Migration Behavior and Survival of Artificially Reconditioned Kelt Steelhead Through the Lower Columbia River

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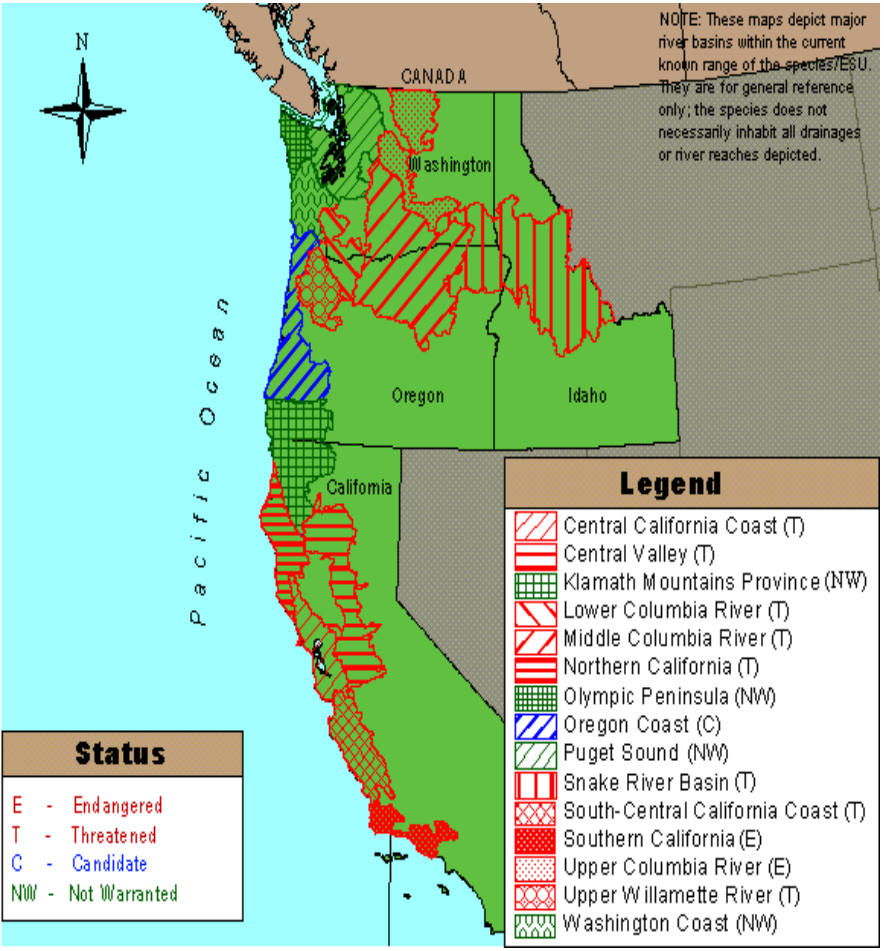
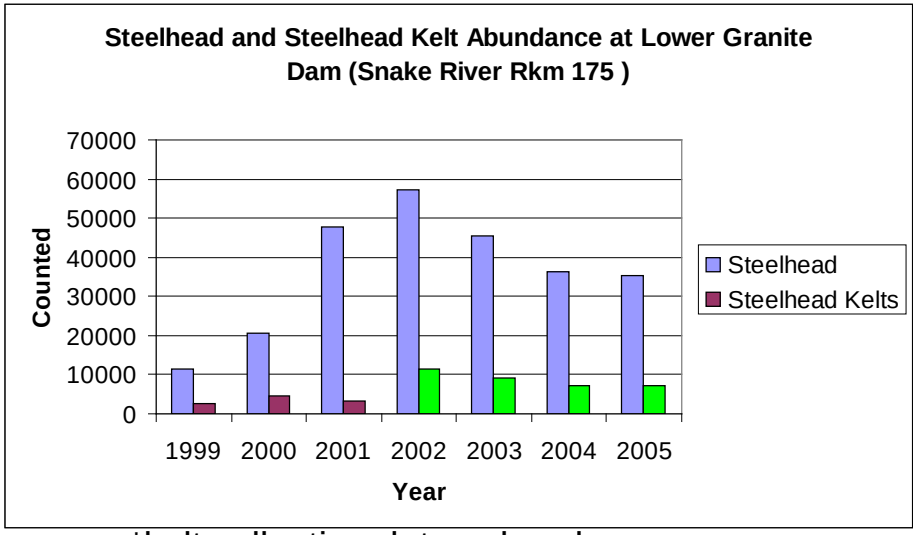
- Why the research was started
  1. All steelhead populations above Bonneville Dam are listed under ESA.

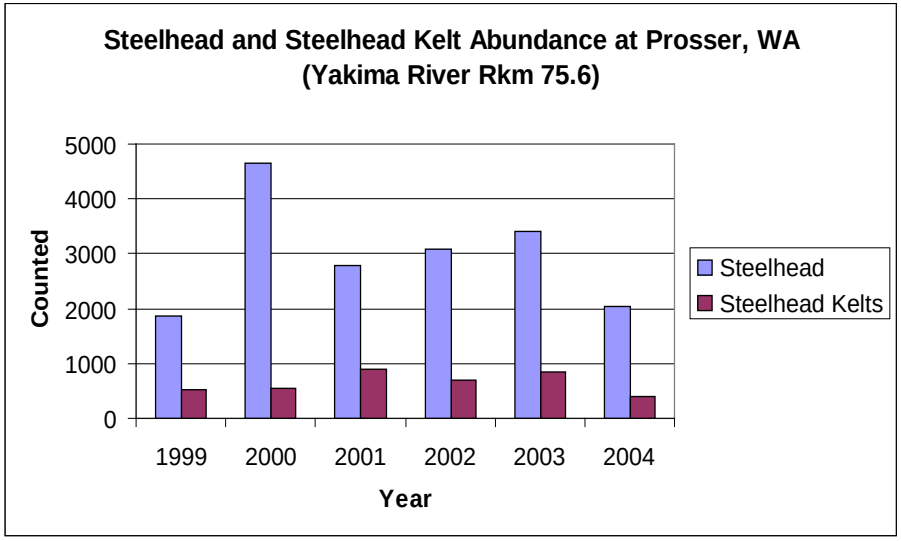


ESU Name	Listing Status1
Upper Willamette River	Threatened
Middle Columbia River	Threatened
Southern California	**Endangered**
South-Central California Coast	Threatened
Central California Coast	Threatened
Upper Columbia River	**Endangered**
Snake River Basin	Threatened
Lower Columbia River	Threatened
Central Valley, California	Threatened
Northern California	Threatened
Klamath Mountains Province	Not Warranted
Oregon Coast	Species of Concern
Southwest Washington	Not Warranted
Olympic Peninsula	Not Warranted
Puget Sound	Not Warranted

