

# Alternate Barging Strategies to Improve Survival of Transported Juvenile Salmonids



# Goal

Determine whether barge release downstream of Astoria improves SARs for Yearling Chinook salmon and Steelhead



# Objectives

- Compare SARs of spring Chinook and steelhead released at Skamania Landing with those released near Astoria

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- Determine prevalence and severity of BKD and *Nucleospora salmonis* in each release group

# Methods

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- Release groups of Chinook salmon and steelhead PIT-tagged at Lower Granite Dam on 6 consecutive Sundays



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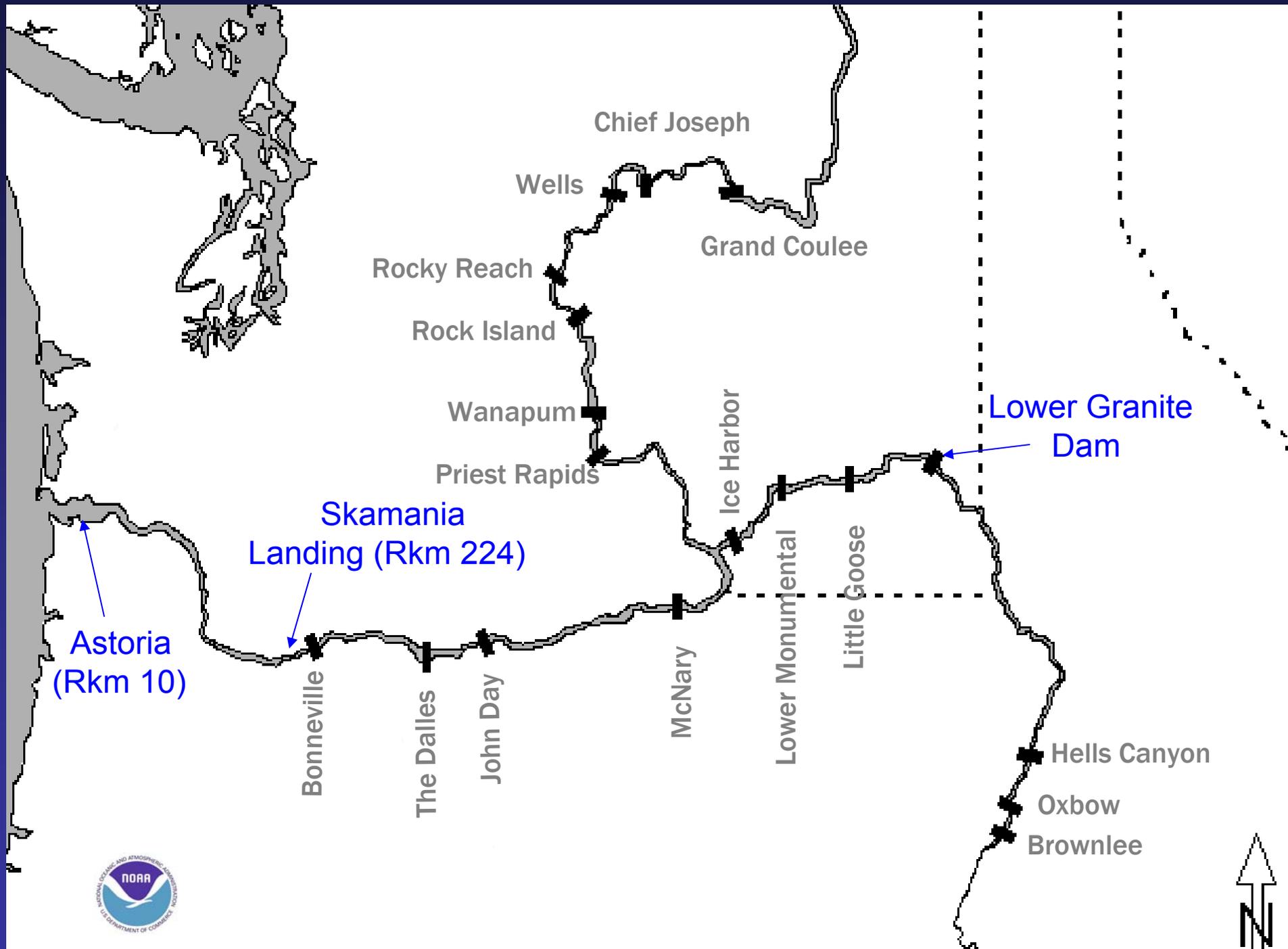
## (Objective 1)

