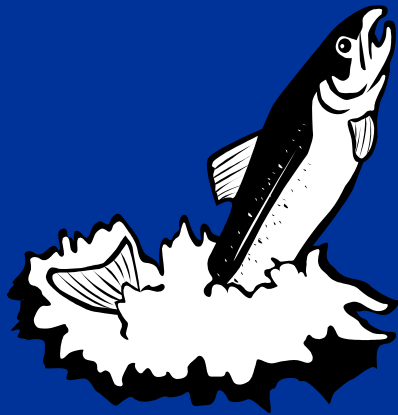


**EDT: Modeling The
Performance of a Steelhead
Population Existing in
Sympatry With Resident
Rainbow Trout**

Upper Yakima steelhead predicted abundance and observations

EDT

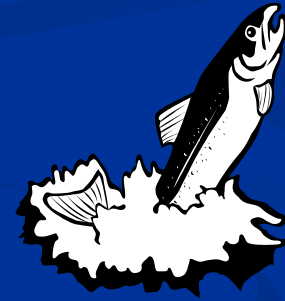
Estimated Neq



1,084 returning adults

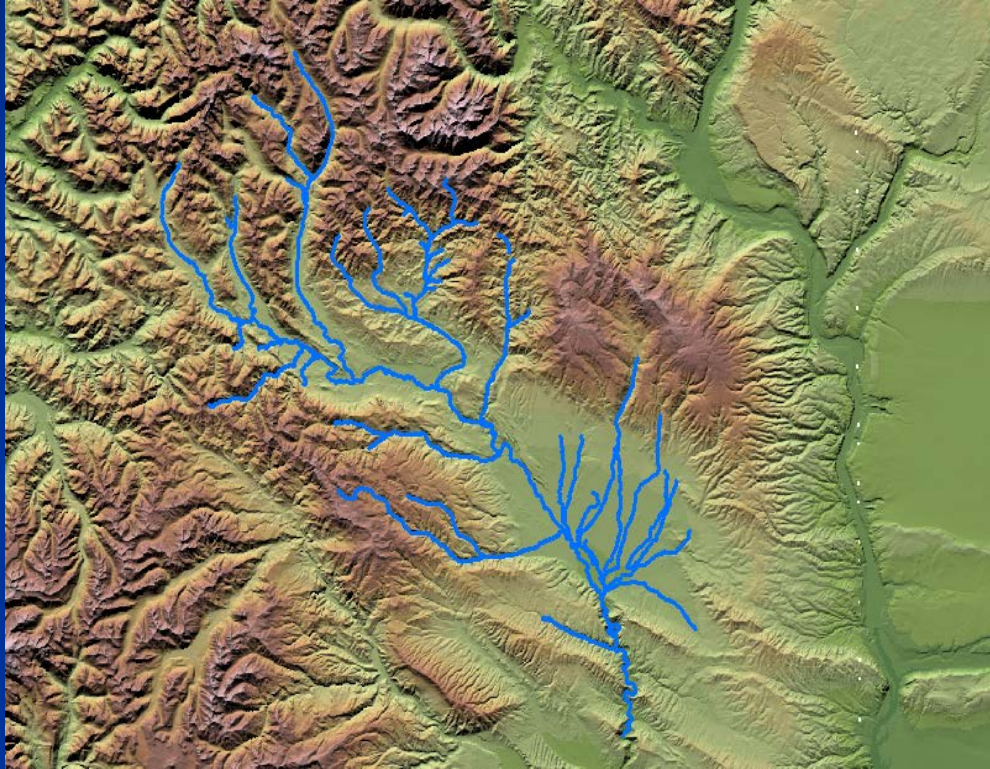
Actual

Roza counts (95-03)



92 returning adults

What does the EDT model capture?



