

Survival and Behavior of Juvenile Chinook Salmon in the Lower Columbia River, Estuary, and Plume



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Outline

- ▶ Background
- ▶ JSATS equipment
- ▶ Summary of results to date
 - Behavior
 - Survival
- ▶ Future direction
- ▶ Conclusions and management implications



Background

- ▶ JSATS was developed to estimate survival between Bonneville Dam and the Pacific Ocean
- ▶ Results from 2005 and 2006 showed higher than expected losses in lower 235 km of CR (up to ~25 to 50%)
 - For context - min estimates of avian predation ~ 2 to 5%
- ▶ In 2007 and 2008 the LCR was partitioned into six reaches; found greatest losses in lower 50 km
- ▶ 2009 added an array at Astoria Bridge (RKM 22) and focused mobile effort (NOAA) to assess fate of fish that cease migration in lower 50 km



JSATS Equipment used in LCR and Estuary

▶ Transmitters

■ Size

- Weight = 0.43 g in air, 0.29 g in water
- Length = 12 mm, same as PIT tag

■ Tag Life

- 23 days (3 sec PRI)
- 32 days (5 sec PRI)

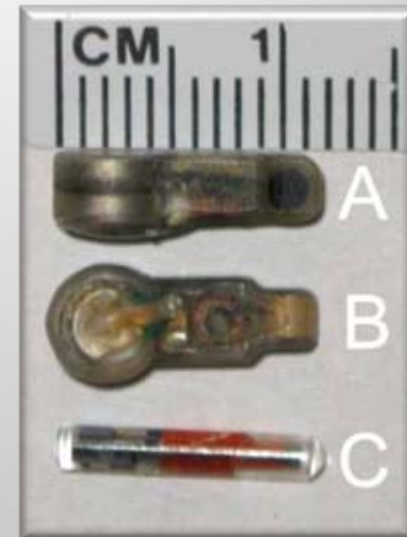
■ Range

- ~300 m

▶ Receivers

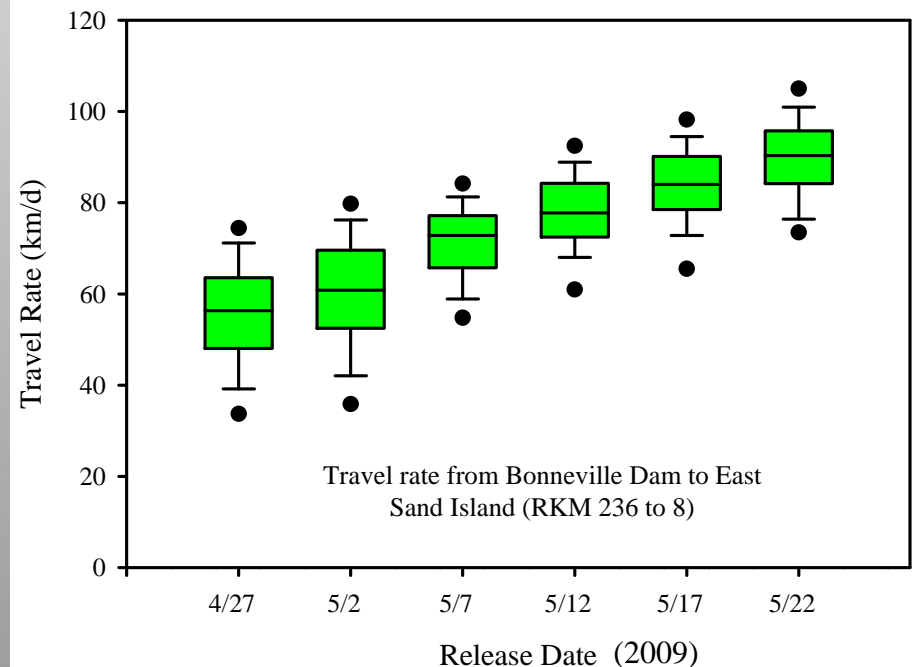
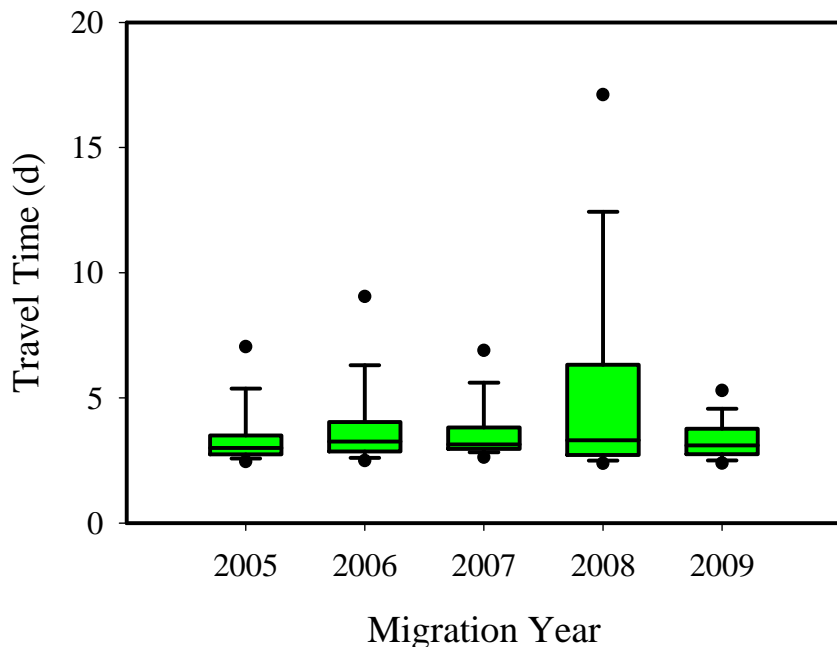
■ Autonomous

