Residence Times of Acoustic-Tagged Juvenile Salmon in Off-Channel, Tidal Freshwater Areas in the Lower Columbia River

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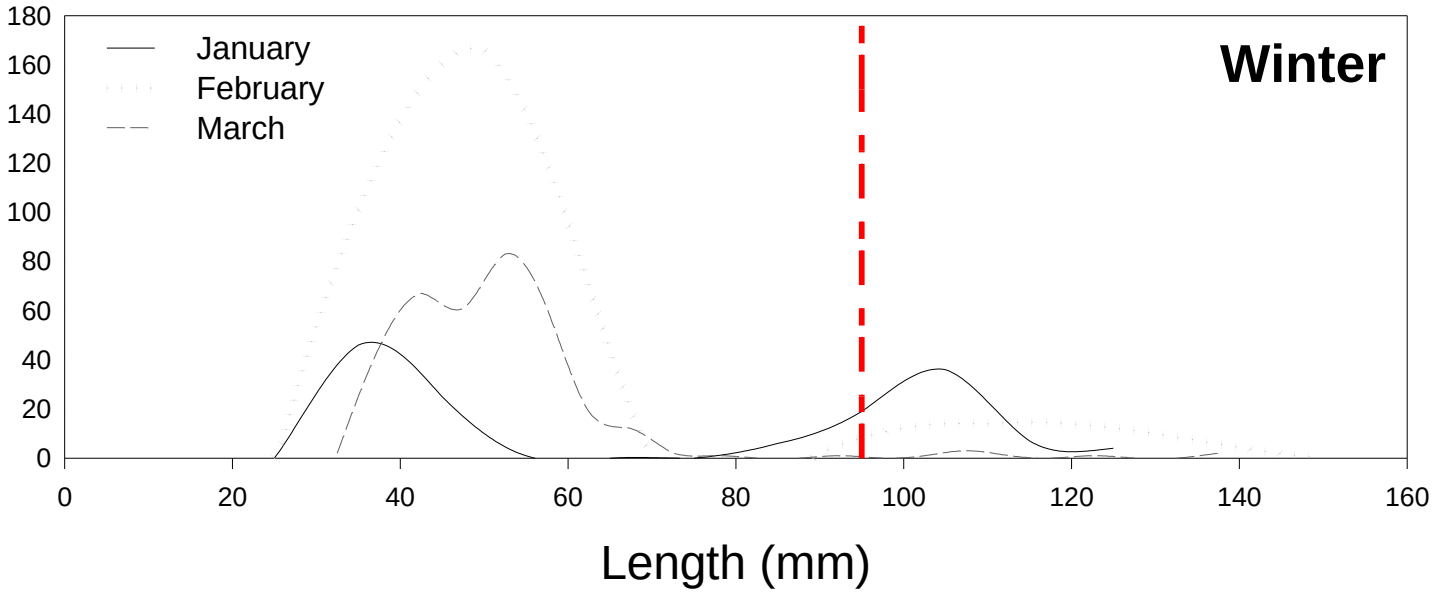
Objective

- Estimate residence times of juvenile salmon in off-channel areas in the vicinity of the Sandy River delta (rkm 200)
  - Spring and Summer – 2007 and 2008
  - Late Winter/Early Spring – 2010 and 2011

Background

- 2007 & 2008 research leveraged tagging of juvenile Chinook salmon (> 95 mm) as part of upstream studies
- 2010 and 2011 research focused on capturing and tagging large (> 95 mm) Chinook salmon known to reside in the study area during winter



