam)

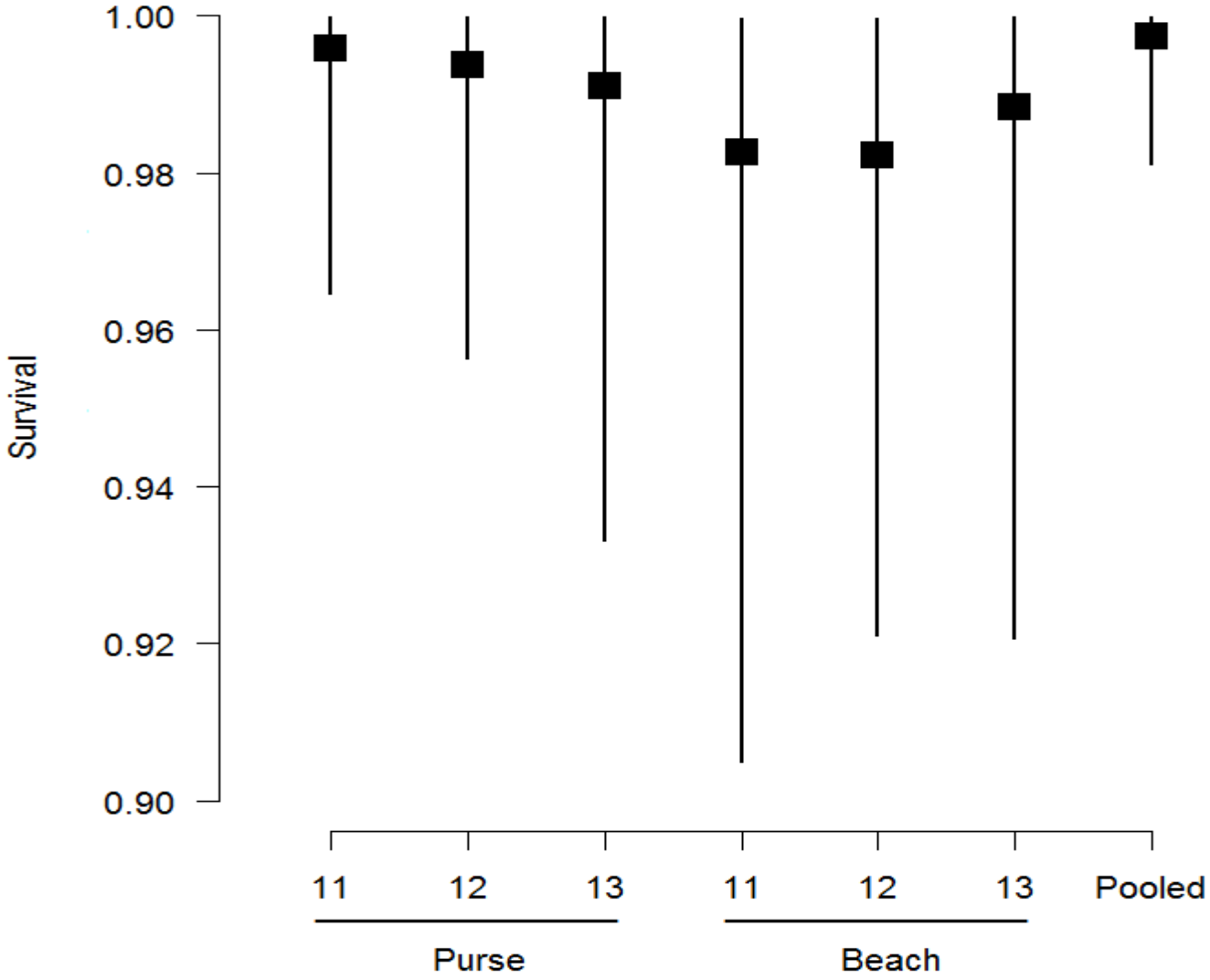
Results

- Tagged 1990 adults steelhead caught in seines and tagged 950 controls with PIT tags over 3 years.
- Immediate survival = 99.7%
- Short-term survival = 96%
- Intermediate survival = 100%
- Cumulative survival = 96%