■ Mobile Tracker



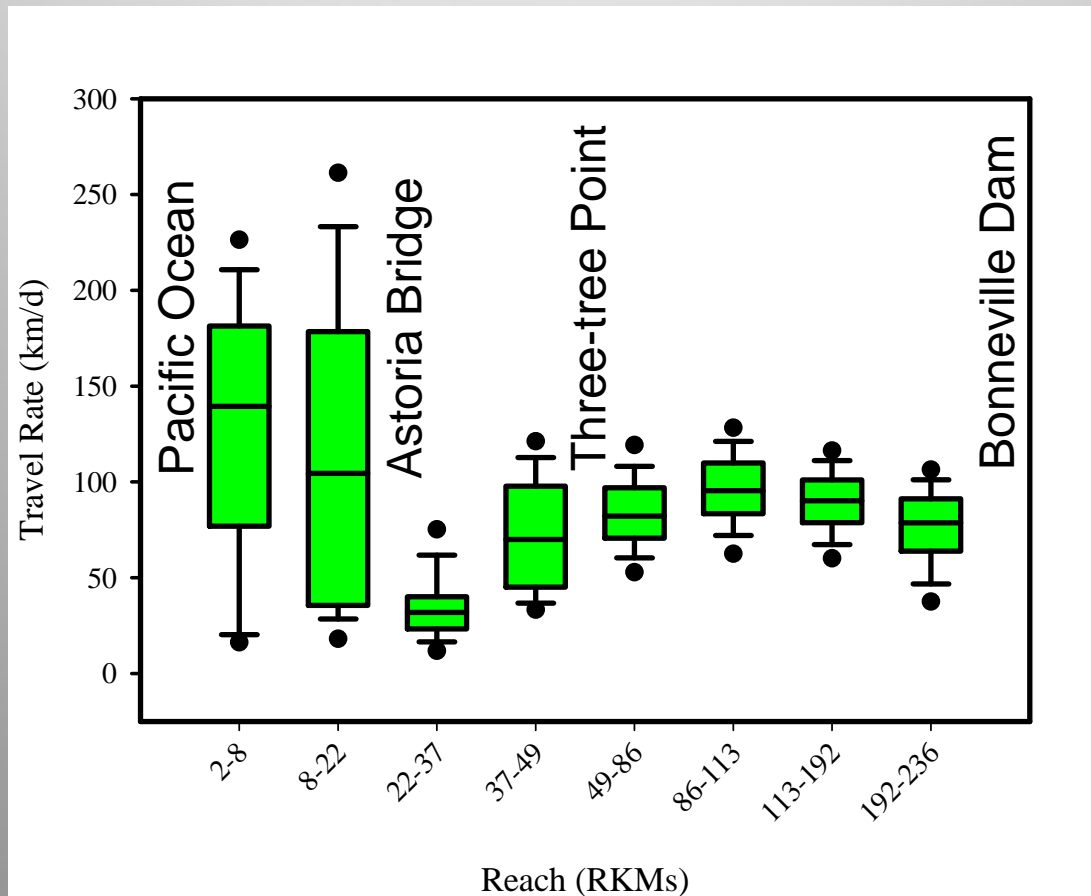
Summary Results- Yearling Chinook Salmon Behavior 2005-2009

- ▶ Travel time from Bonneville to East Sand Island averaged less than 4 days – with more variability in 2008
- ▶ Fish travel faster later in the season



Summary Results- Yearling Chinook Salmon Behavior 2009

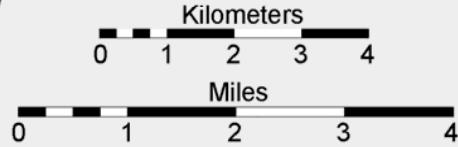
- ▶ Fish slow down as they enter the 'wide part' of the estuary – until they commit



Washington



- Receiver
- ⓪ River kilometer along navigation channel



Yearling Chinook (2008)