Sather et al. 2011

Study Area and Detection Arrays

Spring/Summer

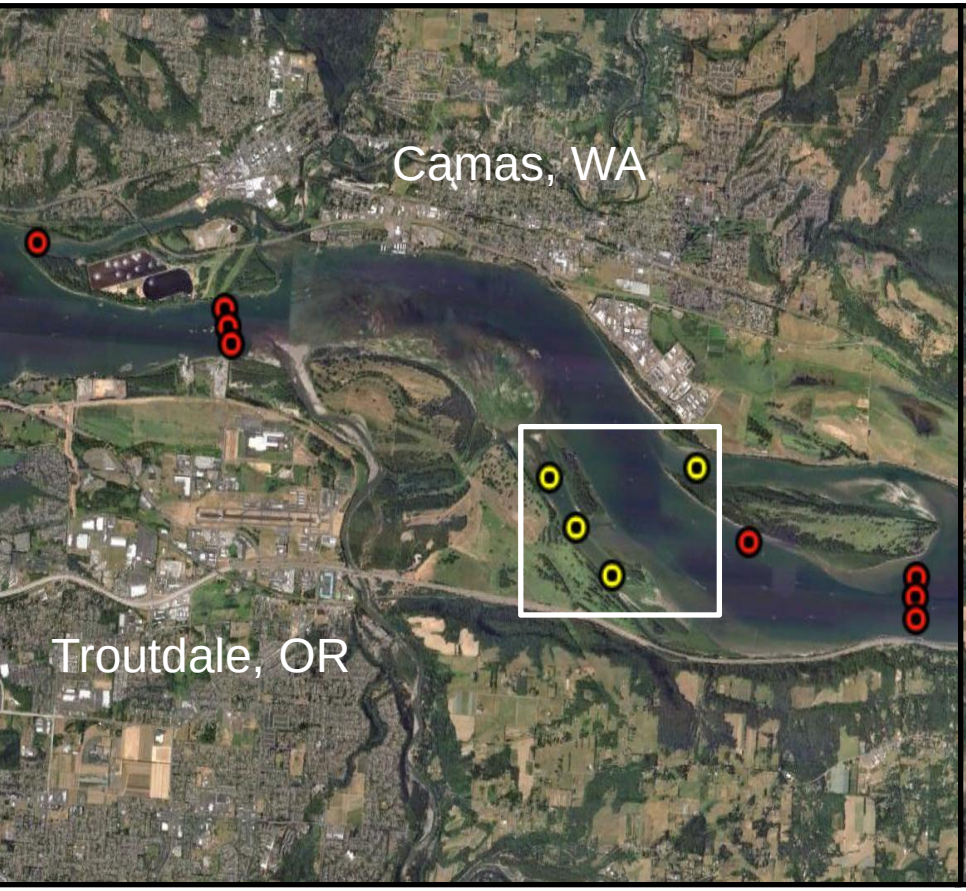
April 27 – August 18, 2007

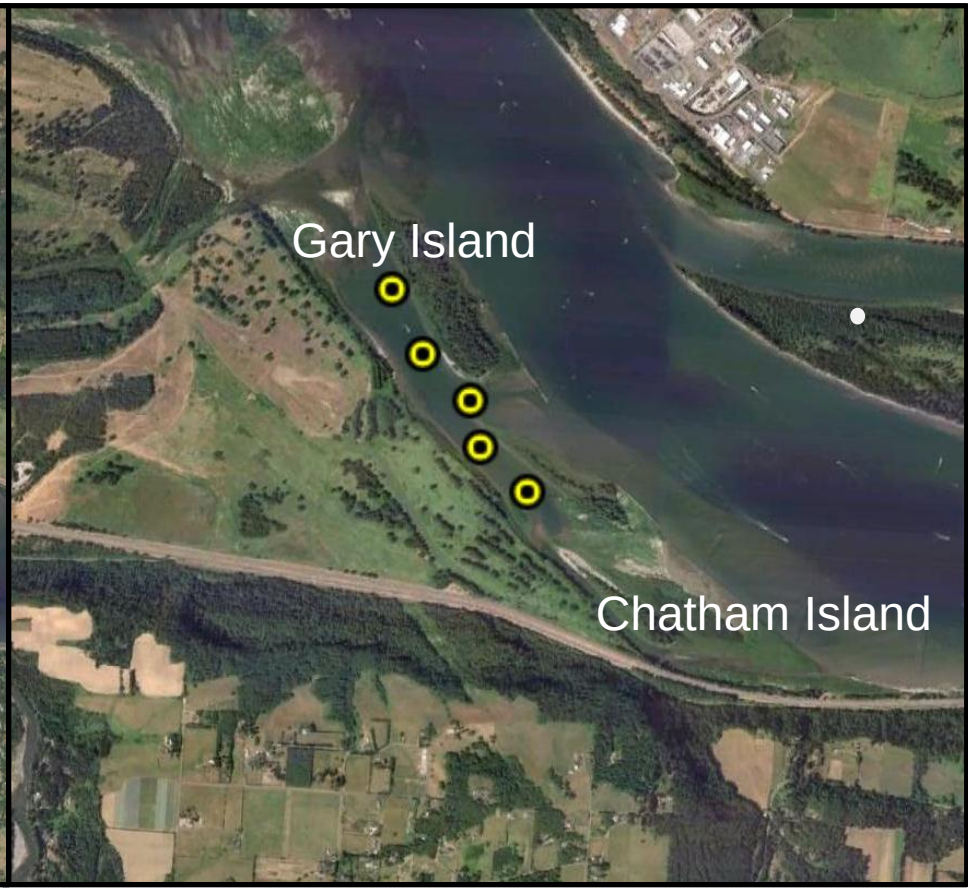
April 26 – July 25, 2008

Late Winter/Early Spring

February 27 – April 23, 2010

February 2 – May 17, 2011

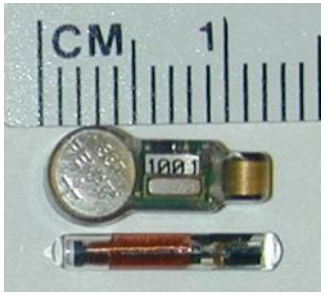




Methods

- Juvenile Salmon Acoustic Telemetry System (JSATS)
  - Tag weight (g): 0.43 - 0.63
- Spring and Summer: 2007 & 2008
  - 20,000+ fish tagged upstream as part of other studies
- Late Winter/Early Spring : 2010 & 2011
  - ~50 fish tagged each year from beach seine collections at SRD
- Residence time = last detection date/time - release date/time
