

Effects of environmental conditions on life history diversity of *Oncorhynchus mykiss* in the Yakima River basin

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Project Objective

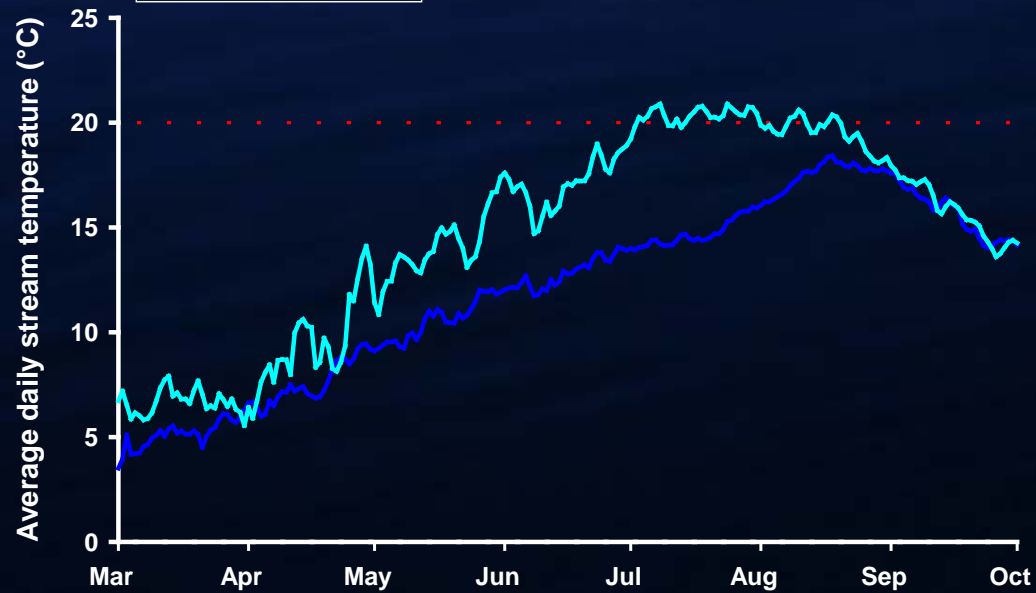
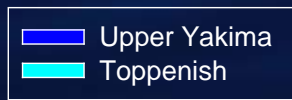
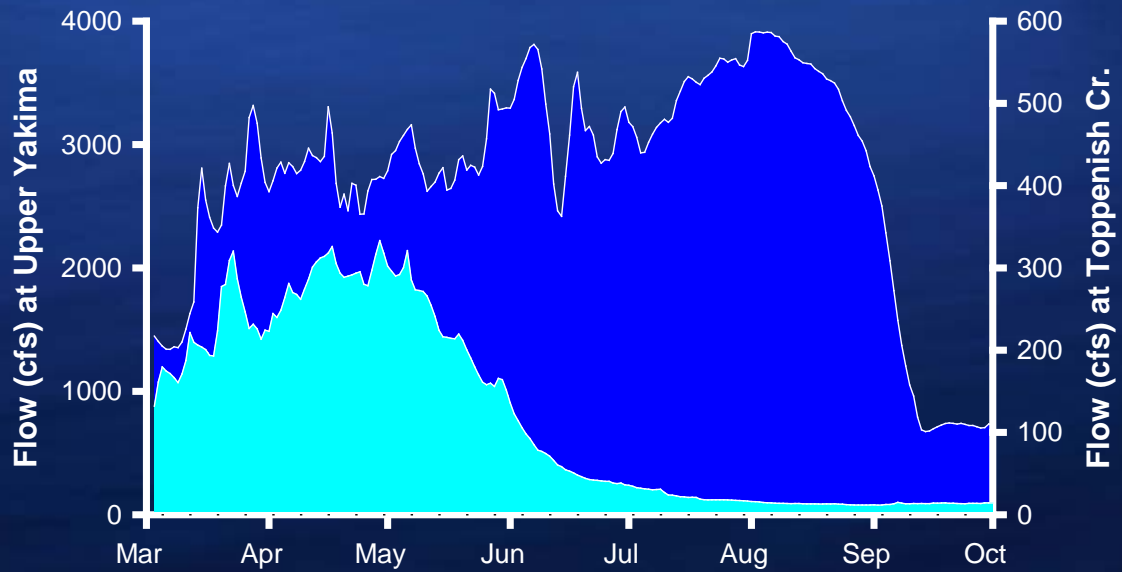
Develop an empirically based modeling approach to quantify the effects of environmental variables on distribution of the two ecotypes in the Yakima Basin