15%

Harrington Point

71%

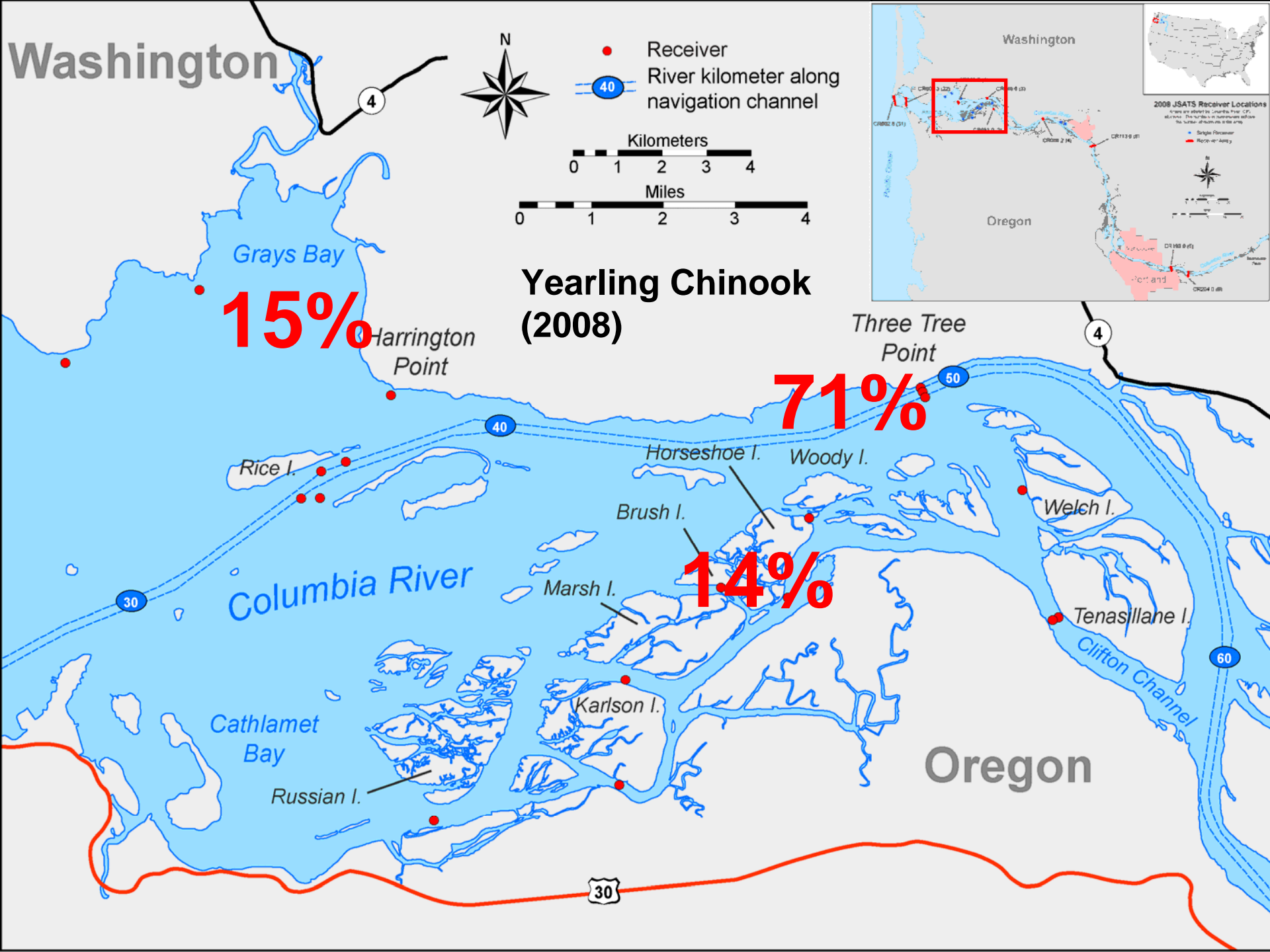
Three Tree Point

14%

Columbia River

Cathlamet Bay

Oregon



Cross-Channel Distribution - Yearlings

East Sand Island and Columbia River Bar

Cape Disappointment

West Sand Island

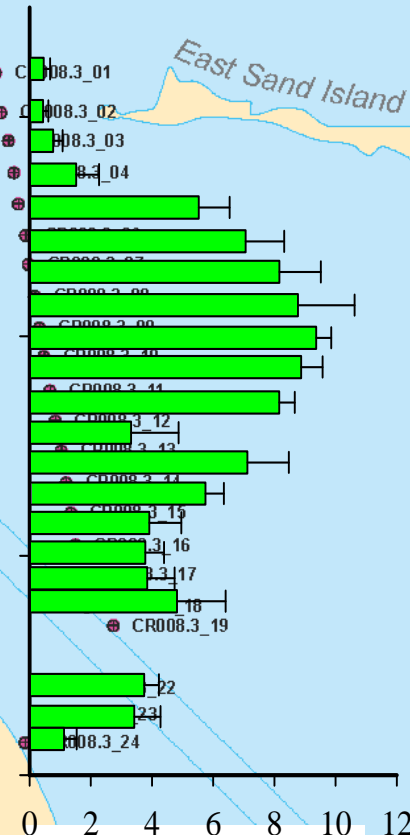
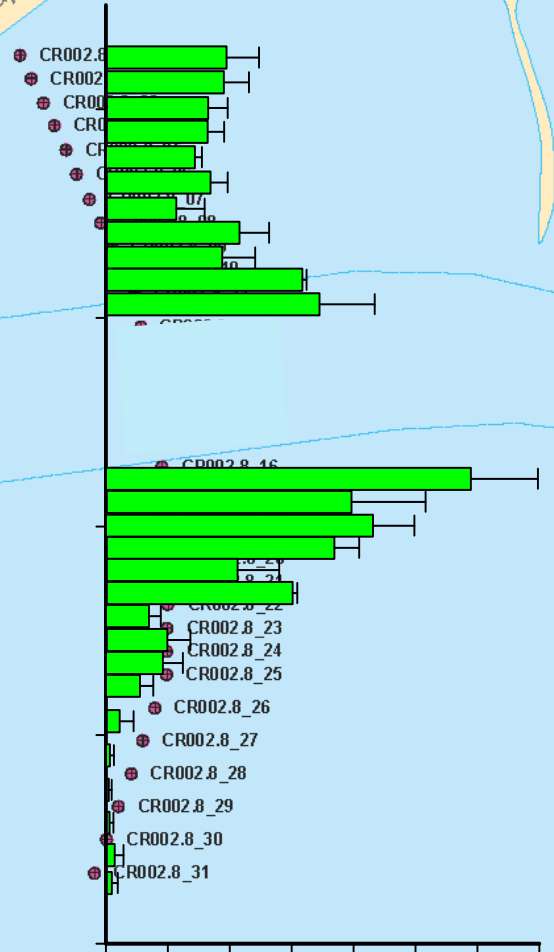
East Sand Island