- Habitat based model
 - Characterizes biotic and abiotic environment
- Not designed to:
 - Quantify complexities
 - Interbreeding sympatric population
 - Production of progeny for both ecotypes

Presentation Objectives:

1. Overview the major factors affecting the proportion of each ecotype
2. Description and Demonstration of an EDT based approach using PED theory
3. Apply adjusted performance of two steelhead populations to a restoration scenario

Overview of major factors affecting abundance of Omykiss Ecotypes

- Degree of sympatry and interbreeding
- Environmental conditions
 - Food abundance
 - Temperature profiles
- Relative productivity of a population
 - Survival to adulthood
 - Fecundity and abundance
- Inherited genetic predisposition and ability of one life history form to produce the other

Potential Egg Deposition Theory Calculations:

- Adjusts the Allopatric productivity

$$P_{AS} = P_{AI} * \left(\frac{WPED_{AI}}{PED_{RI} + WPED_{AI}} \right)$$

- Adjusted productivity represents the **sympatric productivity** of an ecotype

What are we intending to capture with the weighting factor?

- Weighting factor represents:
 - Genetic “bias”
 - Favor production of one ecotype over the other
- Must reasonably solve for weighting factor before adjusted values could be applied!

Systematic approach to applying the P.E.D. equations to the Yakima Subbasin

➤ Modeled parameters

1. Ecotypes modeled independently

➤ Individual watersheds

1. Capacity
2. Productivity
3. Neq
4. Weighted fecundity



➤ Unknown Parameters

1. Ecotypes modeled in sympatry

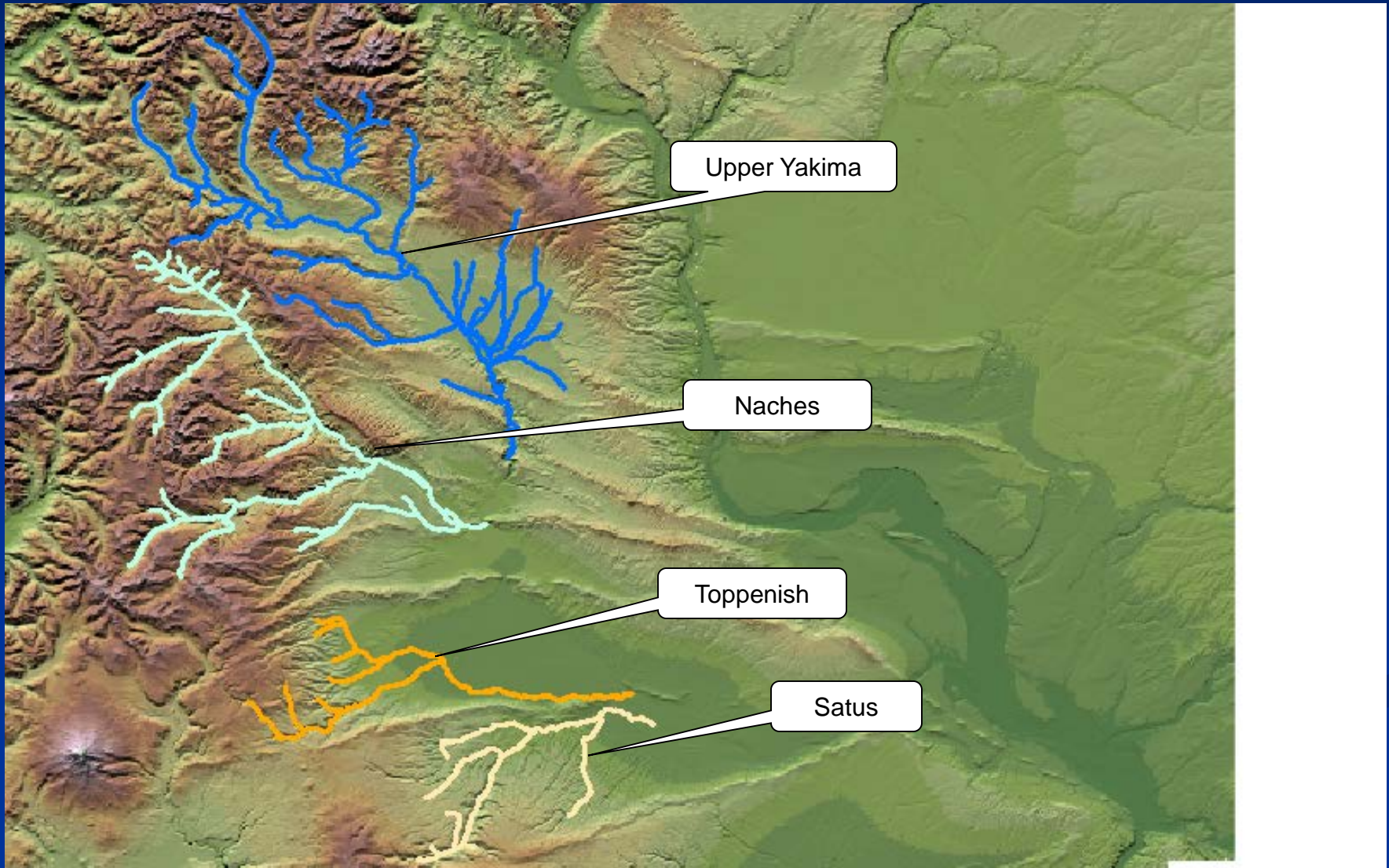
➤ Individual watersheds

1. Productivity
2. Neq

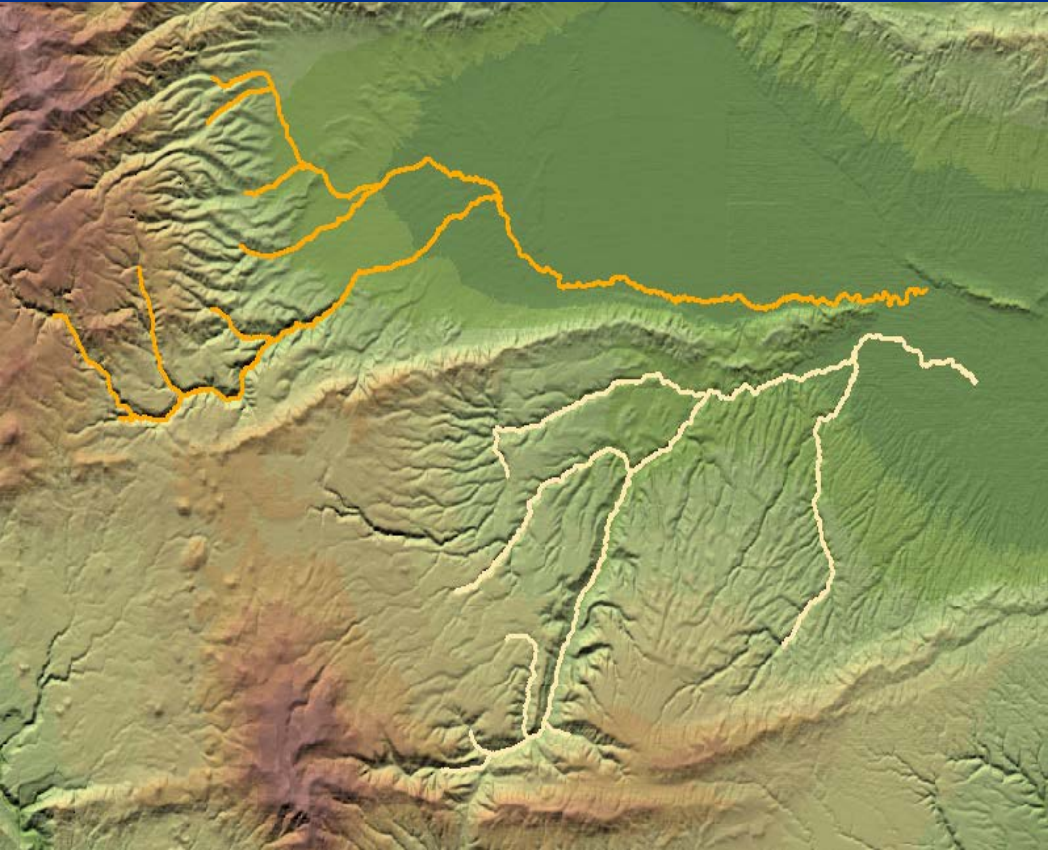
- Population performance parameters generated for both ecotypes from EDT model