Key Concepts

- *O. mykiss* are phenotypically plastic
- Interbreeding between ecotypes occurs
- Cross-ecotype production occurs
- Rainbow trout populations can give rise to anadromous populations and vice versa





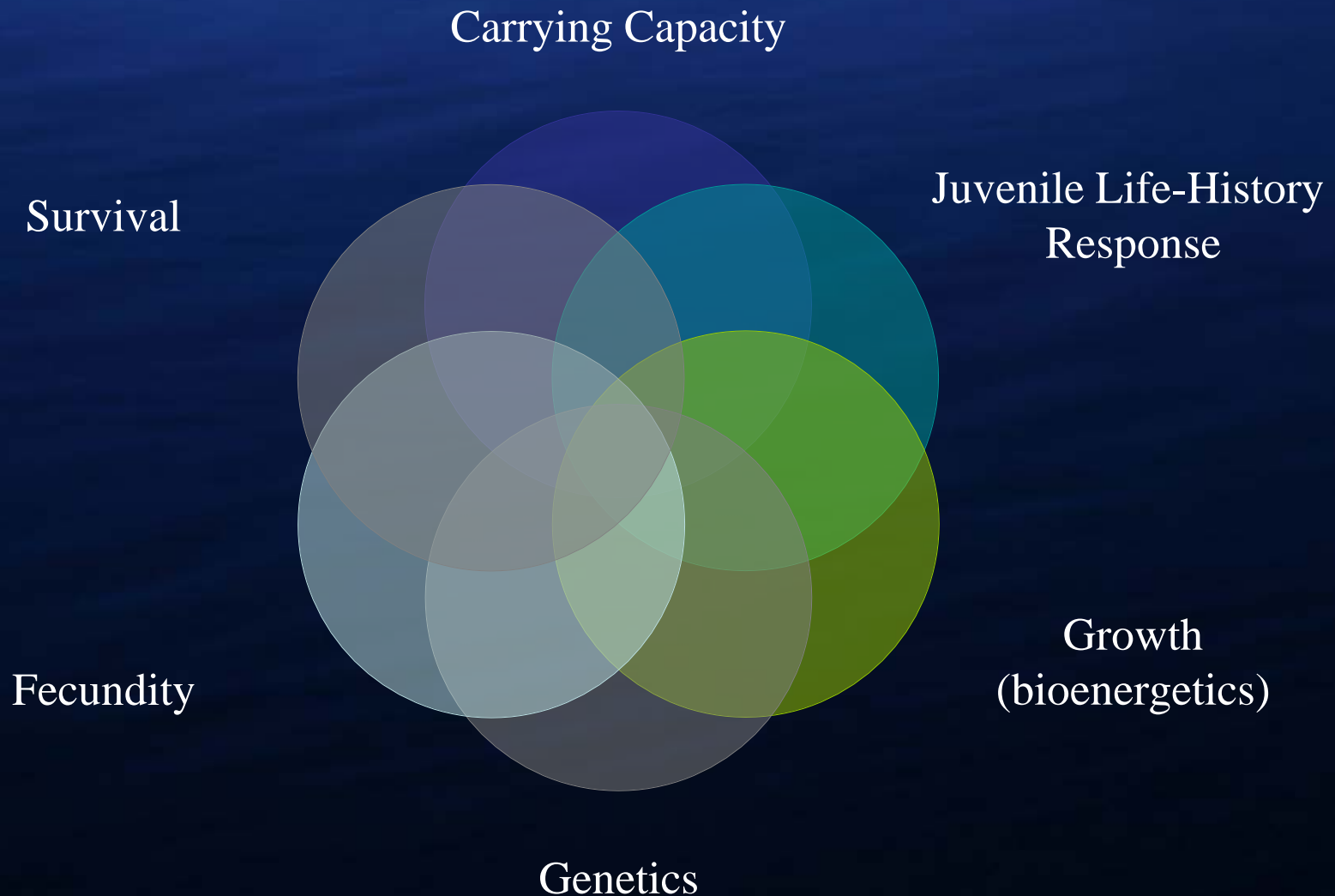


**← Yakima River
(near Cle Elum)**



**Taneum Creek →
(tributary)**

Key Model Components



Summary of Model Functions

- Daily growth
- Flow and temp effects on freshwater survival
- Summer carrying capacity
- Over-winter survival
- Size-dependent marine survival
- Age-dependent resident maturation
- Ecotype and size-dependent fecundity
- Spawner fidelity
- Cross ecotype production



Model Framework (Excel Spreadsheet)

<http://www.fishsciences.net/projects/yakima>

Microsoft Excel - LHRM_draft_v3.2

File Edit View Insert Format Tools Data Window Help

add zoom to toolbar

B7 Satus Cr.

Yakima Basin *O. mykiss* Life-History Response Model

Version 3.0 Developed by: Cramer Fish Sciences, Gresham OR

Resident Model Results

Note: Model results were summarized on October 1, Year 10 unless otherwise noted.

Anadromous Model Results

Select Model Reach: **Model Reach** Satus Cr. (Selected)
 ALT Yakima (Kittitas)