  - 2007-2008 by node; 2010-2011 for all nodes combined

Juvenile Salmon Tagging Summary

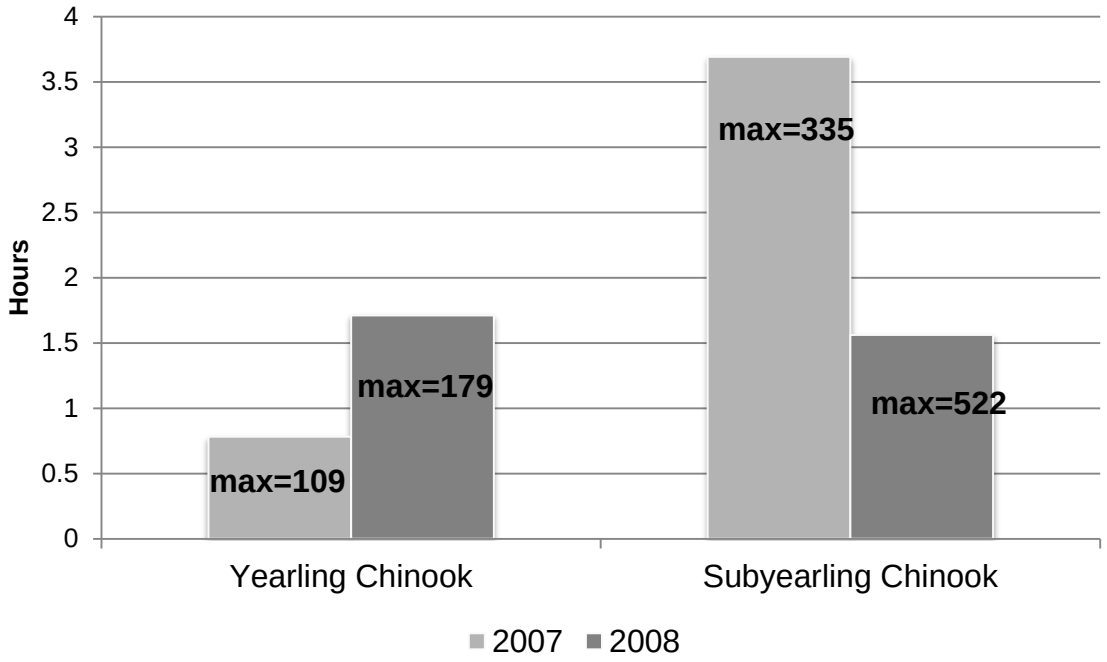


JSATS Acoustic Micro-Transmitter (Top) and a PIT Tag (Bottom) (circa 2007) 6 mm width x 4 mm height x 16 mm length, weight 450 mg in air, volume 0.394 cm^3

Year	n	Location Tagged	Season Tagged	Fish	Mean Fork Length (mm)	Genetic Stock Estimate
2007	>23,000	Upstream of Bonneville	Spring Summer	Yearling CH Subyearling CH	145 105	No
2008	23,340	Upstream of Bonneville	Spring Summer	Yearling CH Subyearling CH	144 115	No
2010	51	SRD	Winter	Chinook	103	Yes
2011	12	SRD	Winter	Chinook	115	Yes
2011	36	SRD	Winter	Coho	116	No

Spring/Summer 2007 & 2008: Residence Times (hours)