- Release groups of Chinook salmon and steelhead PIT-tagged at Lower Granite Dam on 6 consecutive Sundays
- Skamania Landing releases at normal barge release site
- Astoria releases in estuary on ebb tide at night

# Methods

## (Objective 1)

- Release groups of Chinook salmon and steelhead PIT-tagged at Lower Granite Dam on 6 consecutive Sundays
- Skamania Landing barge releases at normal release site
- Astoria releases in estuary on ebb tide at night
- Compare SARs and compare adult migration histories to evaluate potential effects on homing



# Number of Chinook salmon tagged and released in 2007

<u>Release date</u>	<u>Skamania</u>	<u>Astoria</u>
26 April	0	0
2-3 May	4,292	2,460
8-9 May	5,008	3,382
16-17 May	5,252	3,924
23 May	2,605	1,394
<u>29-31 May</u>	<u>224</u>	<u>225</u>
<b>Total</b>	<b>17,381</b>	<b>11,385</b>

# Number of steelhead tagged and released in 2007

<u>Release date</u>	<u>Skamania</u>	<u>Astoria</u>
26 April	0	0
2-3 May	4,716	3,821
8-9 May	5,765	4,869
16-17 May	6,459	4,353
23 May	10,927	6,523
<u>29-31 May</u>	<u>3,315</u>	<u>3,193</u>
<b>Total</b>	<b>31,182</b>	<b>22,759</b>

# Tagging targets 2007

<u>Species</u>	<u>Target</u>	<u>Actual</u>
Chinook salmon	53,000	28,766
Steelhead	53,000	53,941



2006

2007

Skamania Astoria

Skamania Astoria

Steelhead      13.8      1.7

Chinook      3.0      0.4



2006

2007

Skamania Astoria

Skamania Astoria

Steelhead

13.8

1.7

12.7

1.7

Chinook

3.0

0.4

1.8

0.6

# Preliminary adult returns 2006 releases-Chinook salmon

<u>Release location</u>	<u>Number of jacks</u>	<u>SAR</u>	<u><math>T_A/T_S</math></u>
Skamania	26	0.11	
Astoria	9	0.06	

0.54

# Preliminary adult returns 2006 releases-steelhead

<u>Release location</u>	<u>Number of adults</u>	<u>SAR</u>	<u><math>T_A/T_S</math></u>
Skamania	228	0.55	
Astoria	154	0.53	

0.96

Objective II: Determine prevalence and levels of *Renibacterium salmoninarum* and prevalence of *Nucleospora salmonis*.  
Relate these to SARs and bird predation rates.



# Objective II



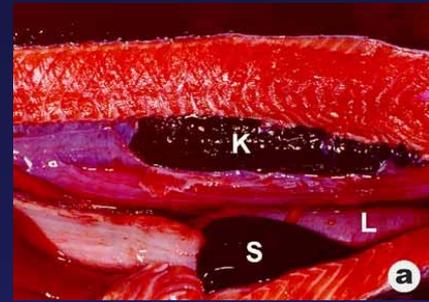
- Determine *Renibacterium salmoninarum* prevalence and infection severity profile for each release group of hatchery and wild steelhead and hatchery and wild Chinook salmon.
- Document levels of *R. salmoninarum* in water of marking troughs at Lower Granite Dam during tagging.