Select Flow Regime: **Model Reach** Average Flow (Selected)
 ALT Average Flow

Run Model: **Run**

Reach	Description	Length (km)	Rkm lower	Rkm upper
Yakima (Easton)	Between Kachess and Cle Elum river	16.4	309.7	326.1
Yakima (Kittitas)	Between the canyon and Taneum Cr.	7	239.2	246.2
Taneum Cr.	Bridge at Rkm 0.7 to Diversion Canal	2.03	0.7	2.7
Naches	Between the mouth and Tieton R.	15.5	6.0	21.5
Yakima (Union Gap)	Between Union Gap And Naches R.	6.2	177.2	183.4
Yakima (Wapato)	Between Satus Cr. and Union Gap	16	155.2	171.2
Toppenish Cr. (upper)	Diversion Canal to NF Toppenish Cr.	20	76.2	96.2
Toppenish Cr. (mid)	Diversion Canal to Simcoe Cr.	10.1	47.2	57.3
Satus Cr.	Logy Cr. To Bull Cr.	19.9	38.0	57.9

	Spawners per KM		Eggs per KM	
	BASE	ALT	BASE	ALT
Resident	290.1	385.5	11,591	132,247
Anadromous	14.0	6.5	57,609	33,039
Anad / Res			4.97	0.25

Resident abundance

Smolt abundance (s)

Environmental Conditions

Resident size at age

Smolt length (spring)

Resident spawner abundance Measured on: 22-Mar

Anadromous spawners

Home Inputs Outputs Base_Calcs Alt_Calcs Abun vs Cap Temp_flow Growth_calcs Habitat_area

Ready Calculate

casey WABC_AFS_Justice Upper Yakima Basin... WABC_AFS_Abstrac... Microsoft Excel - LH...