Clatsop Spit

0



% of fish detections



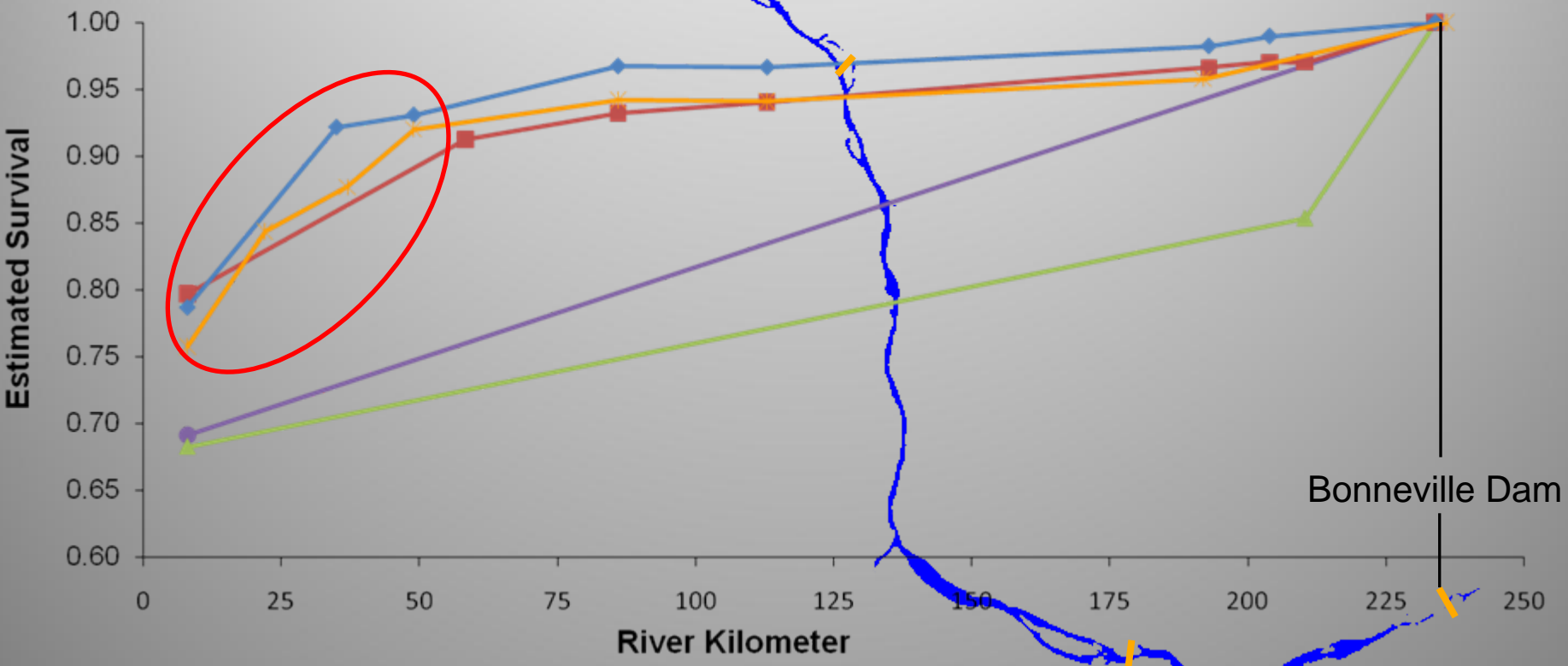
% of fish detections

Yearling Chinook Salmon Survival Lowest in Final 50 km of Columbia River Estuary



*Minimum loss due to avian predation ~ 2.5%

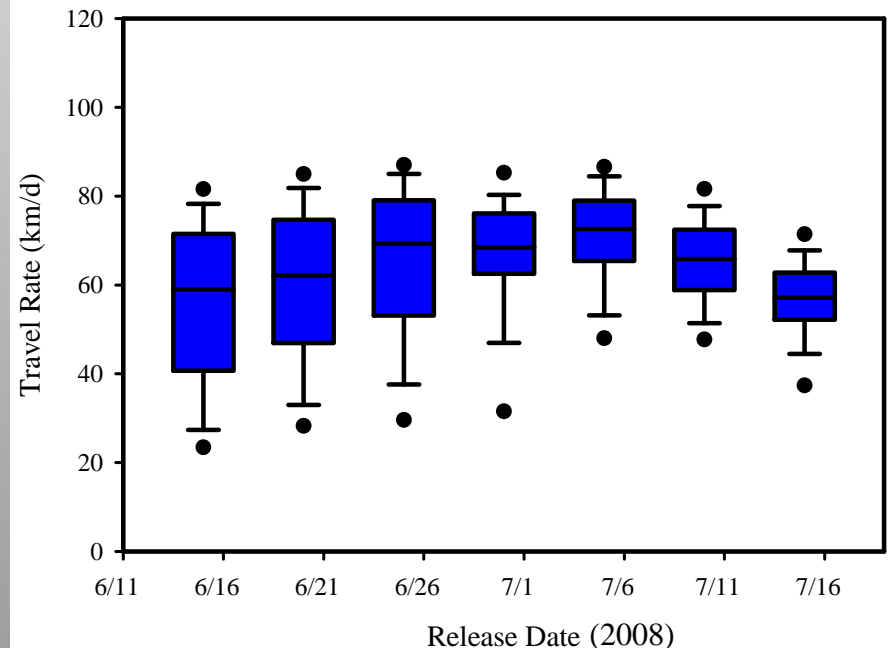
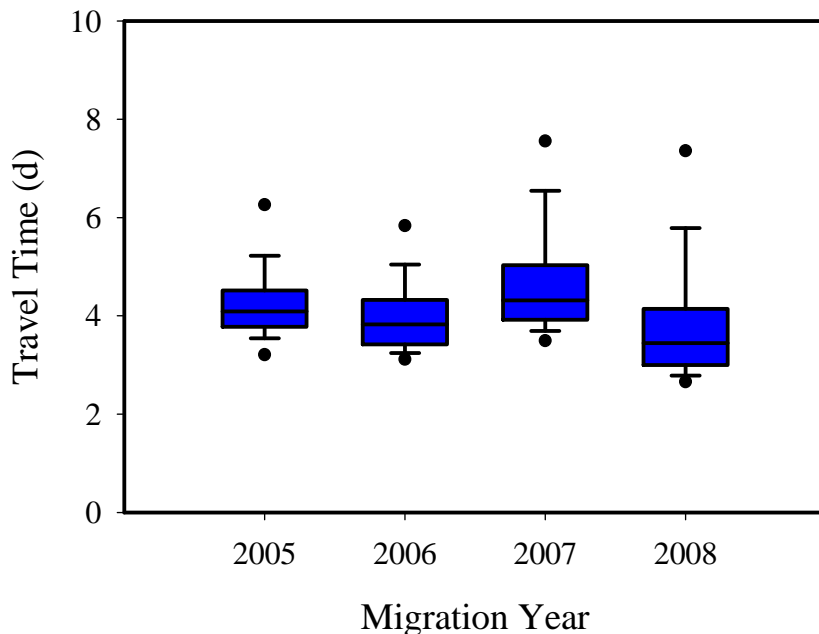
- 2005
- 2006
- 2007
- 2008
- 2009