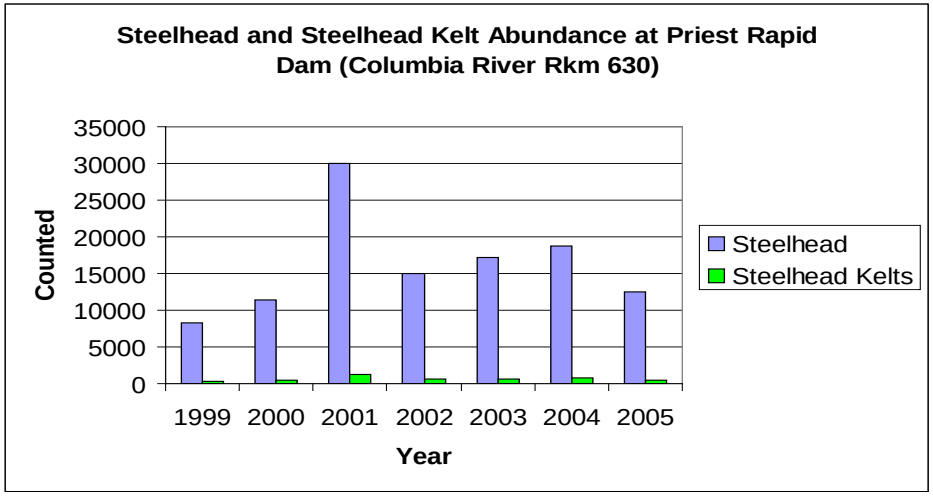
•Why the research was started

2. Kelt steelhead seem abundant above the mainstem dams.





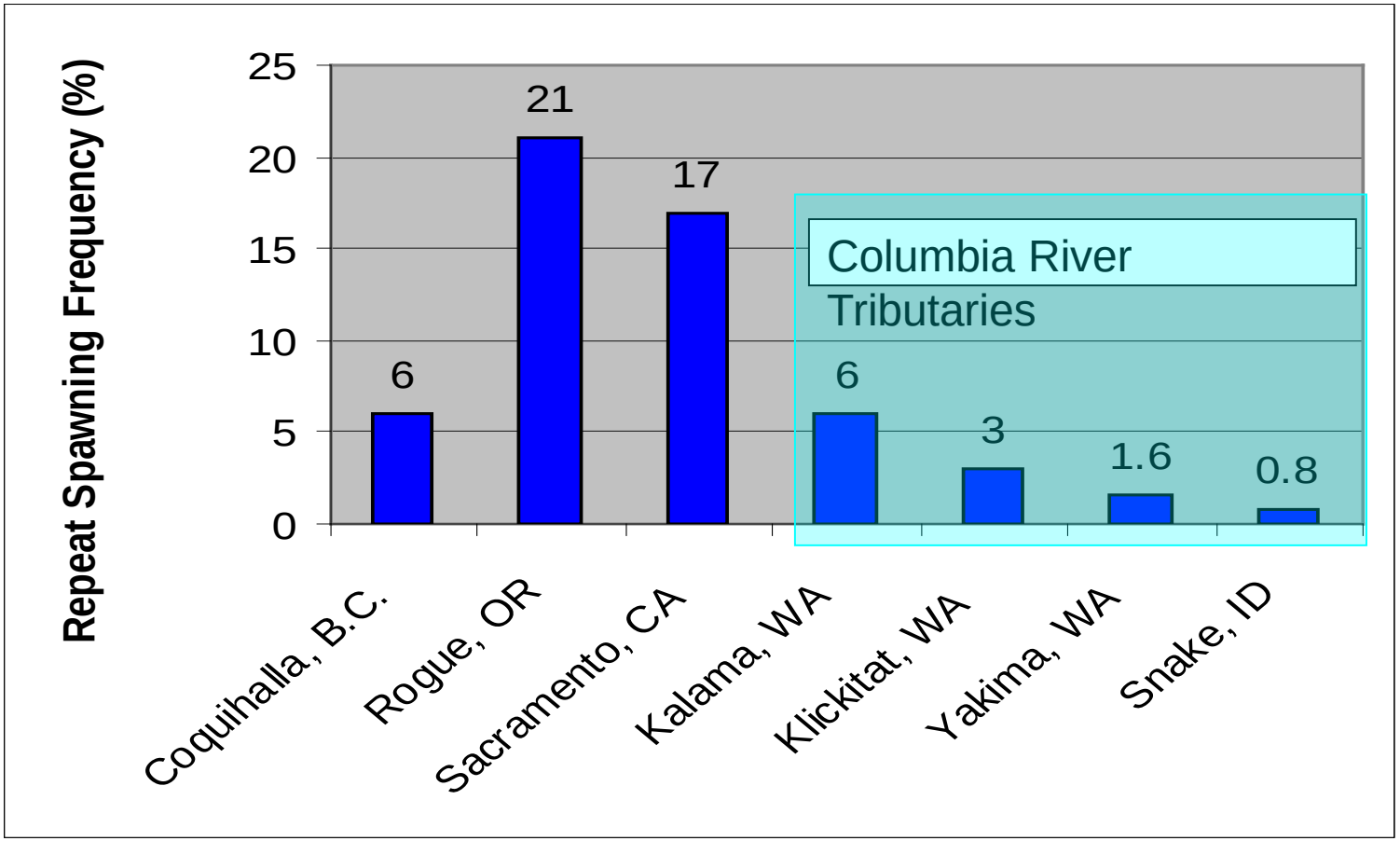
*kelt collection data colored **green** are estimates based on earlier Lower Granite Dam collections.