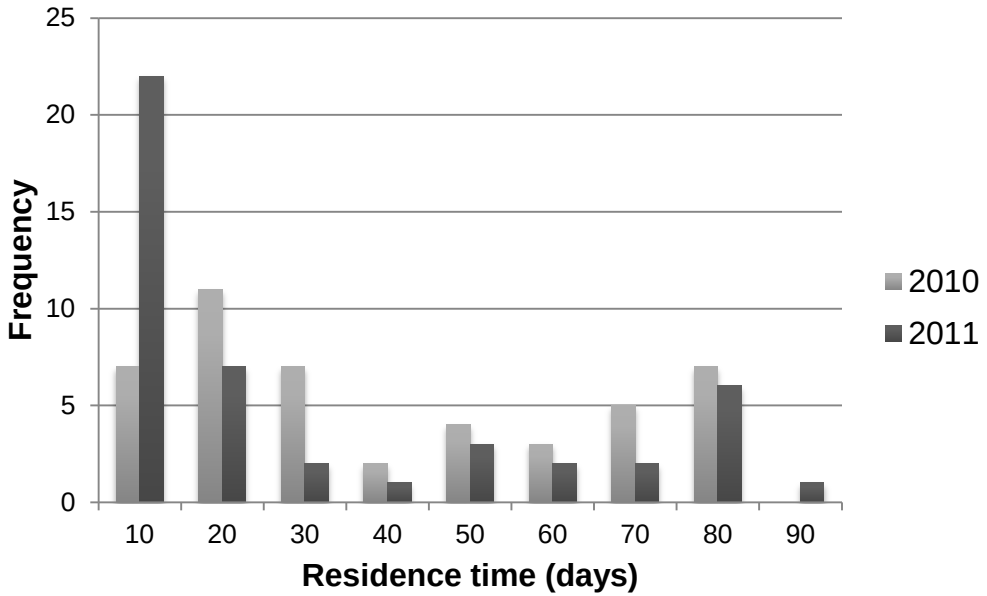
- Residence times were short (<4 hours)
- The longest residence times were exhibited by subyearling Chinook salmon during 2007.



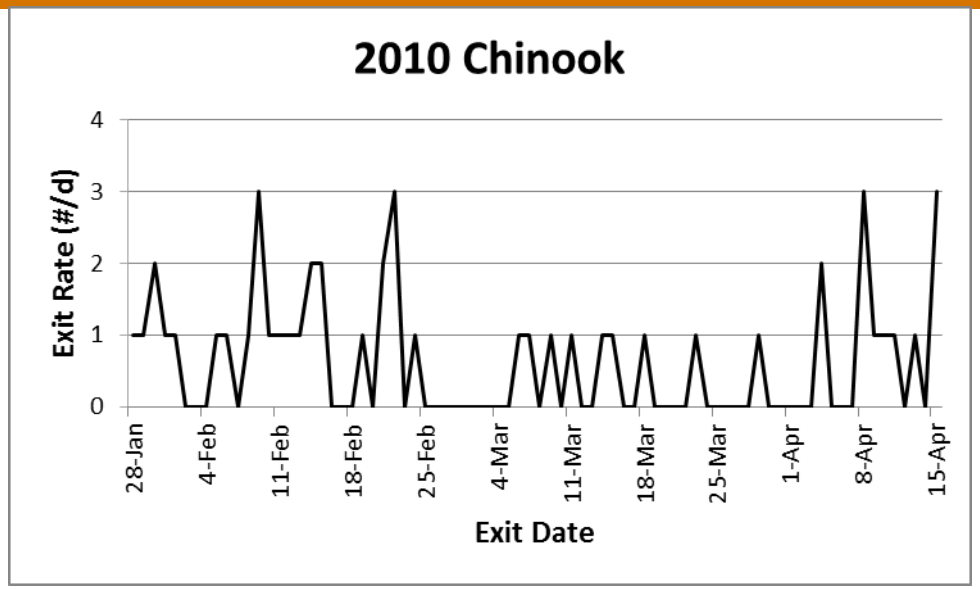
Late Winter/Early Spring 2010 & 2011: Residence Times (days)