- ✓ Adjusted values for both ecotypes

Geographic areas defined for various populations of *O. mykiss*



Solving for the weighting factor:



- Satus & Toppenish Cr
 - Exclusively steelhead
 - Used to solve for weighting multiplier
- Iterative calculations
 - Varying weighting factor
 - Resident population
 - Productivity < 1
 - $N_{eq} \sim 0$
- Rationale?
 - Biological observations

Satus Cr

Independent

	Resident		Anadromous	
Prod	4.92		2.59	
Cap	5,264	Resident PED	1,561	Anadromous PED
Neq	4,194	1,954,331	Rightmost Column	Leftmost column
Eggs	466		2,115	

Interacting populations

Steelhead Neq*Eggs*W _A	W _A Weighting Multiplier	Resident Productivity	Resident Capacity	Resident Neq	Anadromous Productivity	Anadromous Capacity	Anadromous Neq
2,028,260	1	2.41	5,264	3,084	1.32	1,561	379
4,056,521	2	1.60	5,264	1,973	1.75	1,561	669
6,084,781	3	1.20	5,264	863	1.96	1,561	766
7,662,767	3.778	1.00	5,264	0.000	2.59	1,561	959
8,113,041	4	0.96	5,264	0	2.59	1,561	959
10,141,301	5	0.79	5,264	0	2.59	1,561	959
12,169,562	6	0.68	5,264	0	2.59	1,561	959
14,197,822	7	0.60	5,264	0	2.59	1,561	959
16,226,082	8	0.53	5,264	0	2.59	1,561	959
18,254,342	9	0.48	5,264	0	2.59	1,561	959
20,282,603	10	0.43	5,264	0	2.59	1,561	959
22,310,863	11	0.40	5,264	0	2.59	1,561	959
24,339,123	12	0.37	5,264	0	2.59	1,561	959

Toppenish Cr

<i>Independent</i>		Resident		Anadromous	
	Prod	4.30		2.66	
	Cap	5,084	Resident PED	887	Anadromous PED
	Neq	3,902	1,818,837	Rightmost Column	Leftmost column
	Eggs	466		2,115	

Interacting populations

	W_A							
Steelhead Neq*Eggs* W_A	Weighting Multiplier	Resident Productivity	Resident Capacity	Resident Neq	Anadromous Productivity	Anadromous Capacity	Anadromous Neq	
1,169,979	1	2.62	5,084	3,141	1.04	887	35	
2,339,957	2	1.88	5,084	2,381	1.50	887	294	
3,509,936	3	1.47	5,084	1,620	1.75	887	380	
4,420,179	3.778	1.25	5,084	1,028	1.88	887	416	
4,679,914	4	1.20	5,084	860	1.91	887	424	
5,849,893	5	1.02	5,084	99	2.03	887	450	
6,003,160	5.131	1.00	5,084	0.000	2.66	887	553	
7,019,871	6	0.88	5,084	0	2.66	887	553	
8,189,850	7	0.78	5,084	0	2.66	887	553	
9,359,828	8	0.70	5,084	0	2.66	887	553	
10,529,807	9	0.63	5,084	0	2.66	887	553	
11,699,786	10	0.58	5,084	0	2.66	887	553	
14,039,743	12	0.49	5,084	0	2.66	887	553	

Upper Yakima

<i>Independent.</i>		Resident		Anadromous	
	Prod	3.62		1.85	
	Cap	23,503	Resident PED	2,360	Anadromous PED
	Neq	17,010	7,926,874	Rightmost Column	Leftmost column
	Eggs	466		2,115	