*2009 survival estimates are preliminary

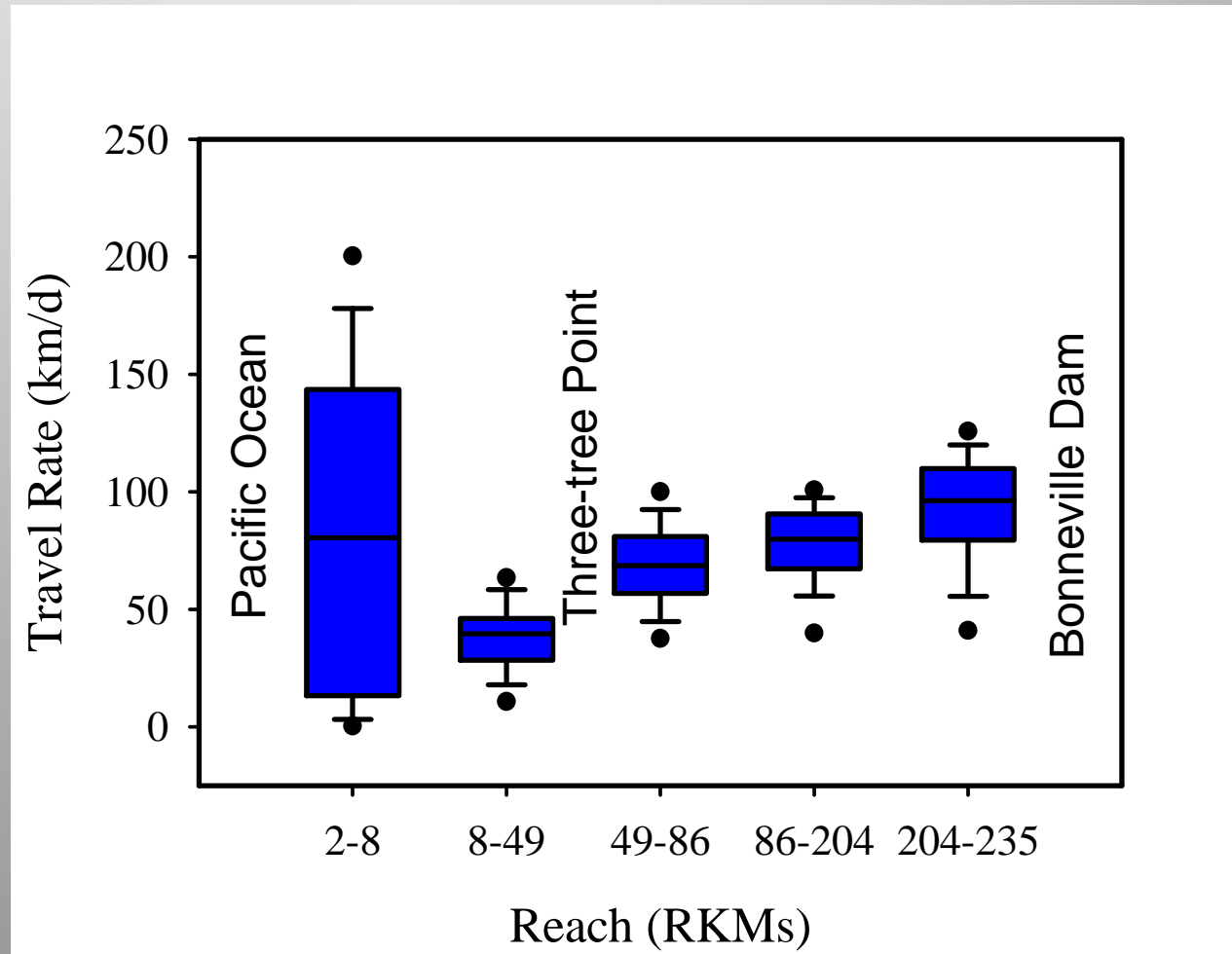
Summary Results- Subyearling Chinook Salmon Behavior 2005-2008

- ▶ Travel time from Bonneville to the ocean averages 4 to 5 days
- ▶ Fish travel faster as season progresses – then slow down late



Summary Results- Subyearling Chinook Salmon Behavior 2008

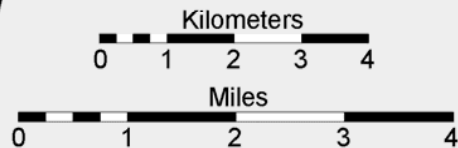
- ▶ Fish slow down as they enter the 'wide part' of the estuary



Washington



- Receiver
- ⓪ River kilometer along navigation channel



Subyearling Chinook (2008)



19%

Harrington Point

Three Tree Point

63%

Rice I.

Horseshoe I.

Woody I.

Brush I.

Welch I.

Columbia River

Marsh I.

17%

Tenasillane I.