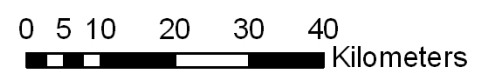
6:55 PM



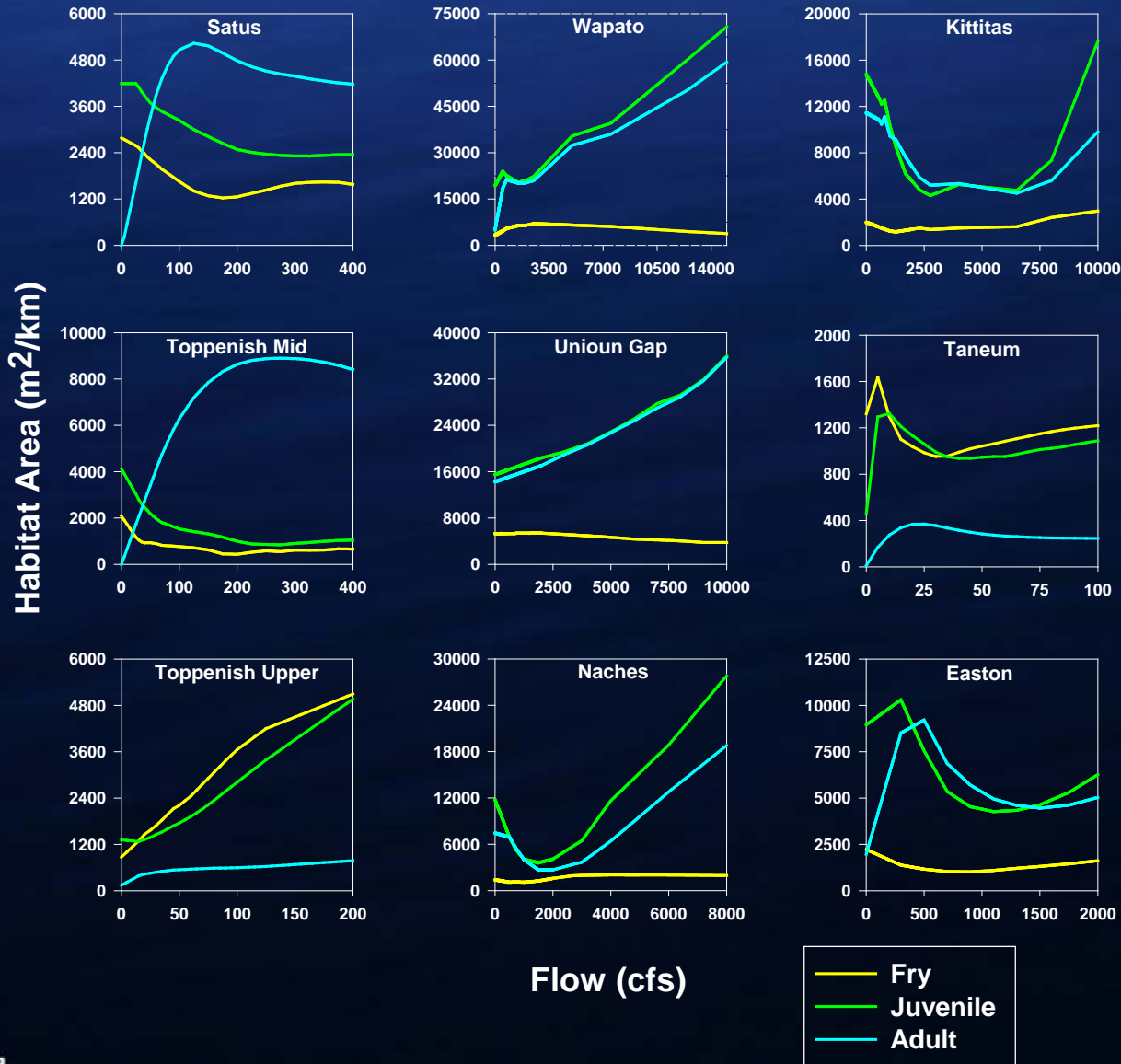
Legend