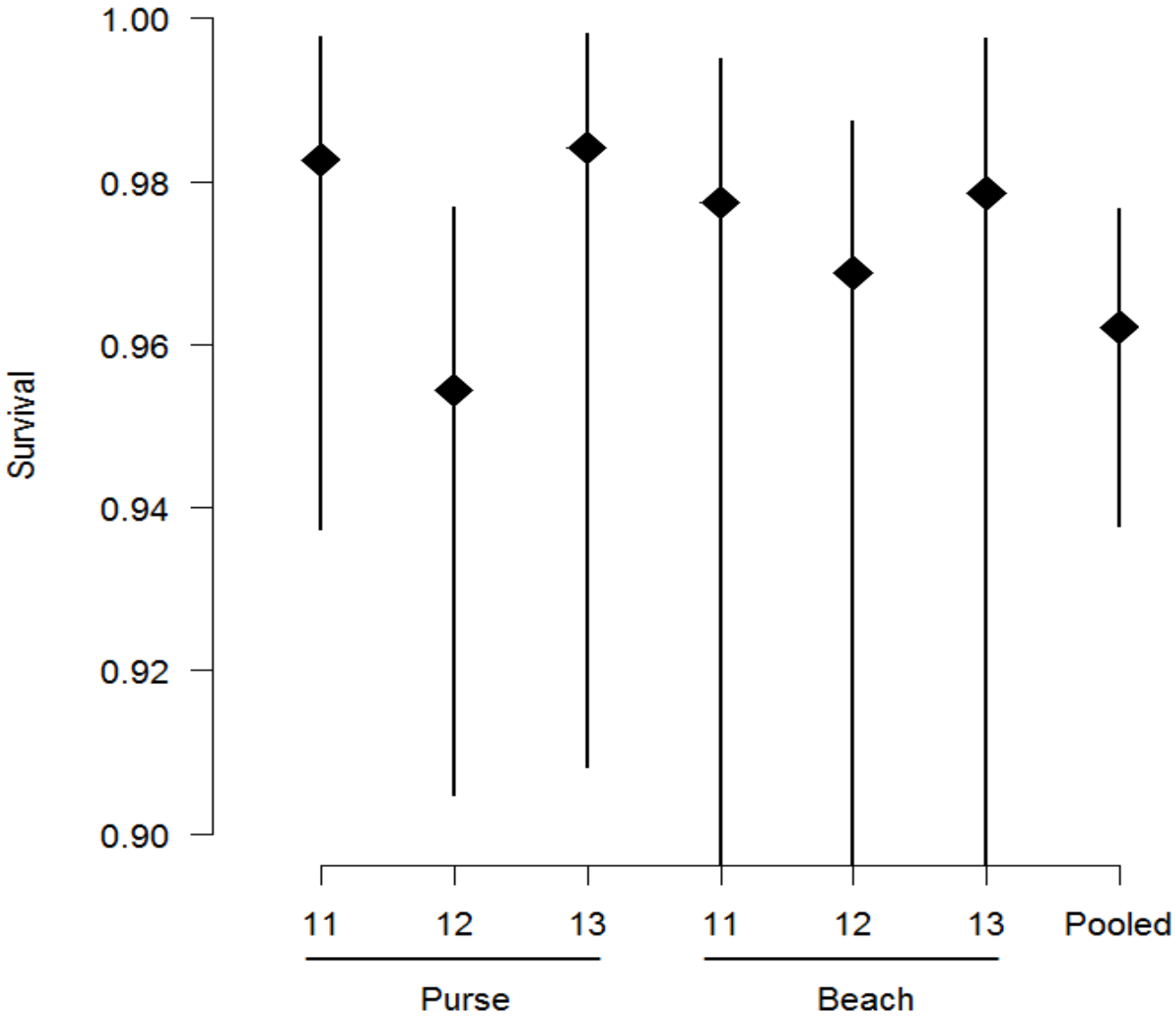
Short-term Survival



Intermediate-term Survival



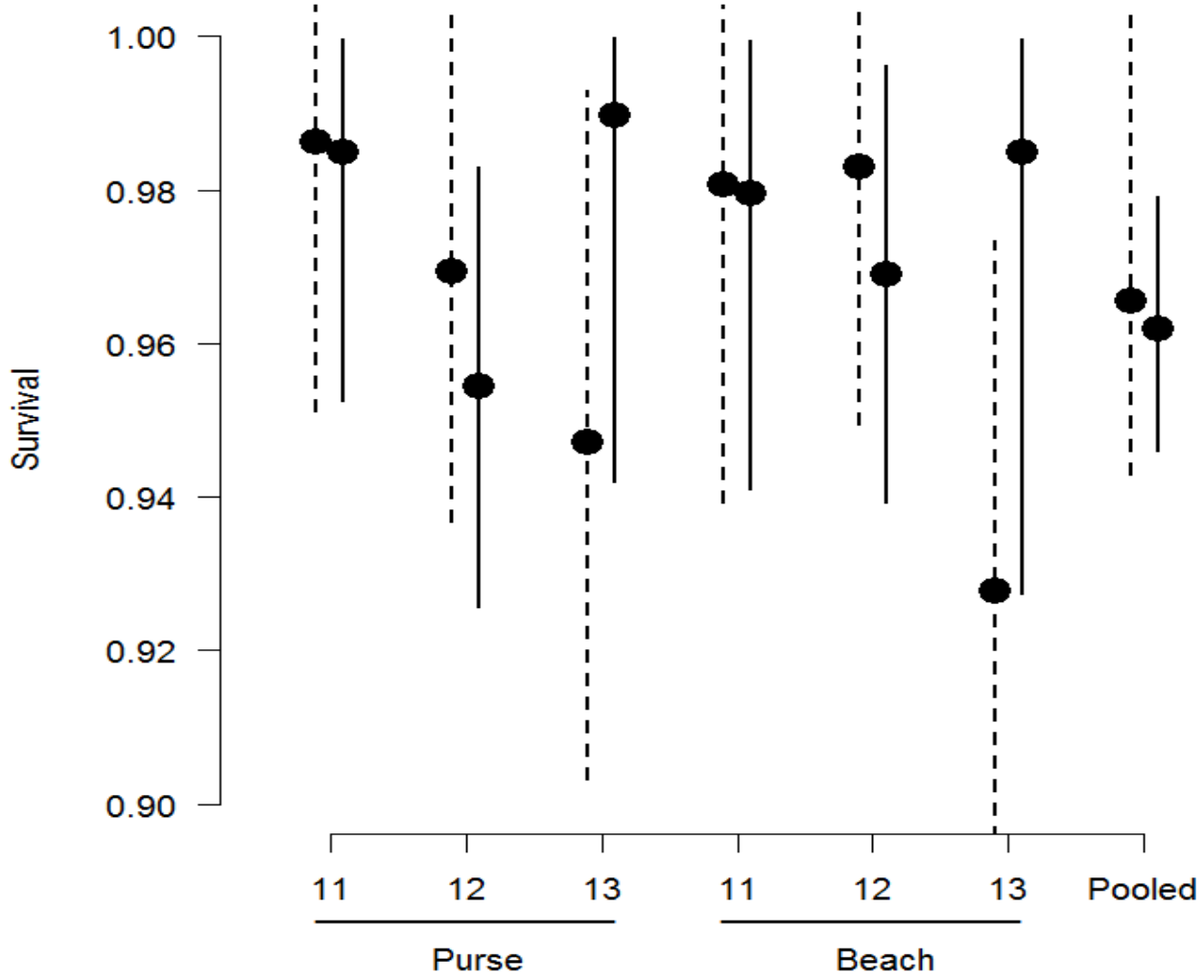
Cumulative Survival



Alternate Short-term Survival Estimate

- Probability of capture for treatment group: $p=t/T$