Chandler Juvenile Evaluation Facility @ Prosser, WA (Yakima River Rkm 75.6)

•Why the research was started

3. Repeat spawner rates are low in the Columbia above mainstem dams.



Data from Busby et al. 1996.; Hockersmith et al. 1995;

Management Strategies

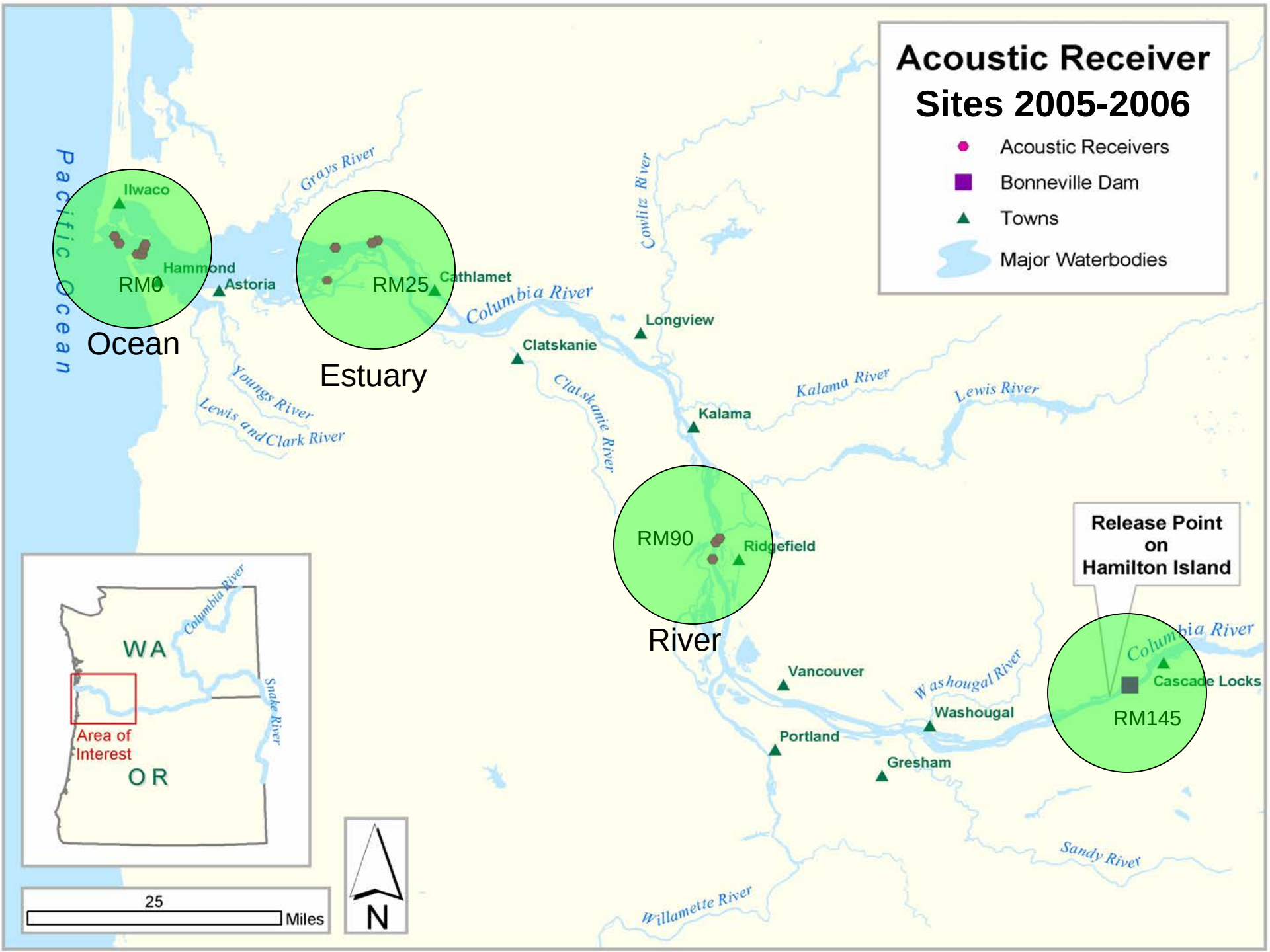
1. Direct Release (capture & release in-river @ Prosser, WA)
2. No-term (capture, transport via truck & release below Bonneville Dam)
3. Short-term (feed 4-8 weeks, transport & release below Bonneville Dam)
4. Long-term (feed 7-9 months & release above Prosser, WA

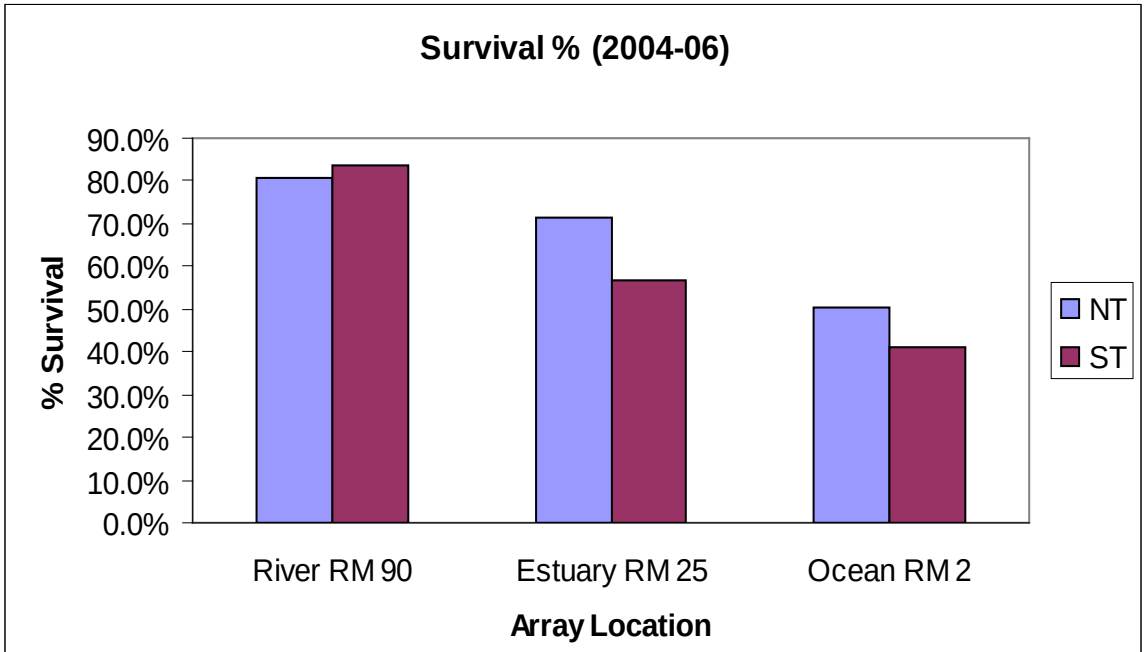
Evaluation of No-Term and Short-Term Treatments