- Dams
- Cities
- Population Boundaries

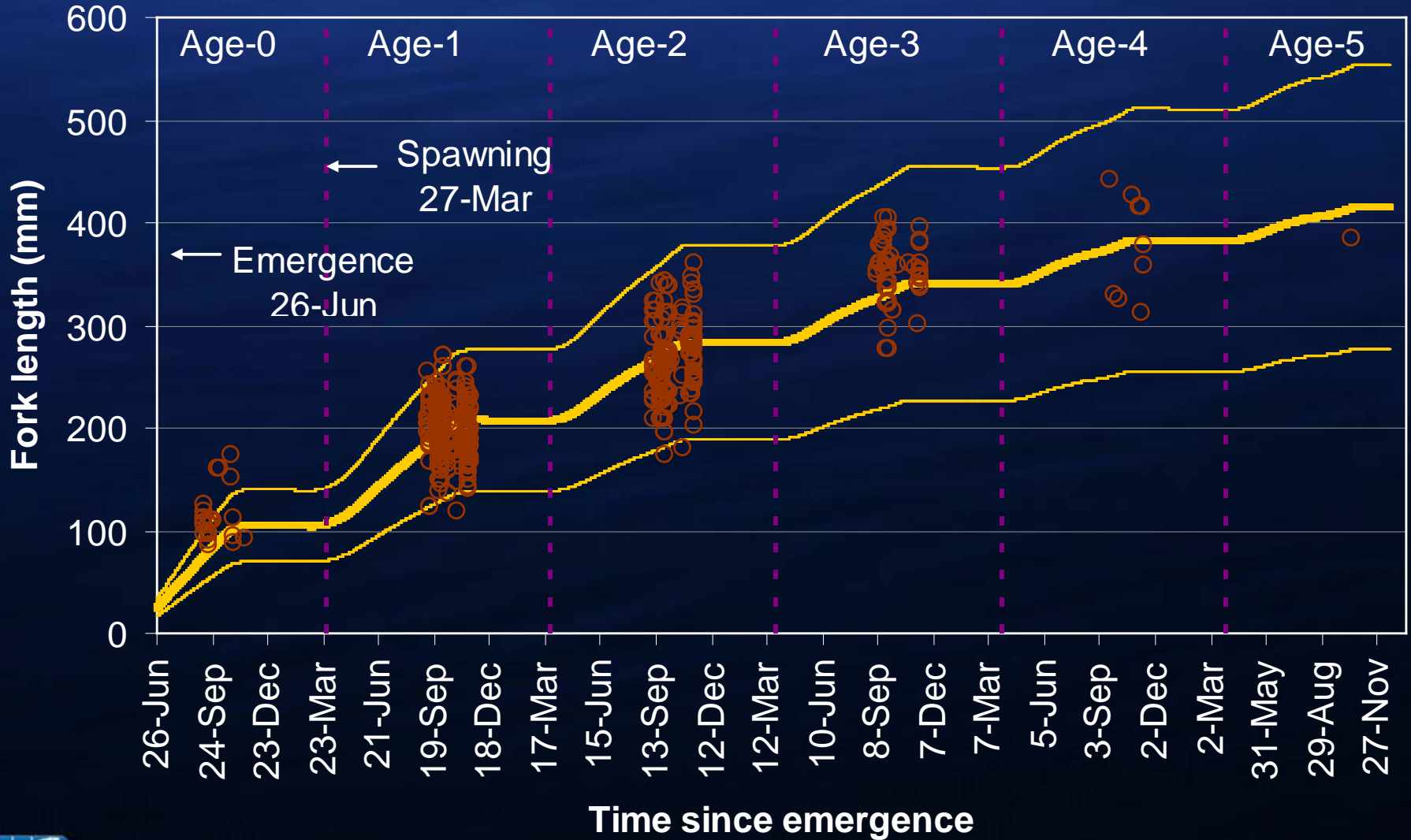
Spatial Structure