- Adjust the observed PIT tag detection at BON to obtain an unbiased estimates based on:
  - PIT tag detection at BON
  - PIT tag retention, and
  - Tagging induced mortality

Short-term Survival
solid line=Ricker-Two-Release
dashed line = Alternate Method



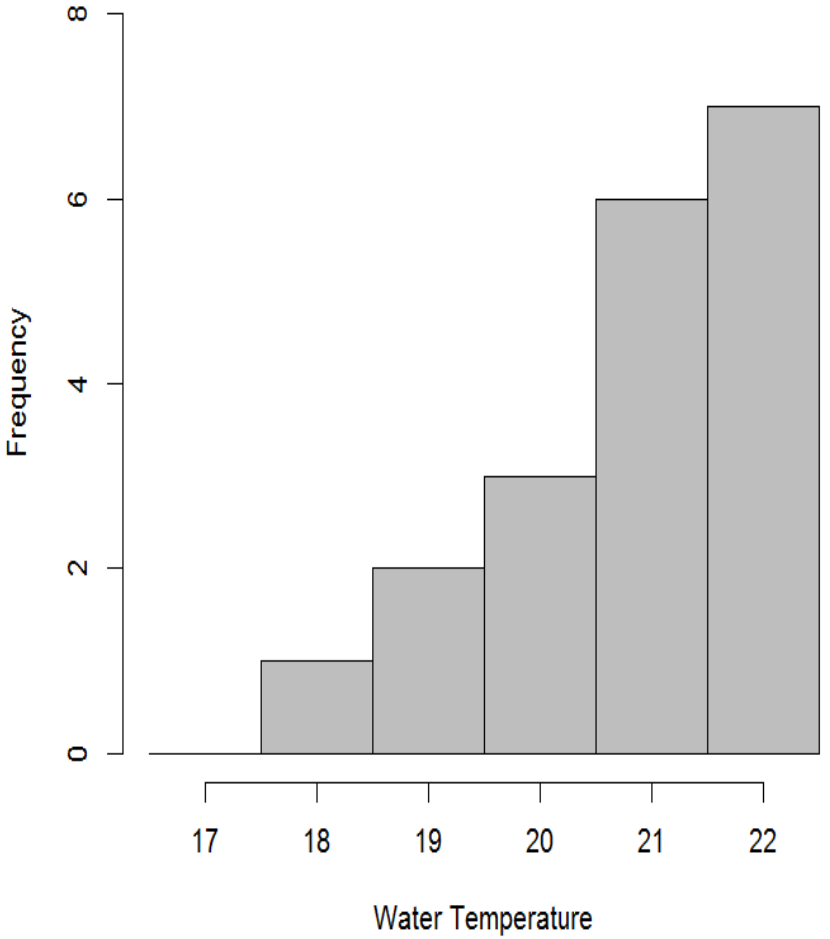
Why was survival so high (>96%)?