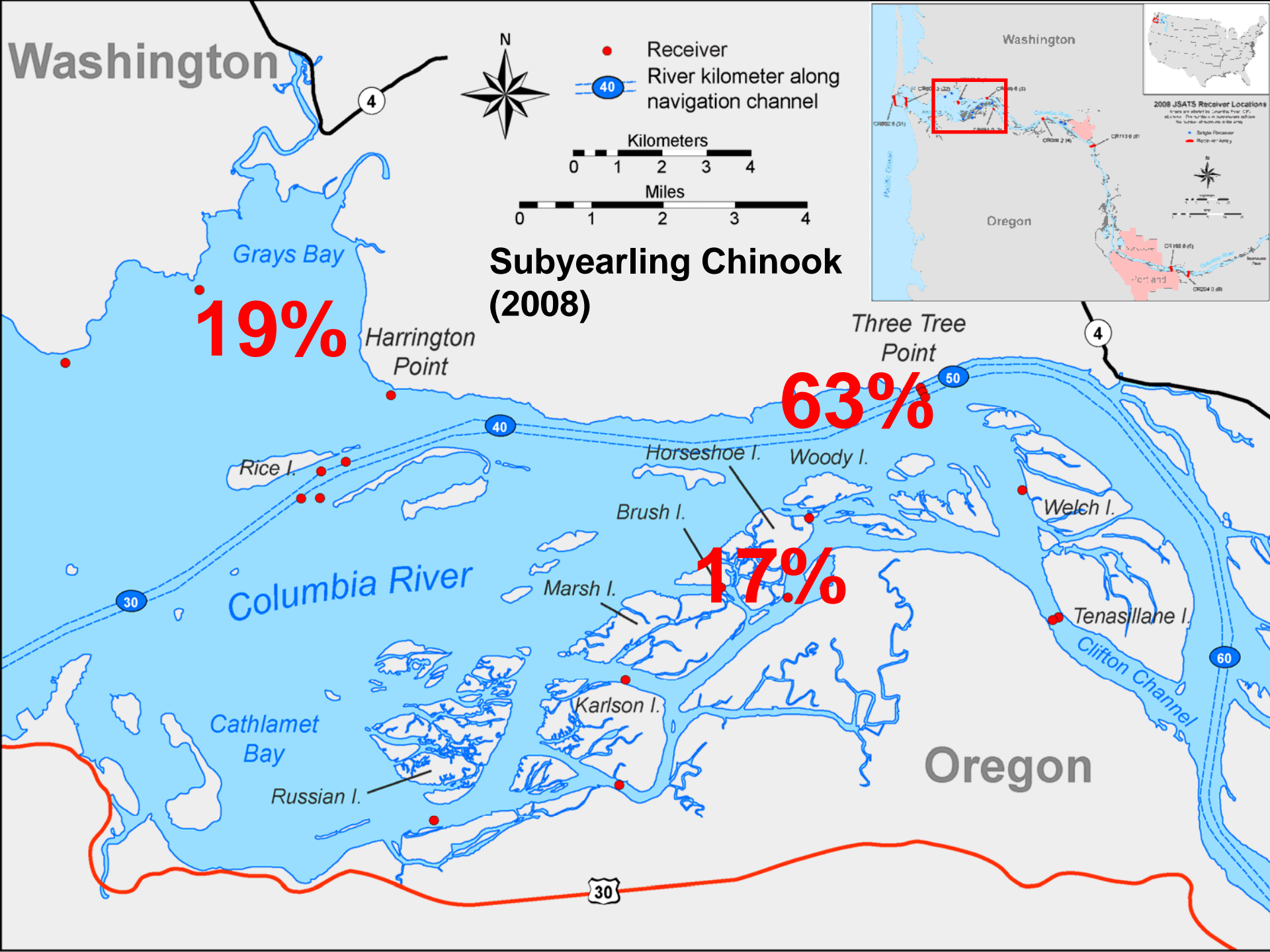
Cathlamet Bay

Karlson I.

Oregon

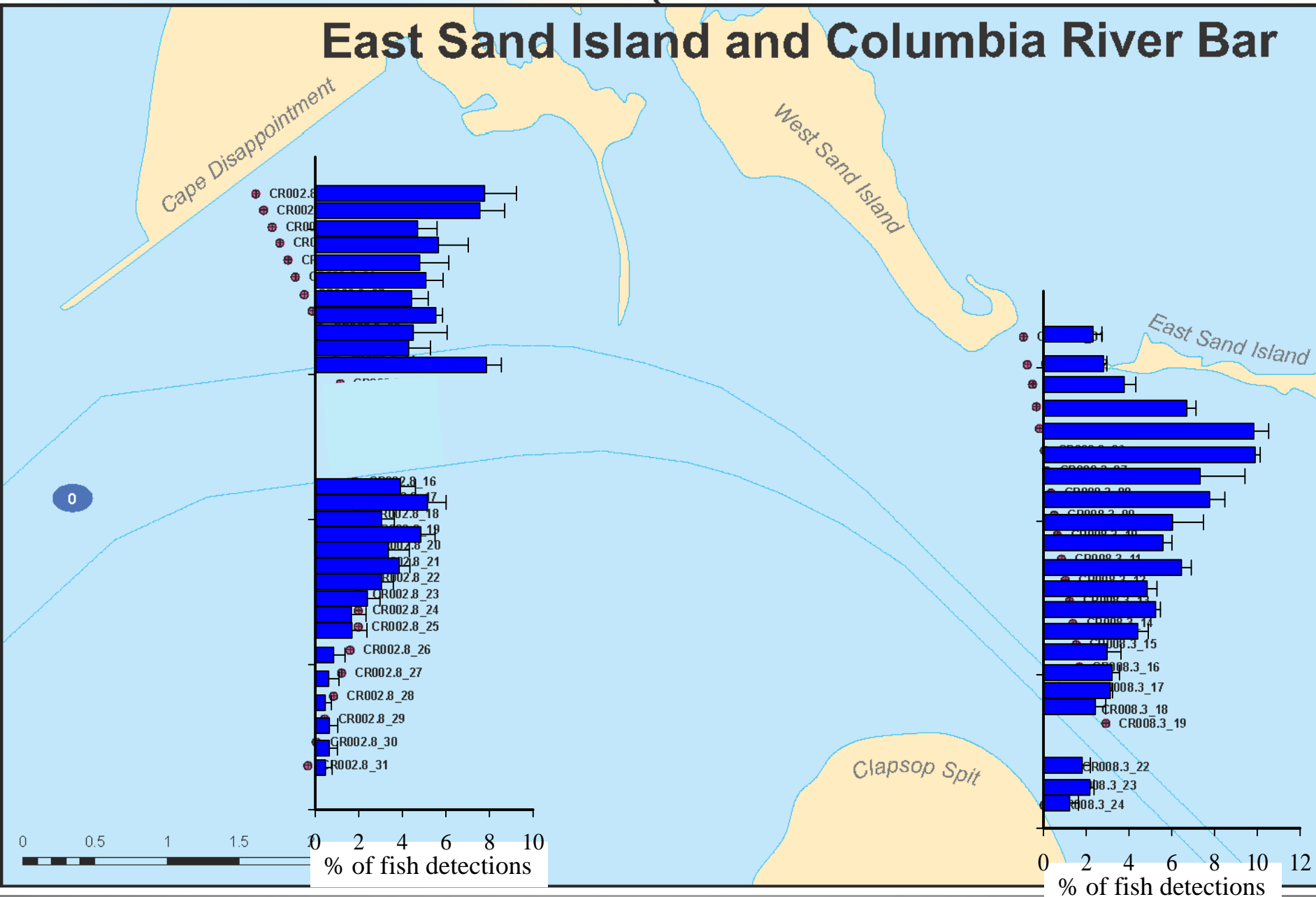
Russian I.