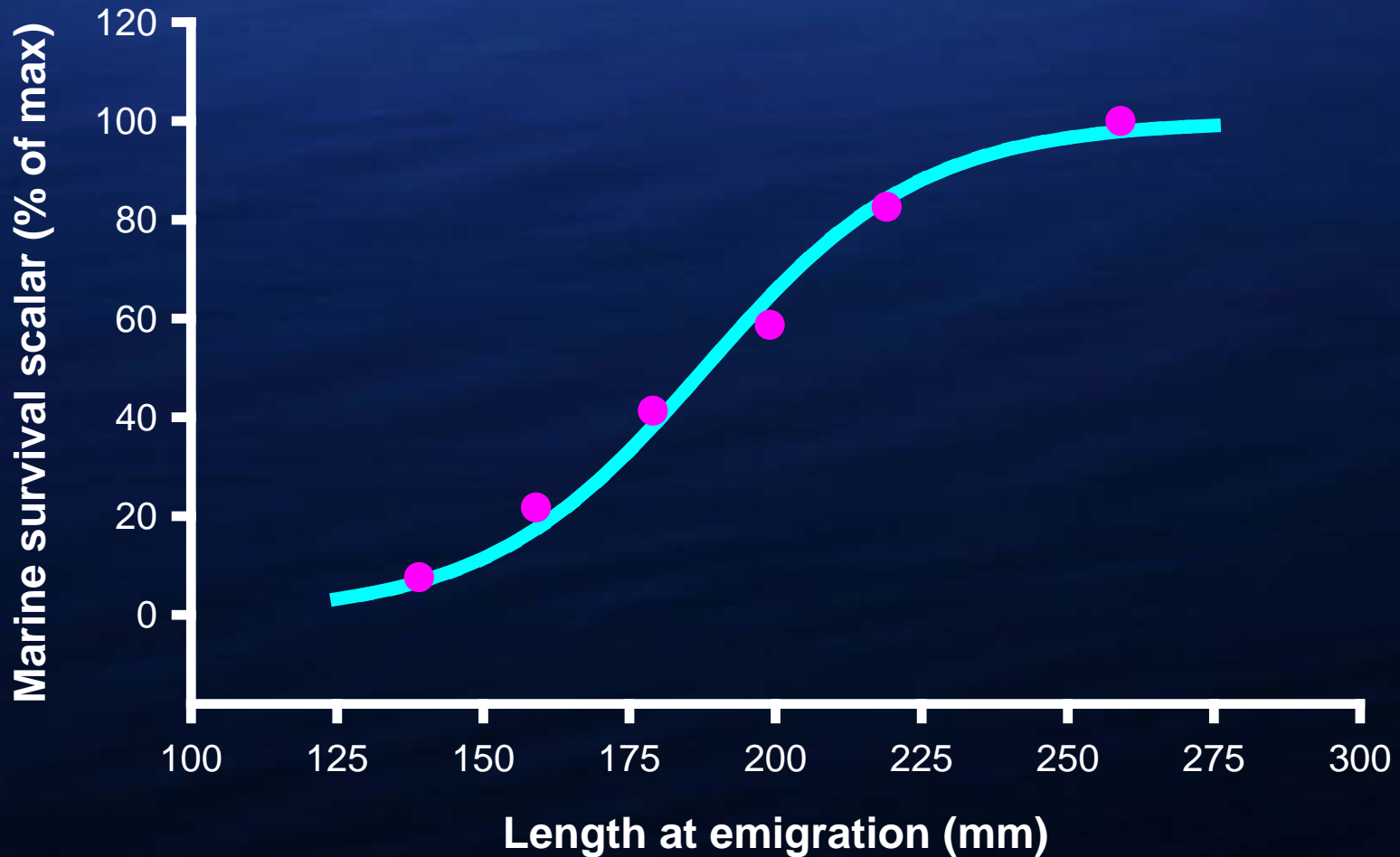
Modeling Effects of Flow on Carrying Capacity