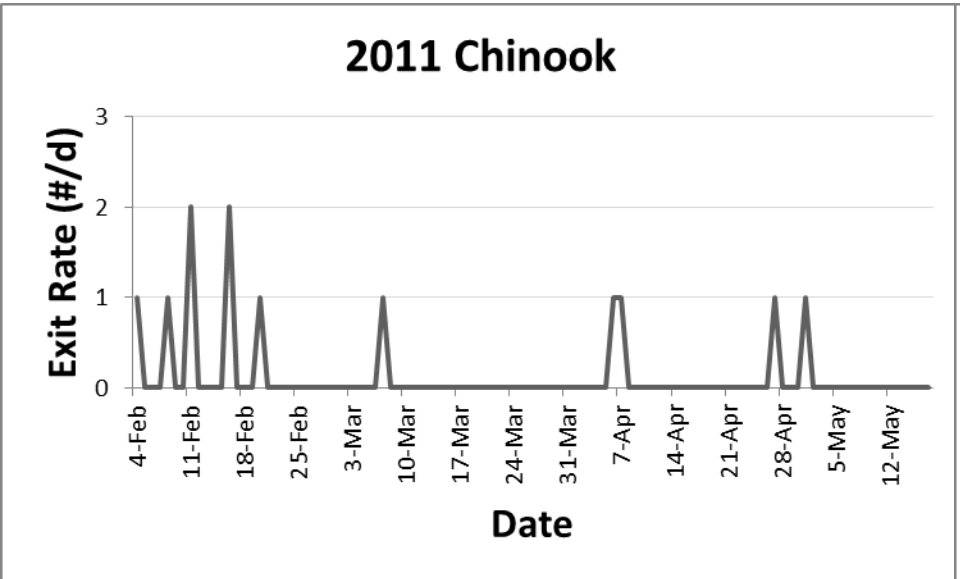
Year	Fish	n	Mean	Median	Min	Max
2010	Chinook	48	34.3	26.3	1.11	78.4
2011	Chinook	12[(a)]	24.7	11.6	0.09	73.7
2011	Coho	36	28.6	11.2	0.02	89.8

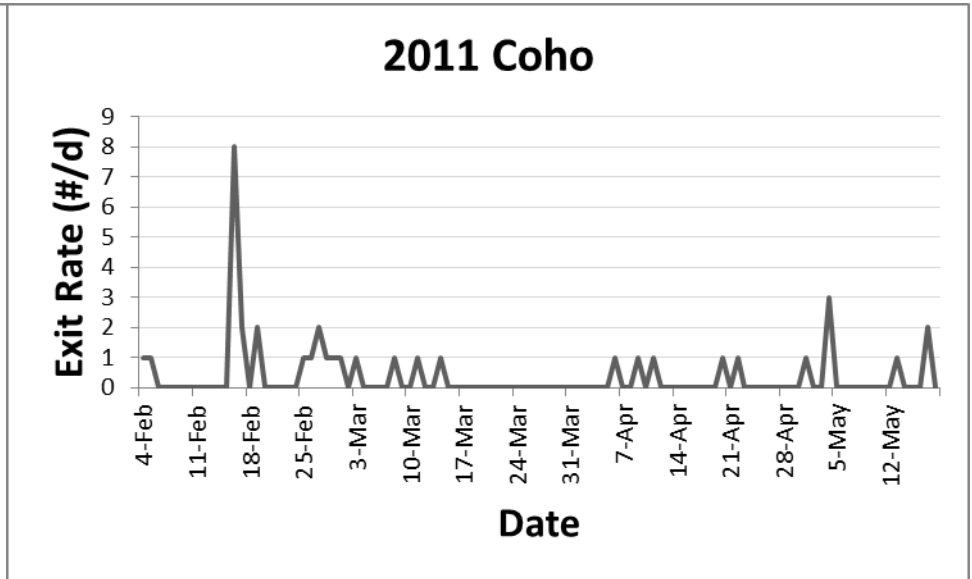
(a) Two transmitters did not exit the study area