30

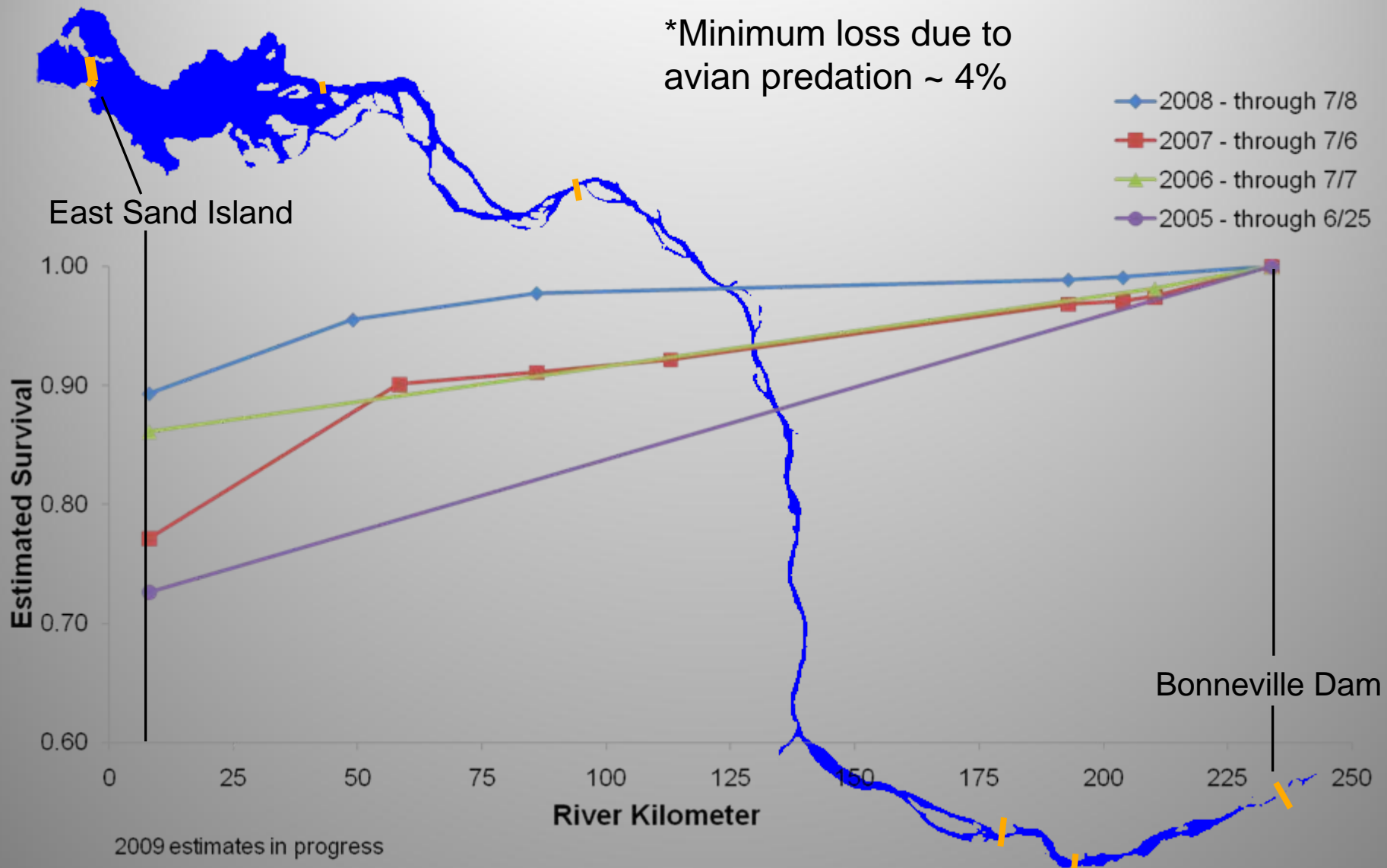


Cross-Channel Distribution - Subyearlings

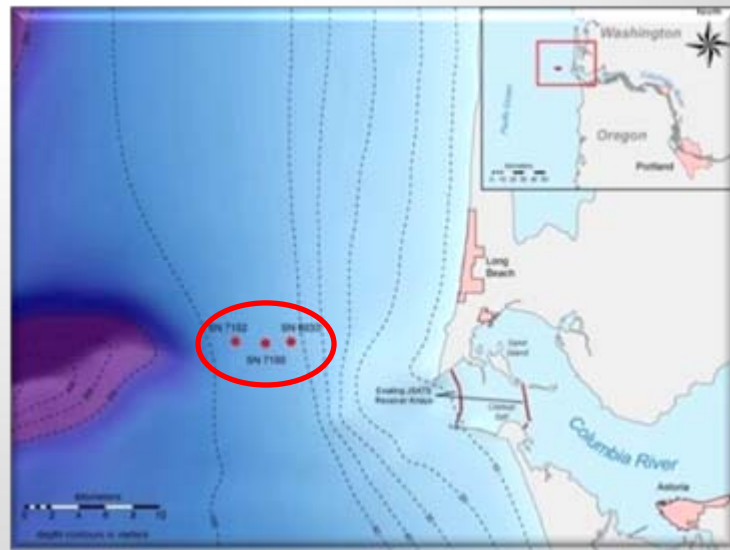
East Sand Island and Columbia River Bar



Subyearling Chinook Salmon Survival lowest in final 50 km



2009 Plume Test: 3 receivers; 6/23-7/21 72 fish Detected



- ▶ 1 yearling Chinook salmon (JDA Pool)
- ▶ 6 subyearling Chinook salmon (Grant County)
- ▶ 65 subyearling Chinook salmon (JDA Pool)
 - Travel time from JDA Pool to RKM 8 = 7.5 d (± 0.20)
 - 46 km/d
 - Travel time from RKM 8 to Plume = 1.3 d (± 0.26)
 - 13 km/d



Future Direction

- ▶ 2010+ Plans
 - ▶ Estuary/Plume work will be closely integrated with BiOp Performance Standards assessments at lower three dams and mobile tracking effort proposed by NOAA
 - ▶ Assess reach survival and behavior, with focus on lower 50 km
 - ▶ Assess LCR/Estuary survival of early vs. late transported groups
 - ▶ Assess passage-route-specific mortality in LCR and Estuary
 - ▶ Collect behavioral data in plume to guide future survival assessment
 - ▶ Increase collaboration with other researchers to address critical uncertainties regarding effects of the FCRPS and habitat mitigation activities on fishes using the LCR and estuary



Conclusions/Management Implications

- ▶ The monitoring capability that has been developed around JSATS technology can be applied and extended to assess the success of FCRPS mitigation strategies and other management actions in the LCR, estuary, and plume.
- ▶ Coordinated/collaborative efforts in 2010+ will take advantage of ~25k JSATS-tagged fish released upstream and present the first opportunity to assess the effects of different FCRPS passage experiences on behavior and survival downstream of the dams
- ▶ Plume tests (2008 and 2009) have been successful and a pilot-scale plume array (20 nodes) is proposed to expand the time/space over which to assess effects of FCRPS mitigation strategies and other estuary management actions on survival to ocean entry



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For more information

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The screenshot shows the homepage of the Juvenile Salmon Acoustic Telemetry System (JSATS) website. The header includes the Pacific Northwest National Laboratory logo and navigation links for PNNL Home, About, Research, Publications, Jobs, Newsroom, and Contacts. A search bar is also present. The main content area features a large banner image of a boat with yellow