Ho: Artificially reconditioned kelt steelhead and non reconditioned kelts survive at the same rate during their downstream migration.

Ho: Artificially reconditioned kelt steelhead and non reconditioned kelts have similar migration metrics.

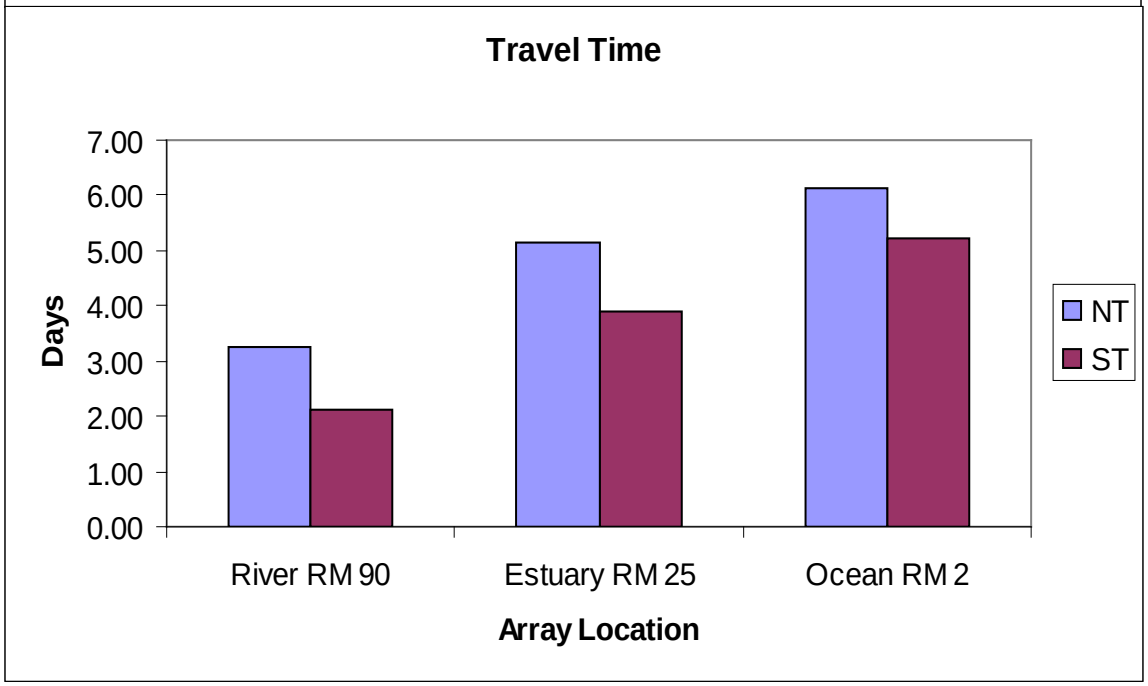
Biotelemetry


Acoustic Receiver Sites 2005-2006
Acoustic Receivers
Bonneville Dam
Towns
Major Waterbodies
Pacific Ocean
Ilwaco
Hammond
Astoria
RM0
Ocean
Grays River
RM25
Cathlamet
Estuary
Columbia River
Cowlitz River
Longview
Clatskanie
Clatskanie River
Youngs River
Lewis and Clark River
Kalama River
Lewis River
Kalama
RM90
Ridgefield
River
Release Point on Hamilton Island
Columbia River
Cascade Locks
RM145
Vancouver
Washougal River
Washougal
Portland
Gresham
Sandy River
Willamette River
WA
OR
Columbia River
Snake River
Area of Interest
25
Miles
N