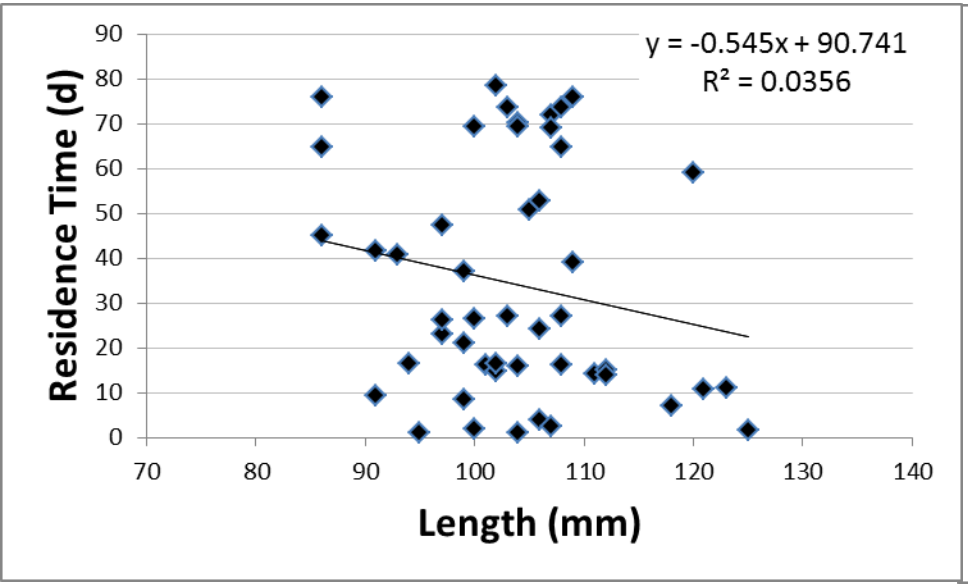
Exit Timing 2010/2011

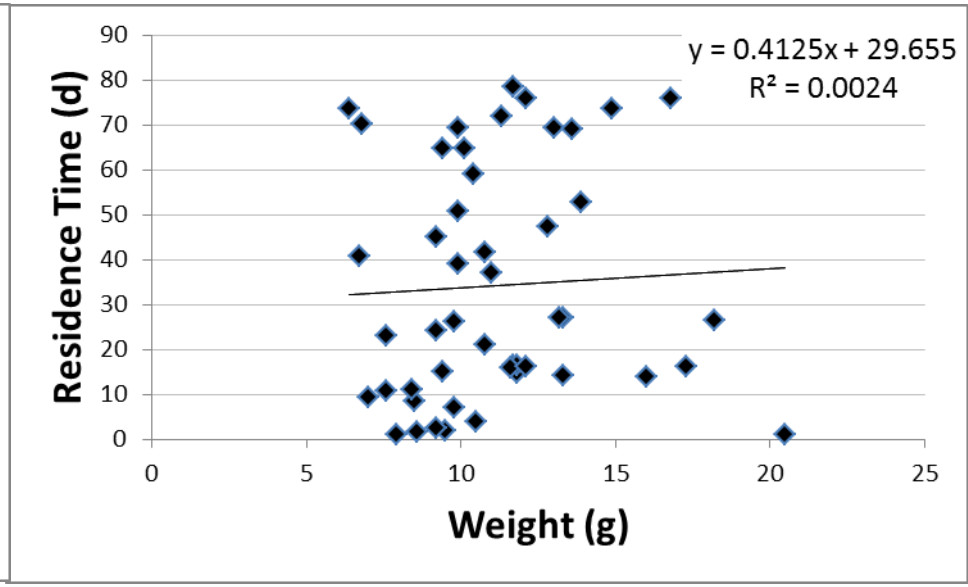