Modeling Growth in Freshwater



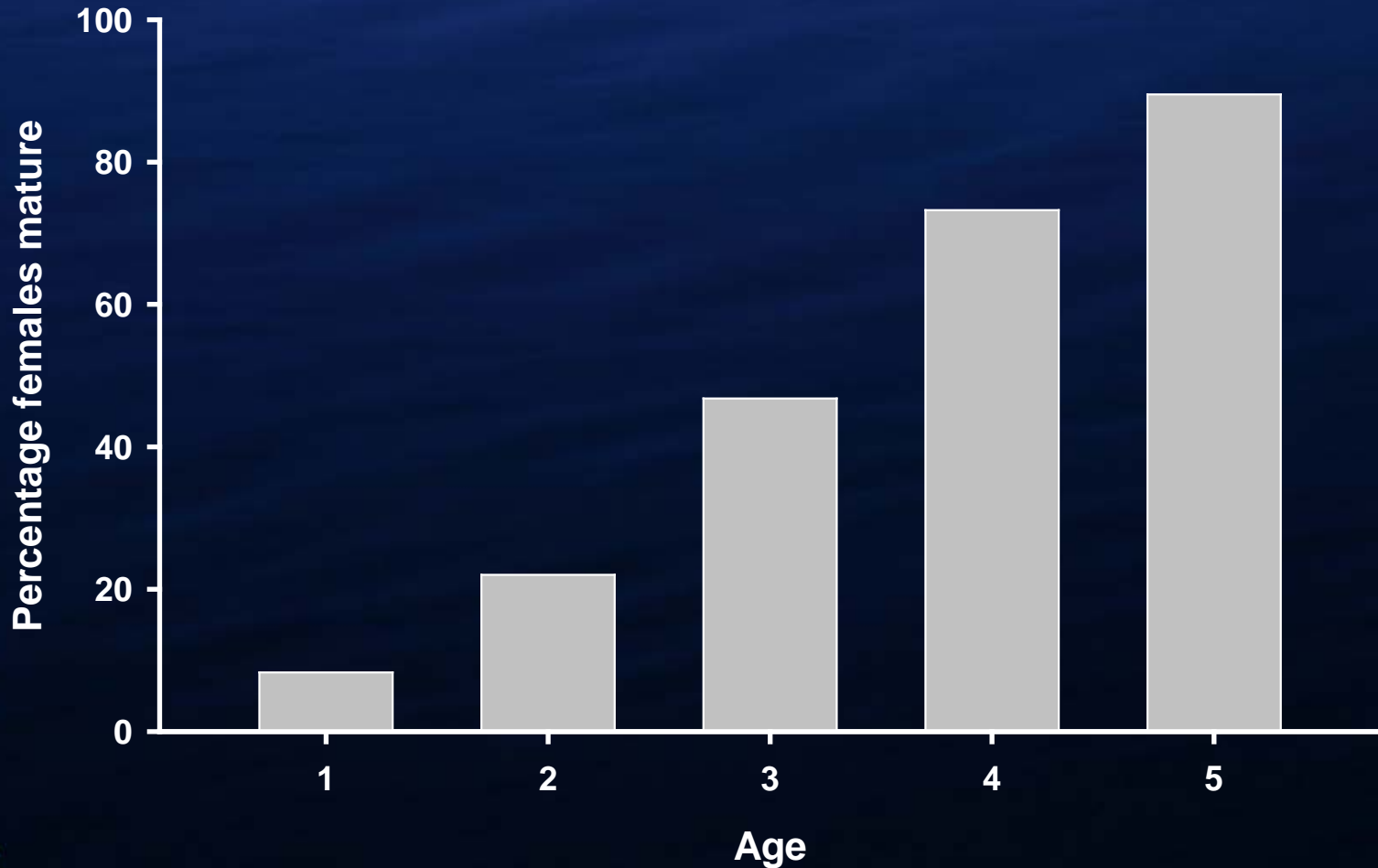
Smolt-to-Adult Return