# Objective II



- Document relationship between bird predation rates and prevalence and levels of *R. salmoninarum*.
- Document relationship between SARs and prevalence and levels of *R. salmoninarum*.

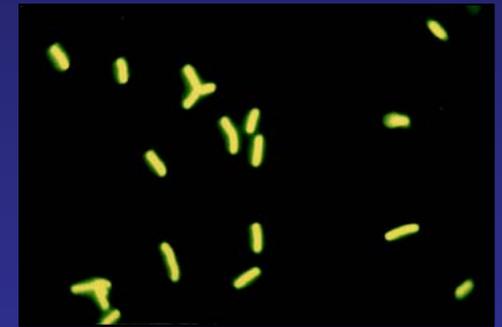
# Objective II



- Determine *Nucleospora salmonis* prevalence for each release group of hatchery and wild steelhead and hatchery and wild Chinook salmon.
- Document relationship between bird predation rates and prevalence of *N. salmonis*.
- Document relationship between SARs and prevalence of *N. salmonis*.

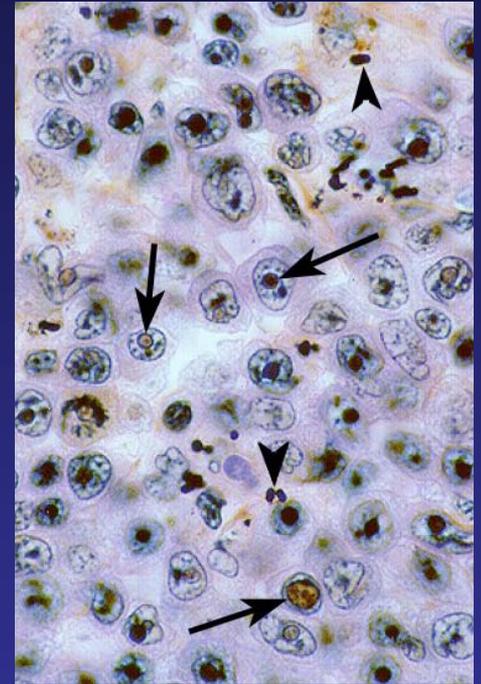
# Why *R. salmoninarum*?

- *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease (BKD), is one of the most important pathogens of wild and cultured salmonids in the Pacific Northwest, including the Columbia and Snake River basins.



# Why *Nucleospora salmonis*?

- *N. salmonis* is a microsporidian parasite of salmonids that infects the nuclei of immature white blood cells and can cause a leukemia-like condition.
- *N. salmonis* infects salmonids in the Columbia and Snake River basins and has been recently recognized as a cause of mortality in certain steelhead populations.



# Why *R. salmoninarum* and *N. salmonis*?

- Both pathogens can cause chronic, subclinical infections in freshwater and seawater.
- Both pathogens can render fish more susceptible to secondary infections.
- Infected fish may survive or die depending on their overall condition and levels of other stressors they encounter.

# Why *R. salmoninarum* and *N. salmonis*?

- *R. salmoninarum* and *N. salmonis* were the most frequently detected pathogens in smolts at LGR in another COE-funded study.
- Investigation of the influence of these pathogens on smolt migration and survival could be enhanced by the use of non-lethal sampling techniques.
- Recent developments in polymerase chain reaction (PCR) technology may enable non-lethal monitoring of these pathogens in smolts.

# Why PCR?

- PCR detects specific unique nucleic acid sequence of pathogen.
- PCR can be accomplished with small tissue samples (~10 mg, 2mm x 3mm).
- Non-lethal methods developed for sampling gill tissue for Na<sup>+</sup>, K<sup>+</sup>- ATPase measurements have been adapted for fish pathogen testing.
- Both *R. salmoninarum* and *N. salmonis* have been detected by PCR in gill tissue samples.