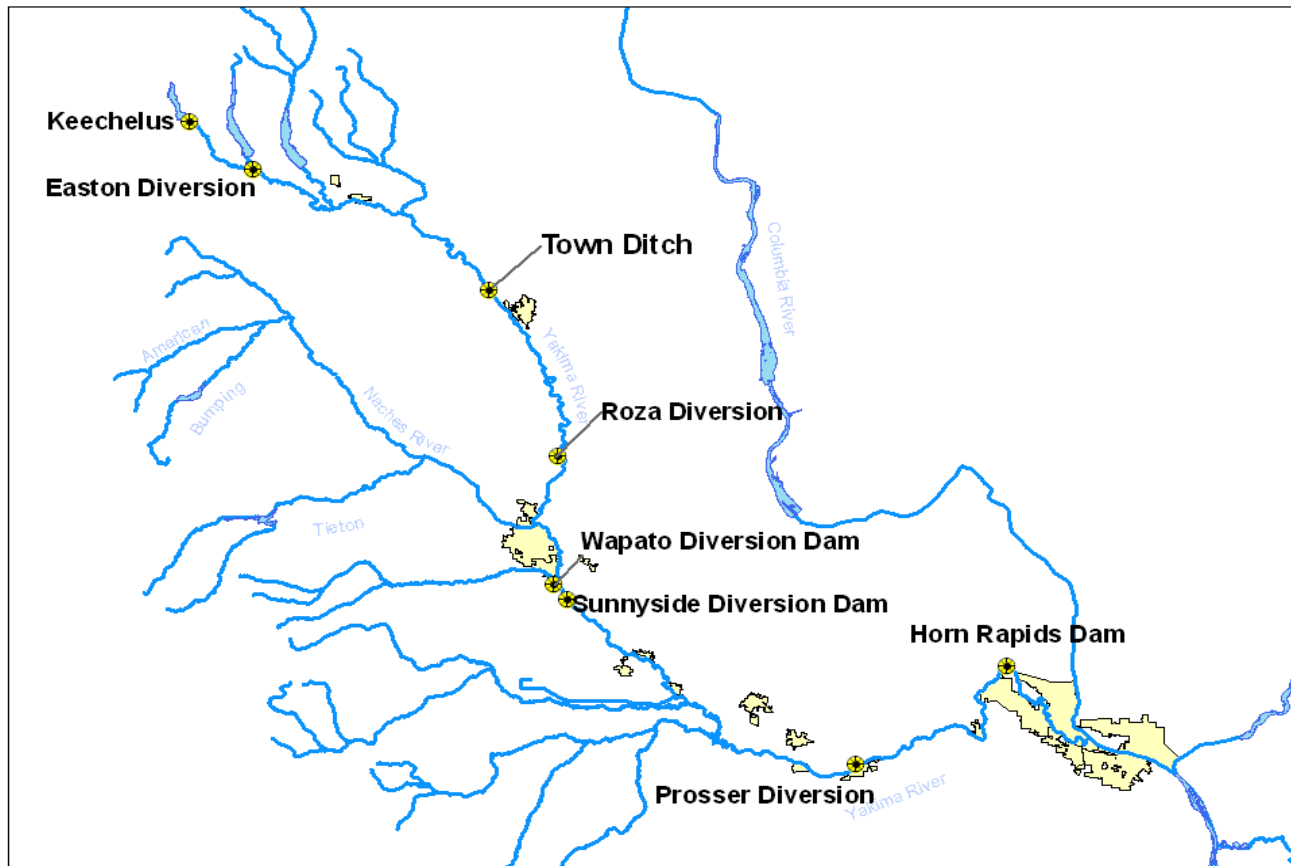
Interacting populations

W_A							
Steelhead Neq*Eggs* W_A	Weighting Multiplier	Resident Productivity	Resident Capacity	Resident Neq	Anadromous Productivity	Anadromous Capacity	Anadromous Neq
2,292,798	1	3.62	23,503	17,010	0.42	2,360	0
4,585,595	2	3.62	23,503	17,010	0.68	2,360	0
6,878,393	3	3.62	23,503	17,010	0.86	2,360	0
8,662,189	3.778	3.62	23,503	17,010	0.97	2,360	0
9,171,190	4	3.62	23,503	17,010	0.99	2,360	0