- Logistic regression to examine possible explanatory covariates (water temperature, date, flow, length, and origin) for treatment and controls

- Log linear models to examine fish condition

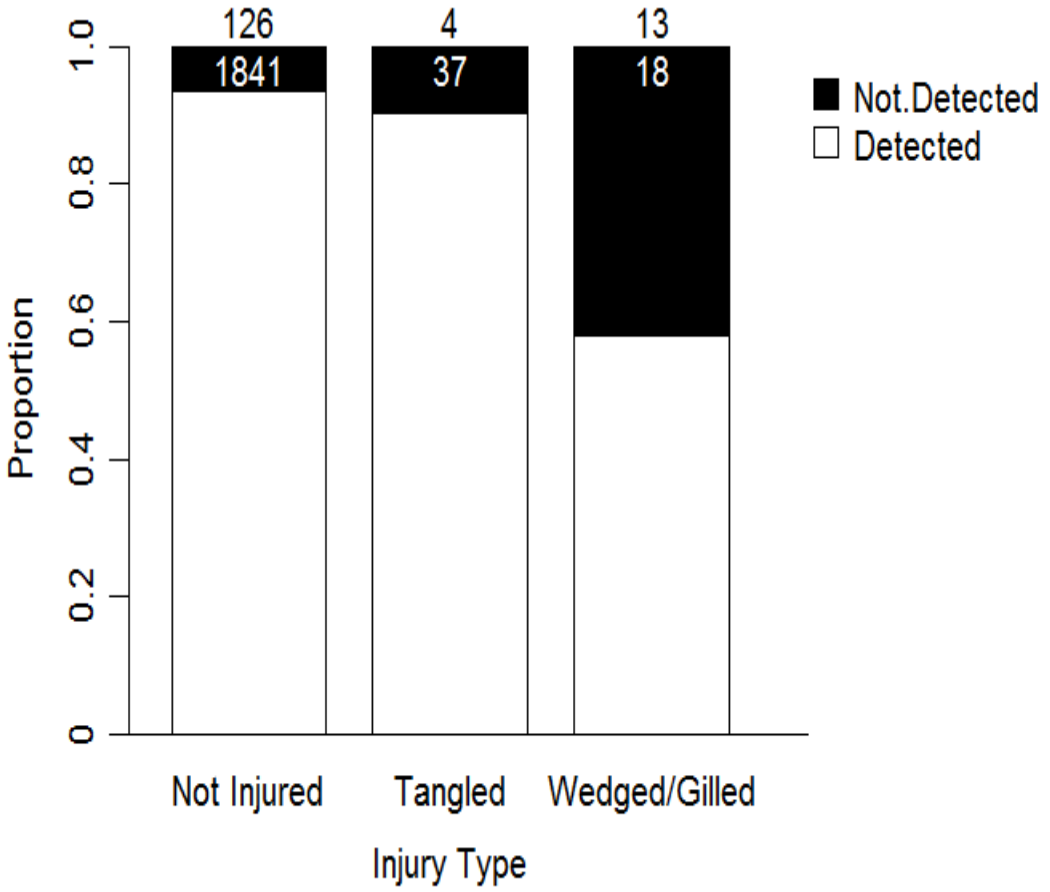
Logistic regression

- Best model was the null or intercept only model which indicates that the covariates explained little of the variation in the detection of control or treatment fish.
- Mean daily water temperature was 19.5°C (range 14.1 – 22.4 °C)
- Median temperature for the date of peak steelhead passage at BON for the last two decades was 21 degrees (Figure on right)
- Suggests local adaptation of Columbia River steelhead to warm water temperatures