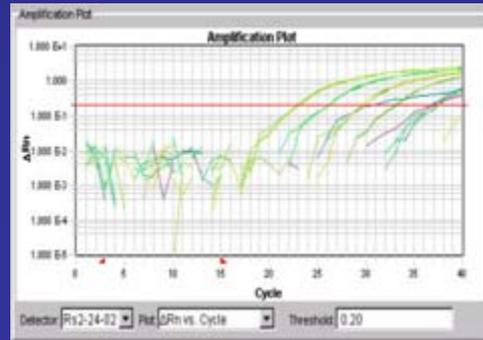
# Methods (Objective II)

- Non-lethal samples: gill tissue samples taken from hatchery and wild steelhead and Chinook salmon marked with PIT tags in each release group at Lower Granite Dam.



# Methods (Objective II)

- Nested PCR (nPCR; non-quantitative) used for detection of both *R. salmoninarum* and *N. salmonis*.
- Real-time quantitative PCR (qPCR) used for quantification of *R. salmoninarum* levels.



# 2007 Pathogen Samples

	Number Tested 2007
Wild Chinook	343
Hatchery Chinook	296
Wild steelhead	328
Hatchery steelhead	385

# Results: 2006 and 2007 *R. salmoninarum* Prevalence by qPCR

Year	No. Positive/Total (%)
2006	1119/1785 (63%)*
2007	287/1352 (21%)

\**R. salmoninarum* prevalence significantly higher in 2006 than in 2007 ( $p < 0.0001$ )

# 2006 and 2007 *R. salmoninarum* Prevalence by qPCR

	No. Positive/Total (%)	
	2006	2007
Chinook W	250/394 (63%)	82/343 (24%)
Chinook H	237/383 (62%)	43/296 (15%)*
Steelhead W	319/498 (64%)	80/328 (24%)
Steelhead H	313/510 (61%)	82/385 (21%)

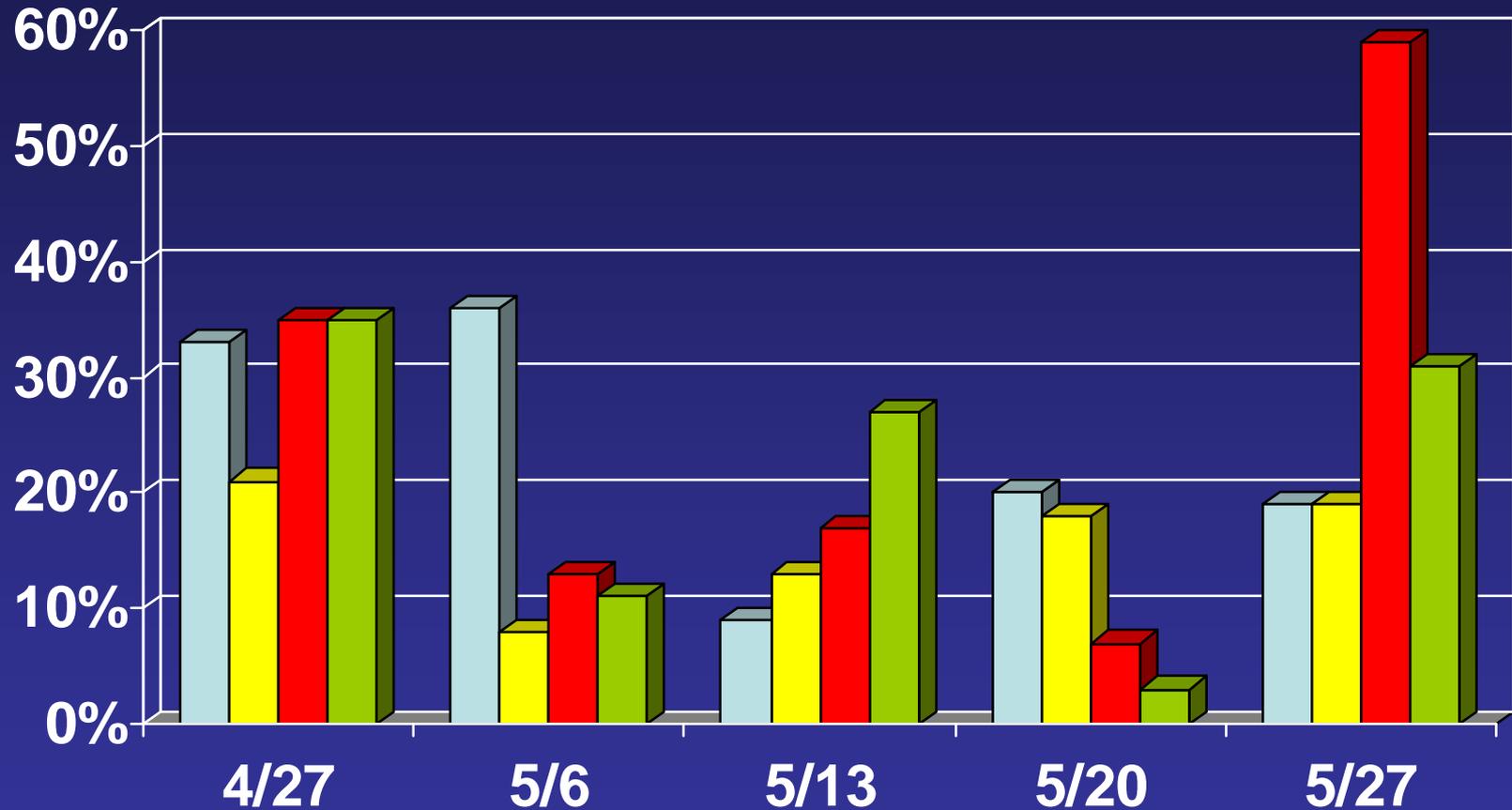
\*2007: *R. salmoninarum* prevalence significantly lower in hatchery Chinook ( $p=0.0098$ ) than in other salmonids