ANOVA

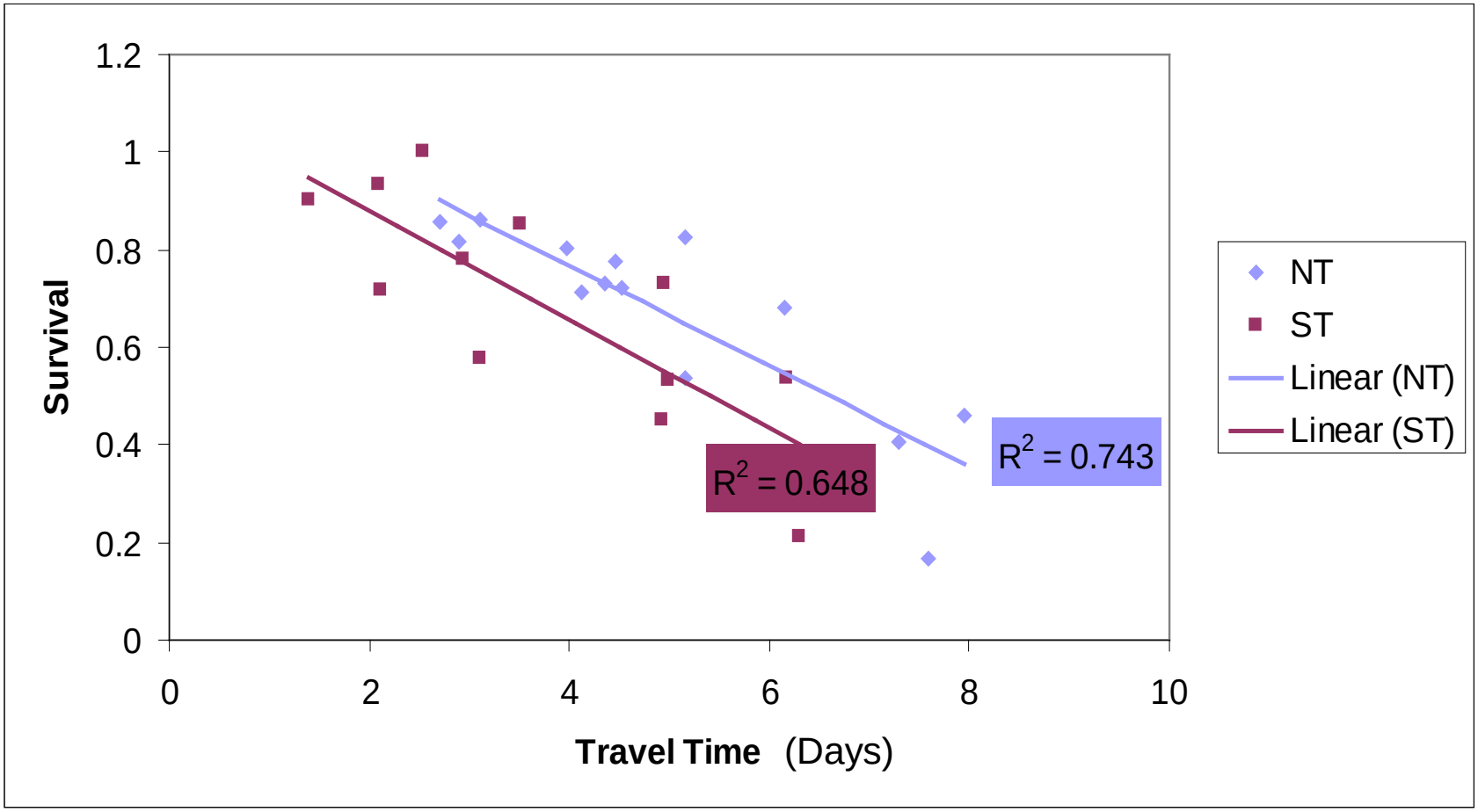
Effect	p-value
Treatment	0.429
Reach	0.014
Trt*Reach	0.771