buoys and a person on the water, with the title 'Juvenile Salmon Acoustic Telemetry System (JSATS)'. Below the banner, there are three main sections: 'Juvenile Salmon Acoustic Telemetry System' with a sidebar menu, 'Juvenile Salmon Acoustic Telemetry System' with a detailed description and a list of applications, and 'Resources' with a 'Contacts' section listing Geoffrey McMichael and the Webmaster.

Juvenile Salmon Acoustic Telemetry System

Home
How JSATS Works
Contact Us

System components

Acoustic Transmitters
Autonomous Receivers
Cabled Receivers

Results

3D Visualization
Scientific Publications and Reports

Juvenile Salmon Acoustic Telemetry System

The Juvenile Salmon Acoustic Telemetry System (JSATS) employs acoustic transmitters and receiving systems to remotely track fish in one, two, or three dimensions. Development of the system was initiated in 2001 for the U.S. Army Corps of Engineers Portland District by the Pacific Northwest National Laboratory and NOAA Fisheries. The goal was to create an acoustic transmitter small enough for implantation in the smallest migratory individuals of the juvenile Chinook salmon and steelhead populations of the Columbia River basin. The JSATS has been used to monitor the behavior, movement, habitat use, and survival of juvenile salmonids migrating from freshwater (through rivers, reservoirs, and past hydroelectric dams) into saltwater. Although the JSATS initially was developed and used extensively to study salmonids, its utility is applicable to a wide range of aquatic species. The JSATS has also been used to monitor the behavior of channel catfish, smallmouth bass, northern pikeminnow, and walleye.

Current and previous applications of the JSATS illustrate the versatility of the system:

- Estimation of survival and travel time of juvenile salmon migrating more than 900 km of freshwater river, reservoir, estuary, and marine habitat
- Assessment of survival and habitat use of juvenile salmonids migrating through an estuarine environment
- Determination of impacts of ferry terminals on juvenile salmonid movements in salt water
- Estimation of route-specific dam passage survival of juvenile salmonids
- Observation of predator-prey interactions
- Evaluation of fish guidance and passage structures at hydroelectric dams using detailed 3D tracking
- Monitoring of delayed mortality of juvenile salmonids transported past hydroelectric dams in barges.

Resources

Contacts

Geoffrey McMichael
Webmaster