# 2006 and 2007 *R. salmoninarum* (Rs) Levels by qPCR

	Geometric Mean No. Rs/mg Gill sample ( $\pm$ SD)	
	2006*	2007
Chinook W	11 ( $\pm$ 3)	7 ( $\pm$ 3)
Chinook H	12 ( $\pm$ 2)	8 ( $\pm$ 3)
Steelhead W	14 ( $\pm$ 2)	9 ( $\pm$ 3)
Steelhead H	14 ( $\pm$ 2)	8 ( $\pm$ 3)

\**R. salmoninarum* levels significantly higher in all salmonids in 2006 ( $p \leq 0.006$ ) compared with 2007.

# 2007 *R. salmoninarum* Prevalence by Sample Date (qPCR)



■ Chinook W ■ Chinook H ■ Steelhead W ■ Steelhead H

# Summary (Objective II, 2007)

- The prevalence of *Renibacterium salmoninarum* detected by qPCR in salmonid smolts sampled at Lower Granite Dam was significantly lower in 2007 than in 2006 ( $p < 0.0001$ ).
- *R. salmoninarum* levels detected by qPCR in salmonid smolts sampled at Lower Granite Dam were significantly lower in 2007 than in 2006 ( $p < 0.0001$ ).
- Additional analyses of the 2007 samples for *R. salmoninarum* are ongoing.

# Summary (Objective II, 2007)

- Analyses of the 2007 samples for *Nucleospora salmonis* are ongoing.
- In 2006, the prevalence of *N. salmonis* was significantly higher ( $p < 0.0001$ ) in hatchery steelhead (23%) than in wild steelhead (6%), hatchery Chinook salmon (1%) and wild Chinook salmon (4%).
- A recently developed qPCR will permit quantification of *N. salmonis* levels in the future.

# Summary (Objective II)

- There was no detectable influence of *R. salmoninarum* or *N. salmonis* on avian predation rates in 2006 based on PIT tag detections on bird colonies; analysis of 2007 results is pending.
- For each sample year, the relation between pathogen prevalence and levels in the tagged population and SARs will be documented.

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