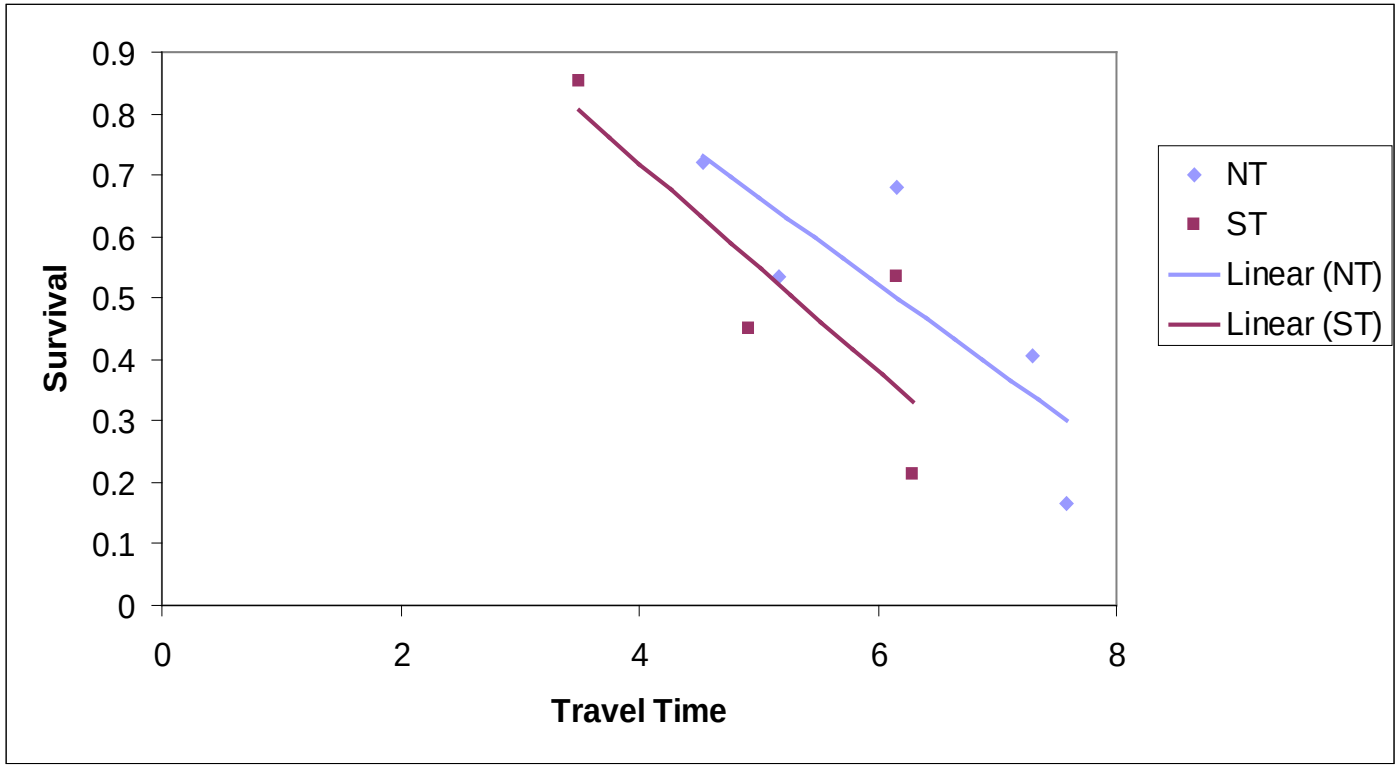
ANOVA

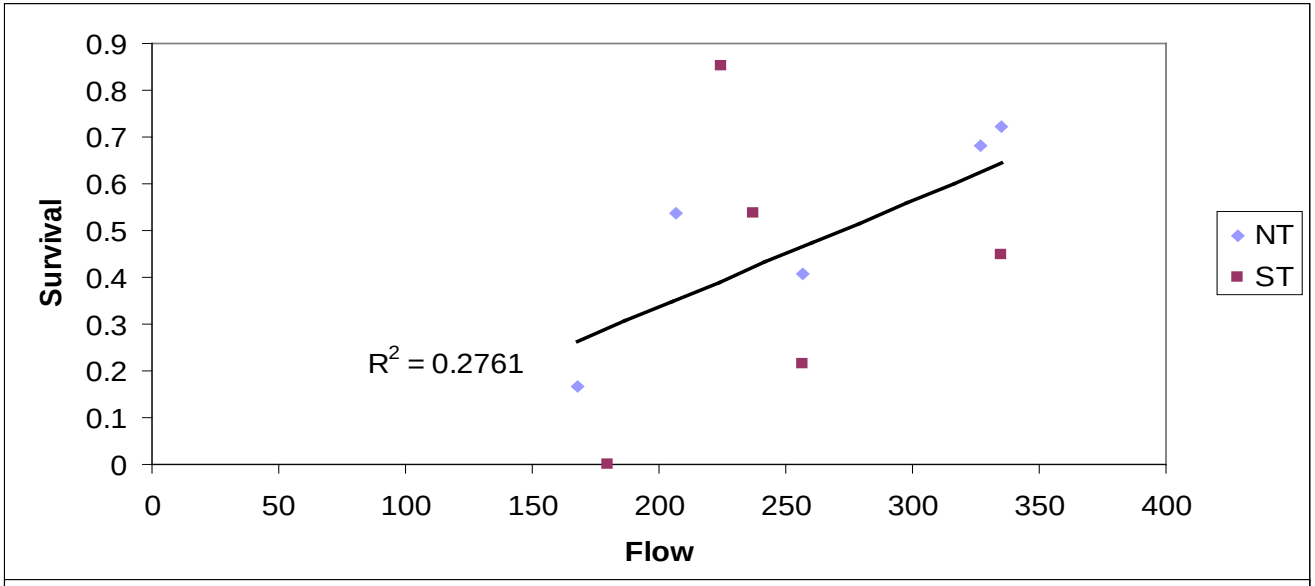
Effect	p-value
Treatment	0.035
Reach	0.000
Trt*Reach	0.962

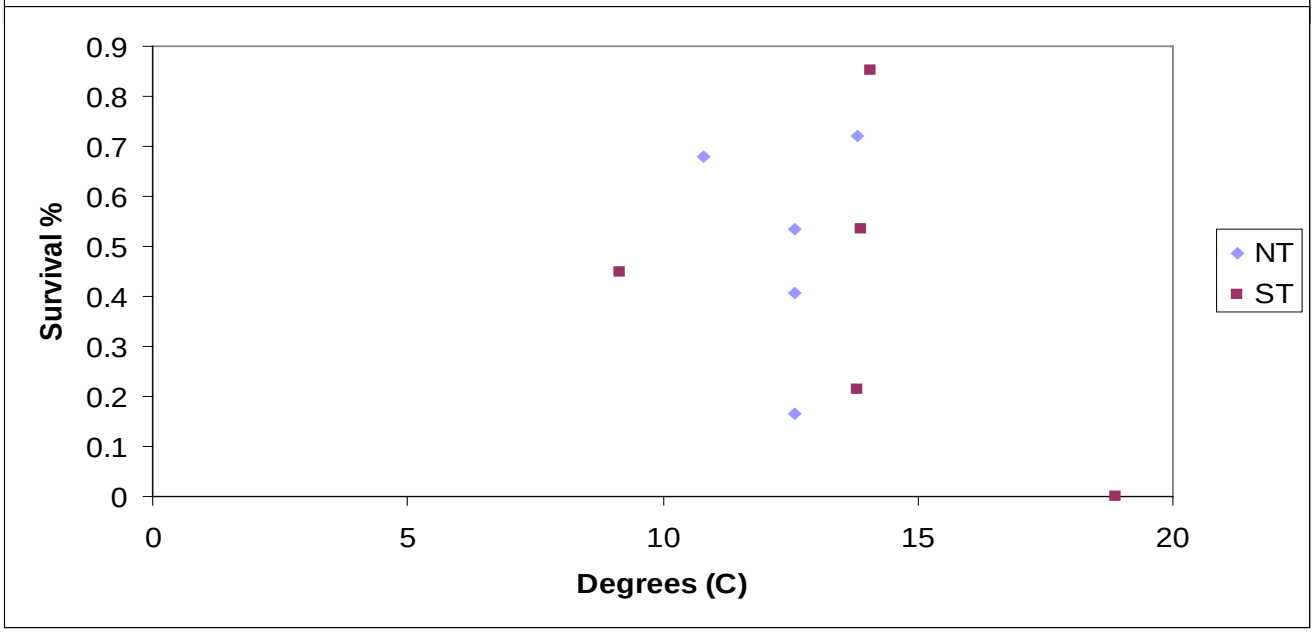
Survival as a function of travel time for no-term (NT) and short-term (ST) kelt steelhead groups released in 2004, 05, and 06.