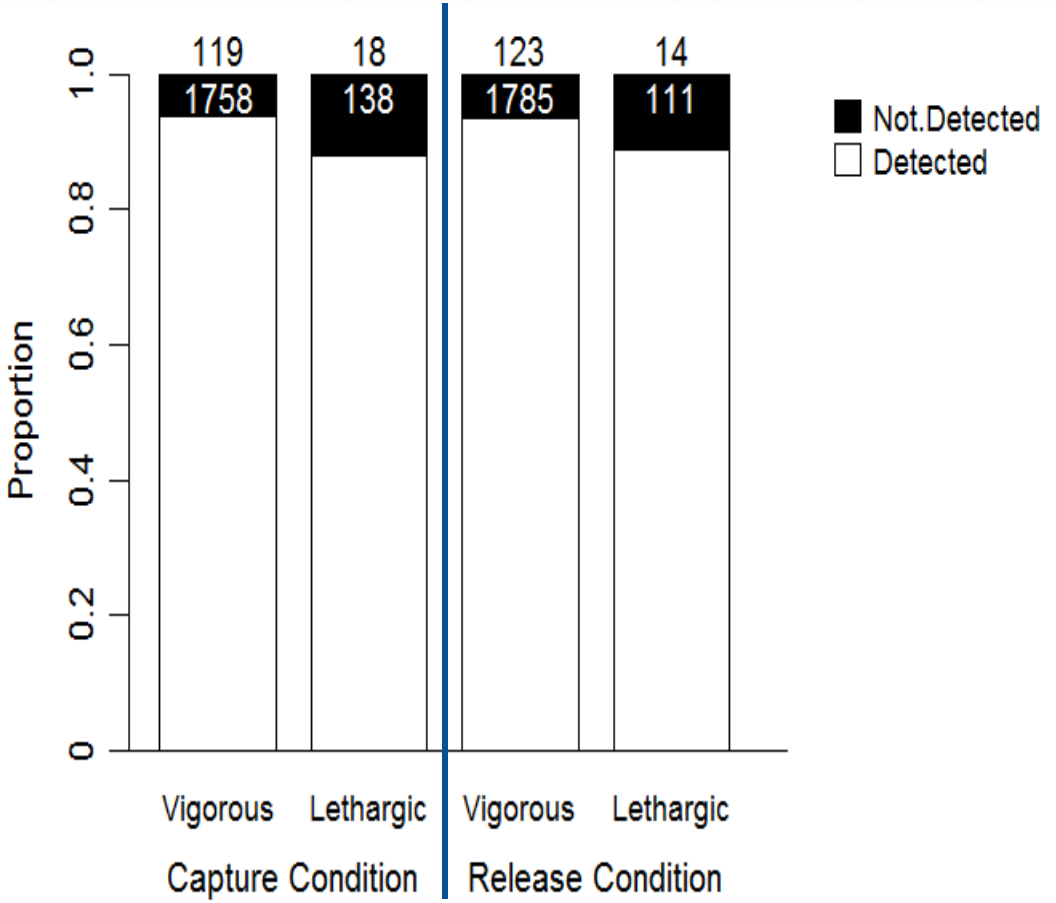
Fish Condition(1)

- 96% of the fish are not injured; exhibit no physical signs of being caught in a net
- High detection for non-injured & tangled fish (94% & 90%) but low (62%) for wedged/gilled
- Previous studies have indicated wedged/gilled are the most seriously injured fish and have lower survival rates



Fish Condition(2)

- Fish were classified as lethargic or vigorous upon recapture and release
- 92% & 94% were classified as vigorous at capture and release
- 94% of fish classified as vigorous at release were detected compared to 88% of fish classified as lethargic



Summary

- Cumulative survival was ~96% for steelhead released from seines
  - Almost all mortality (4%) was short-term (fishery to BON, 15km, 2.7 days)
- High steelhead survival in the study is likely due to a variety of factors
  - Steelhead caught in seines were in good condition
    - 96% were not injured
    - 94% were vigorous on release
  - Catch was low and averaged 11 salmon and 1 steelhead per set
  - Fish were in gear for a short amount of time; 71 and 44 minutes per set for purse and beach seines
  - Seiners typically use a brail to hoist fish from the water to the deck, which causes mortality through crushing especially when catch is high
  - Since steelhead were individually netted from the seine in this study, there was no mortality due to crushing

Questions?