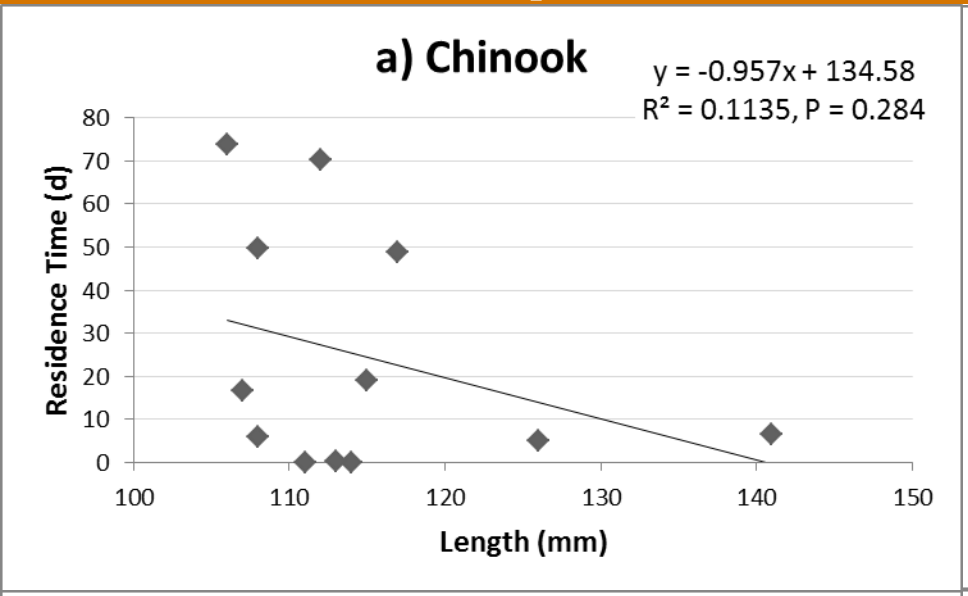


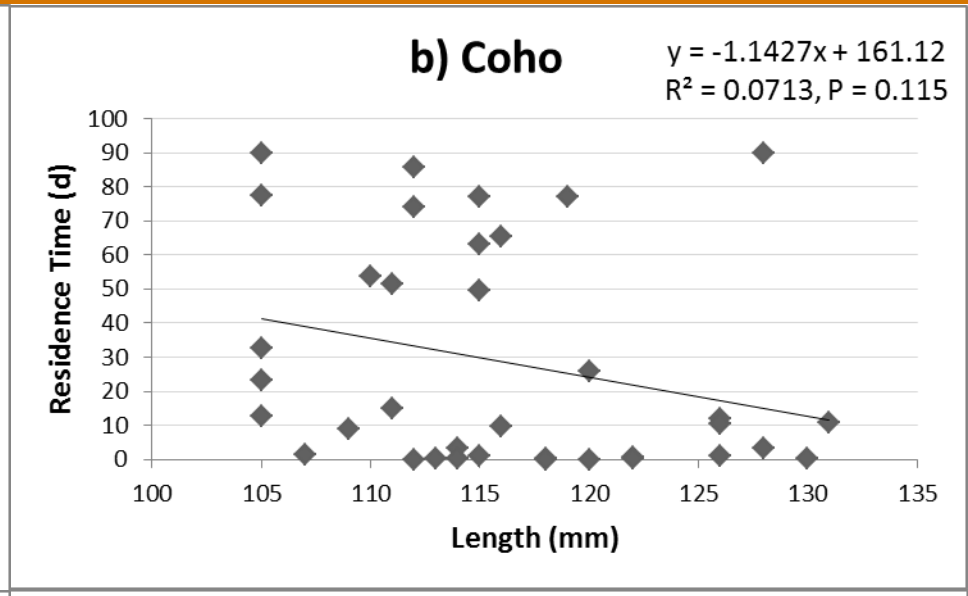
Residence Time and Length/Weight Relationships: 2010