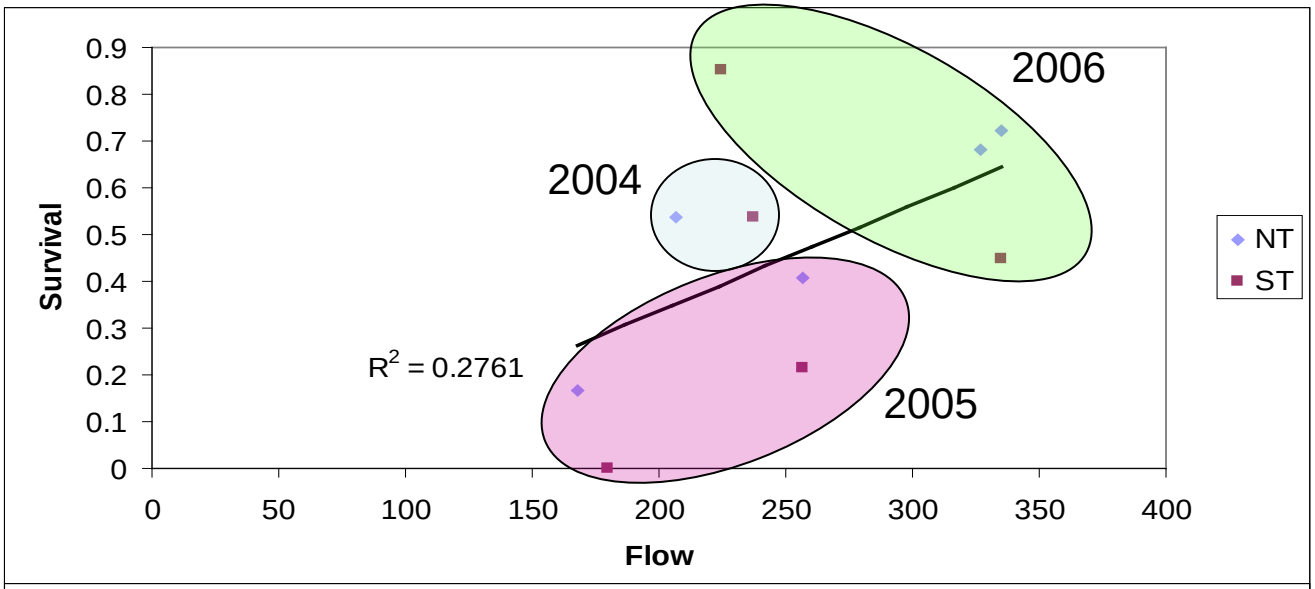


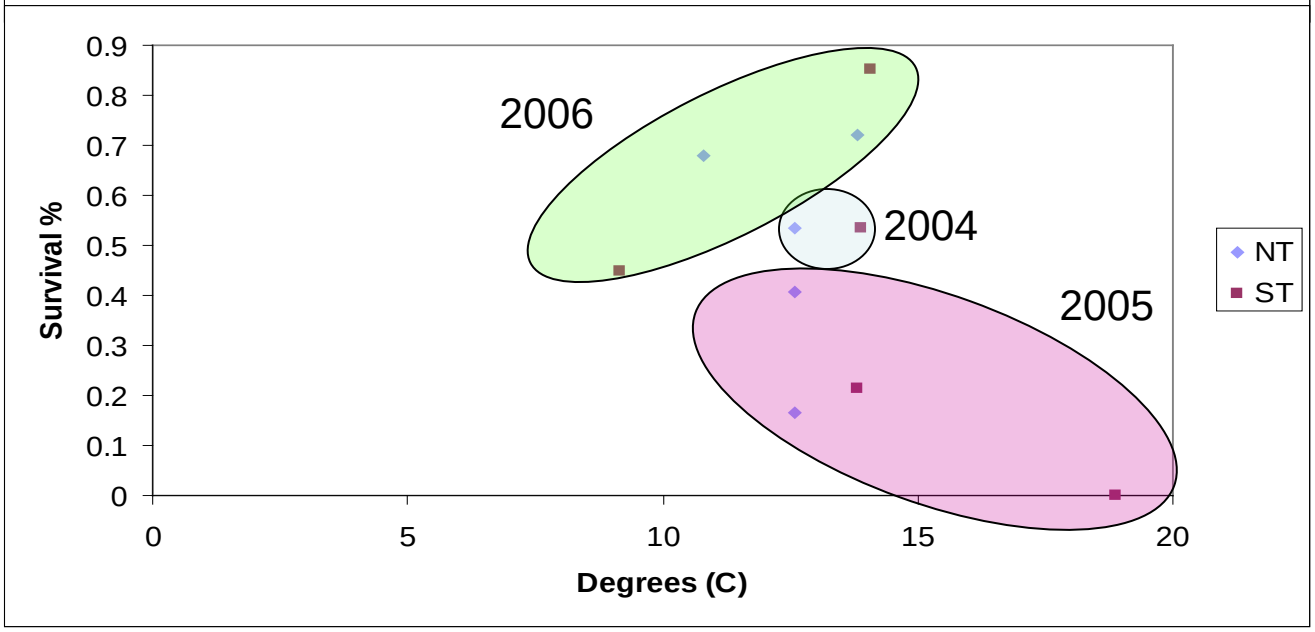
Survival as a function of travel time from release to ocean detection for no-term (NT) and short-term (ST) kelt steelhead groups released in 2004, 05, and 06.