10,213,267	4.4545	1.58	23,503	8,645	1.04	2,360	94
11,764,344	5.131	1.46	23,503	7,375	1.11	2,360	225
13,756,785	6	1.32	23,503	5,743	1.17	2,360	349
16,049,583	7	1.20	23,503	3,865	1.24	2,360	454
18,342,381	8	1.09	23,503	1,987	1.29	2,360	533
20,635,178	9	1.00	23,503	109	1.34	2,360	594
22,927,976	10	0.93	23,503	0	1.85	2,360	1,084
25,220,773	11	0.865680838	23503	0	1.85	2359.959	1,084

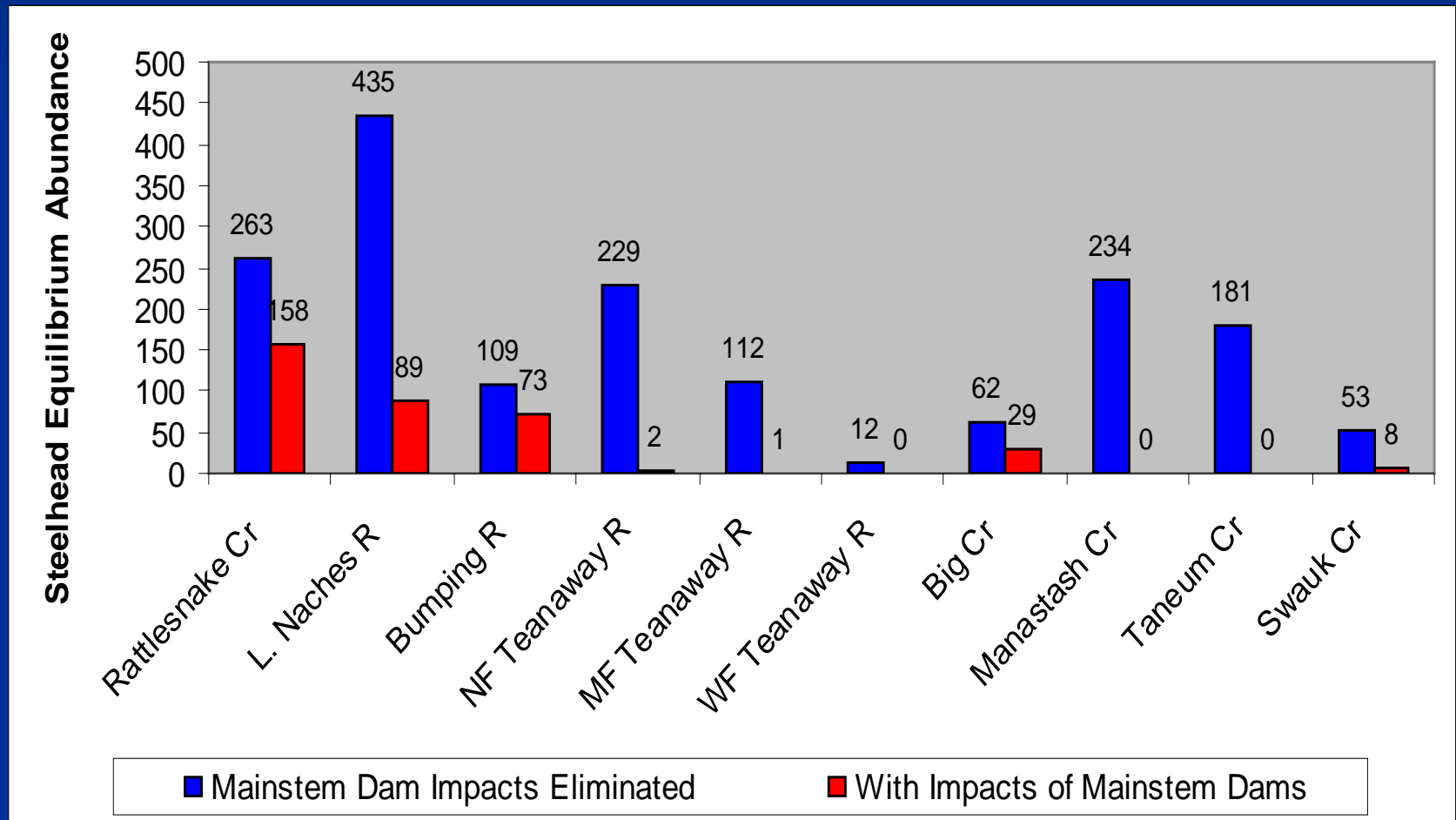
Applying the adjusted performance to a restoration scenario