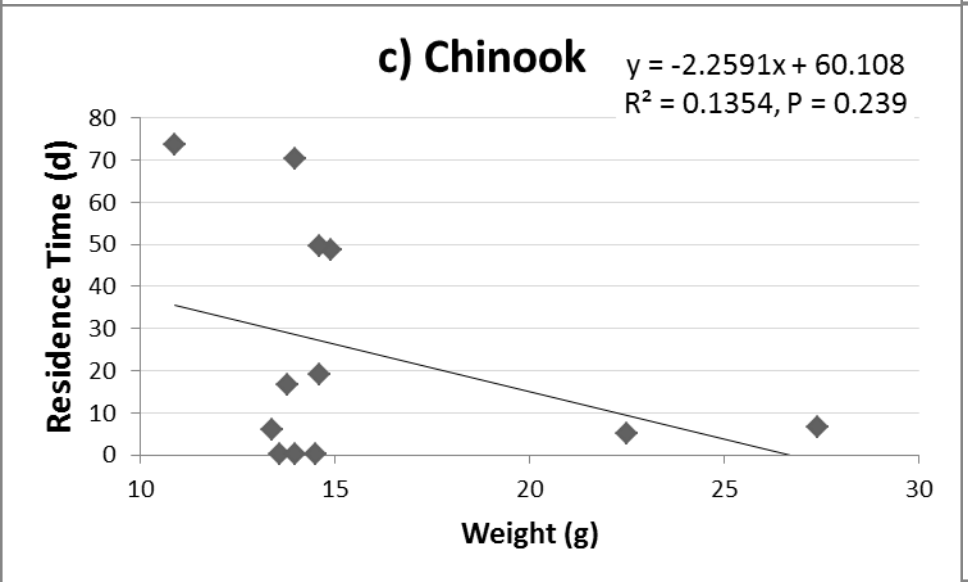


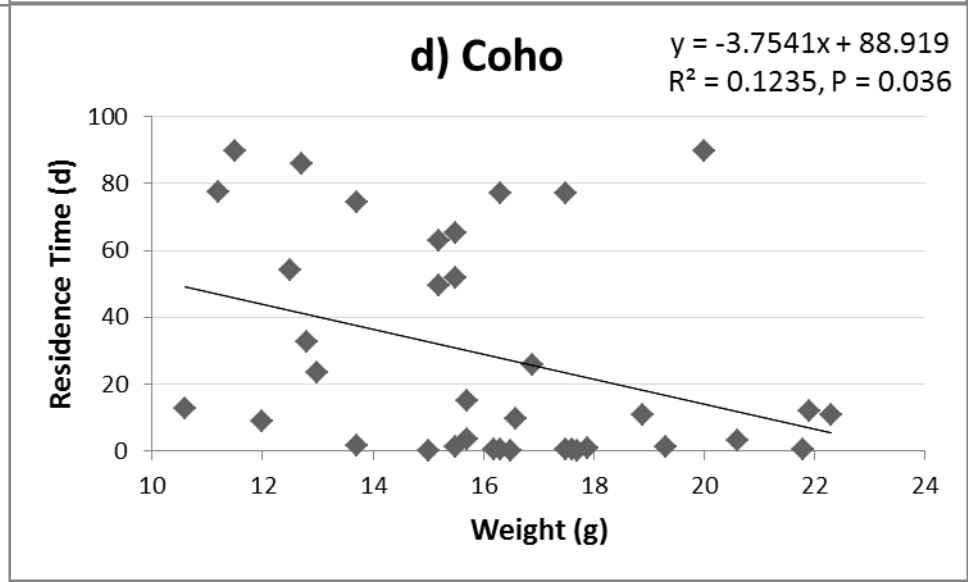


Residence Time and Length/Weight Relationships: 2011









Synthesis and Interpretation of Findings

- The two phases of this investigation revealed contrasting migration patterns for juvenile Chinook salmon (>95mm) in the SRD
  - Spring/Summer 2007 and 2008
    - Fish collected at upriver juvenile bypass facilities
    - 3-11% of tagged juvenile salmonids migrated through off channel areas in the vicinity of the SRD
    - Tagged fish were actively migrating
  - Winter 2010 and 2011
    - Fish collected by beach seine in SRD
    - Fish residing for extended periods
    - Tagged fish were not actively migrating

Year	Mean Residence Time*
2007	<1-4 hrs
2008	<1-2 hrs
2010	34 days
2011	25 days**

*2007/2008 by node; 2010/2011 for all nodes combined

**Coho and Chinook salmon combined

Management Implications

- Differences in residence time between the two phases likely reflects differences in life history strategies of juvenile Chinook salmon.
  - Spring/summer fish were actively migrating and had minimal use of SRD.
  - Late winter Chinook salmon were not actively migrating and were presumably using shallow water habitats for rearing.
- This study's documentation of extended residence time during late winter/early spring in tidal freshwater by juvenile Chinook salmon indicates:
  - Restoration of shallow water habitats may benefit salmon populations in late winter and early spring.
  - Research should not necessarily focus just on the spring and summer peak migration periods for juvenile salmon.
  - Restoration actions which promote expression of multiple life history strategies (e.g. winter rearing) may increase salmon performance.

Limitations

- The 2010/2011 residence times estimates are conservative.
  - We do not know how long a sampled fish may have been in the area before it was captured and tagged.
- The maximum observable residence time is limited by tag life.
  - 2010 ~60 d and 2011 ~90 d tag life
- The migration characteristics we observed are not representative of all juvenile salmon life history stages in the LCRE year-round.
  - Size: juvenile salmon < 95 mm fork length could not be sampled.
  - Timing: juvenile salmon residence times during late summer, fall, and early winter were not estimated.
  - Species/stock: sockeye and chum were not studied and stock-specific estimates for Chinook salmon were not possible with the sample sizes available.
- Only a few off-channel areas of tidal freshwater have been studied.
  - Movements from the main channel to habitats up tributaries, sloughs, culverts, etc.
- While tag effects for JSATS transmitters have been thoroughly examined and are minimal, we do not know how the implanted tag may have affected fish behavior.

Recommendations

- Technology advances
  - Smaller transmitter
  - Long-life transmitter
  - Improved receiving detectability in shallow water
- Sampling design
  - Year-round tagging and monitoring
  - Stocks emigrating from the Columbia and Willamette in late summer, fall, and winter
- Integration and coordination
  - Multiple acoustic telemetry studies in different locations for different purposes
  - Many, if not all, have tagged fish entering and using the LCRE

Acknowledgements

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