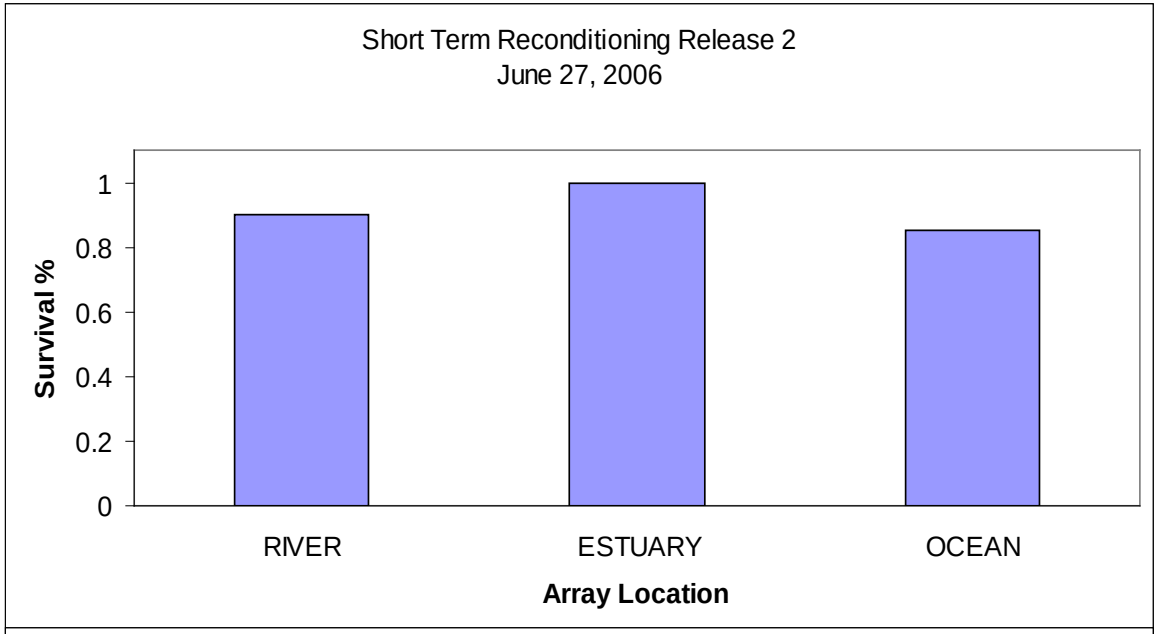


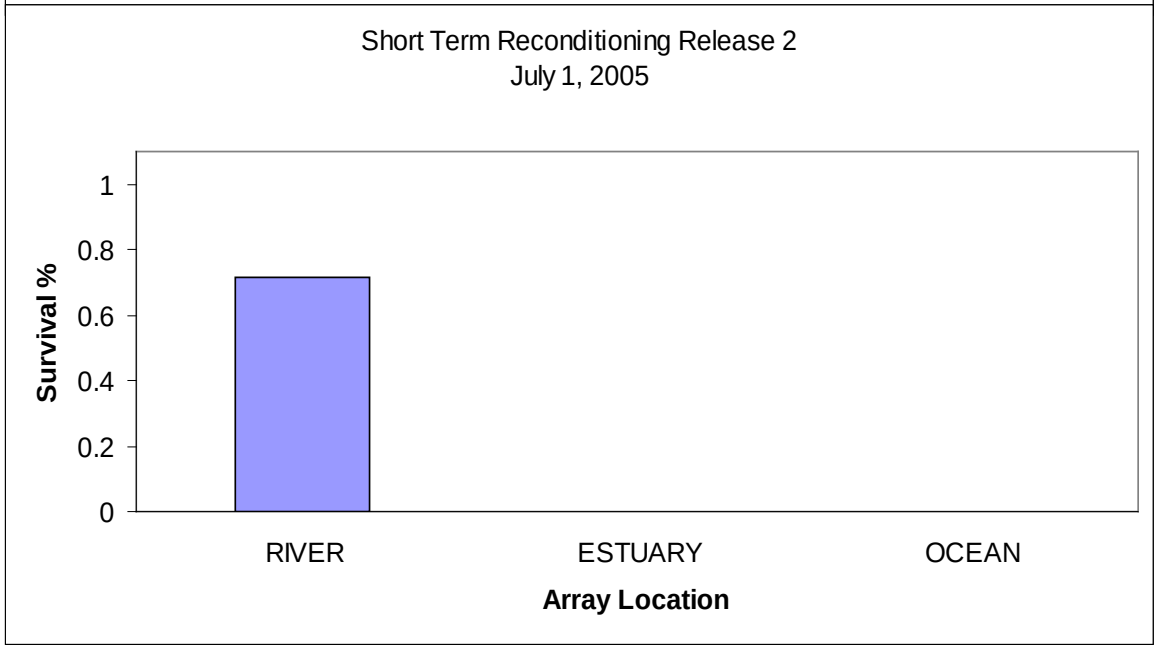

Survival
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
50
100
150
200
250
300
350
400
Flow
R2 = 0.2761
NT
ST


Survival %
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
Degrees (C)
NT
ST


Survival
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
50
100
150
200
250
300
350
400
Flow
2006
2004
2005
R^2 = 0.2761
NT
ST


Survival %
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
Degrees (C)
2006
2004
2005
NT
ST





THE GOOD

Flow 224,500 cfs

Water Temperature 14.1C

S to the ocean 85.2%

Average travel time to the river array 1.4 days; to the ocean array 3.5 days

THE BAD

Flow 180,000 cfs @ Bonn

Water Temperature 18.9C

S to the ocean 0%

Average travel time to the river array 2.1 days.

Collection and Return Migration History for No- and Short-term Reconditioned Kelts

	No-Term			**Short-Term**		
Collection year	Fish In	Returned to Bonn (%)	Survival (release to ocean)	Fish In	Returned to Bonn (%)	Survival (release to ocean)
2002	--	--	--	479	43 (9%)	--
2003	--	--	--	208	8 (4%)	--
2004	75	5 (7%)	53.5%	105	5 (5%)	53.6%
2005	98	1 (1%)	28.7%	106	0 (0%)	10.7%
2006	55	na	70.1%	56	na	65.1%
average		3%	50.3%		6%	41%

Summary

- Since the dams are highly selective against the kelt strategy, they could be altering the evolutionary trajectory of steelhead populations.
- No-term and short-term release strategies are low intervention management scenarios that allow for the recruitment of marine nutrients and are low cost.
- Kelt steelhead released below Bonneville Dam traveled quickly downstream. Many reached the ocean in 5 to 6 days.
- Short-term treated kelts traveled downstream faster than no-term treated kelts, however survival estimates between the groups was not significantly different.
- About 50% of the kelt steelhead released below Bonneville Dam reached the ocean. The mortality rate appears to be about constant from release to ocean entry. (no reach seems more important than another). Perhaps we should release fish closer to the ocean.
- Environmental conditions greatly influence survival to the ocean. Flow seems most important. High flow = greater survival.
- Utilizing this previously lost resource could lead to novel approaches to restoration.

Information Needs

- Procedures to screen kelts to predict survival.
- Reproductive success of long-term fish.
- Differential stock contribution to kelt reconditioning programs.
- Geographic replication.
- Ocean survival.

Estuary Detection Patterns

1. Direct linear progression to the ocean.
2. Oscillating movement at the top of the estuary (~RM30). Movements correlated with tide. Ebb tide = downstream; Flood tide = upstream movement.