- Scenario designed to address one of the major factors affecting relative abundance of steelhead population
 - *Improving probability of survival to adulthood*
- Increase survival:
 - Diversion points
 - Bypass systems

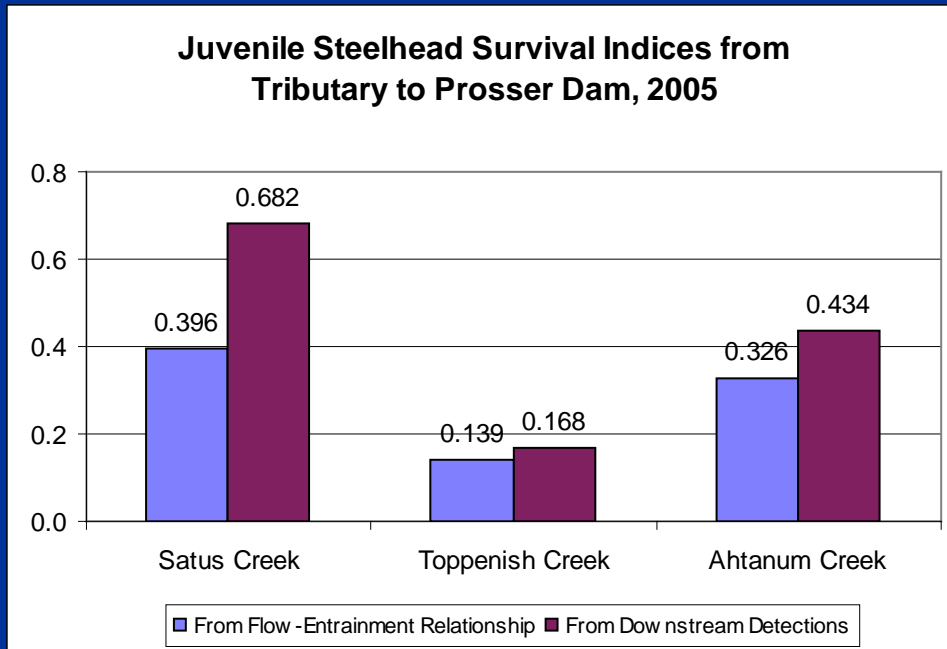
Diversions modeled with improved survival:



Yakima Tributaries modeled: with and without mainstem dam impacts on smolt survival



Discussion:



- Poor Survival
 - **Detrimental effects**
 - Productivity
 - Abundance
- Diversions reduce SAR's
 - Predation
 - Inside and immediately below the bypass structures (Fast et al 1991)
- 2001 outmigration
 - Produced 35 returning adult steelhead to Upper Yakima
- Lind 2005 pitting survival



Heck, who cares how many are left to spawn, I won the derby!