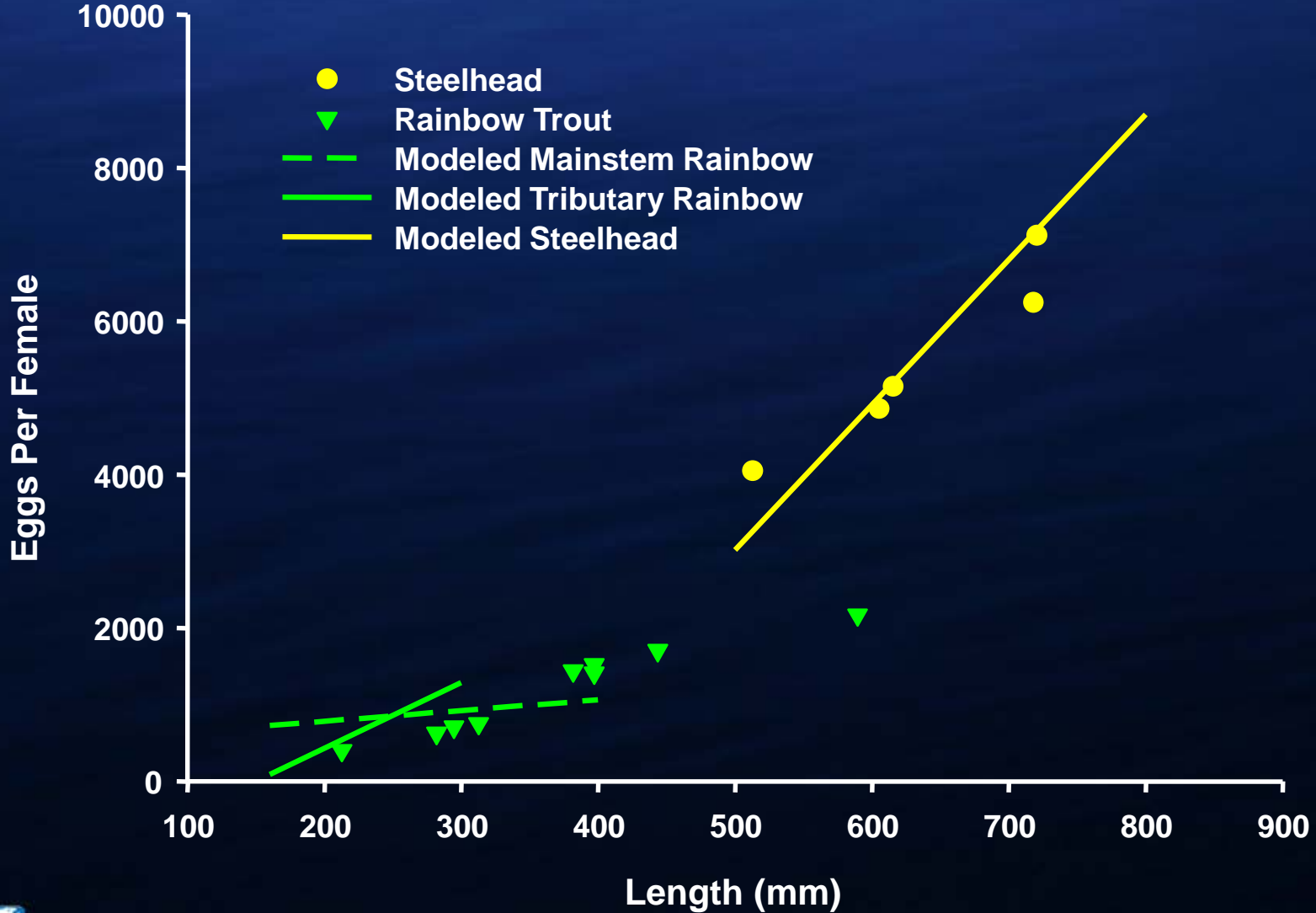
Data from Ward and Slaney (1989)



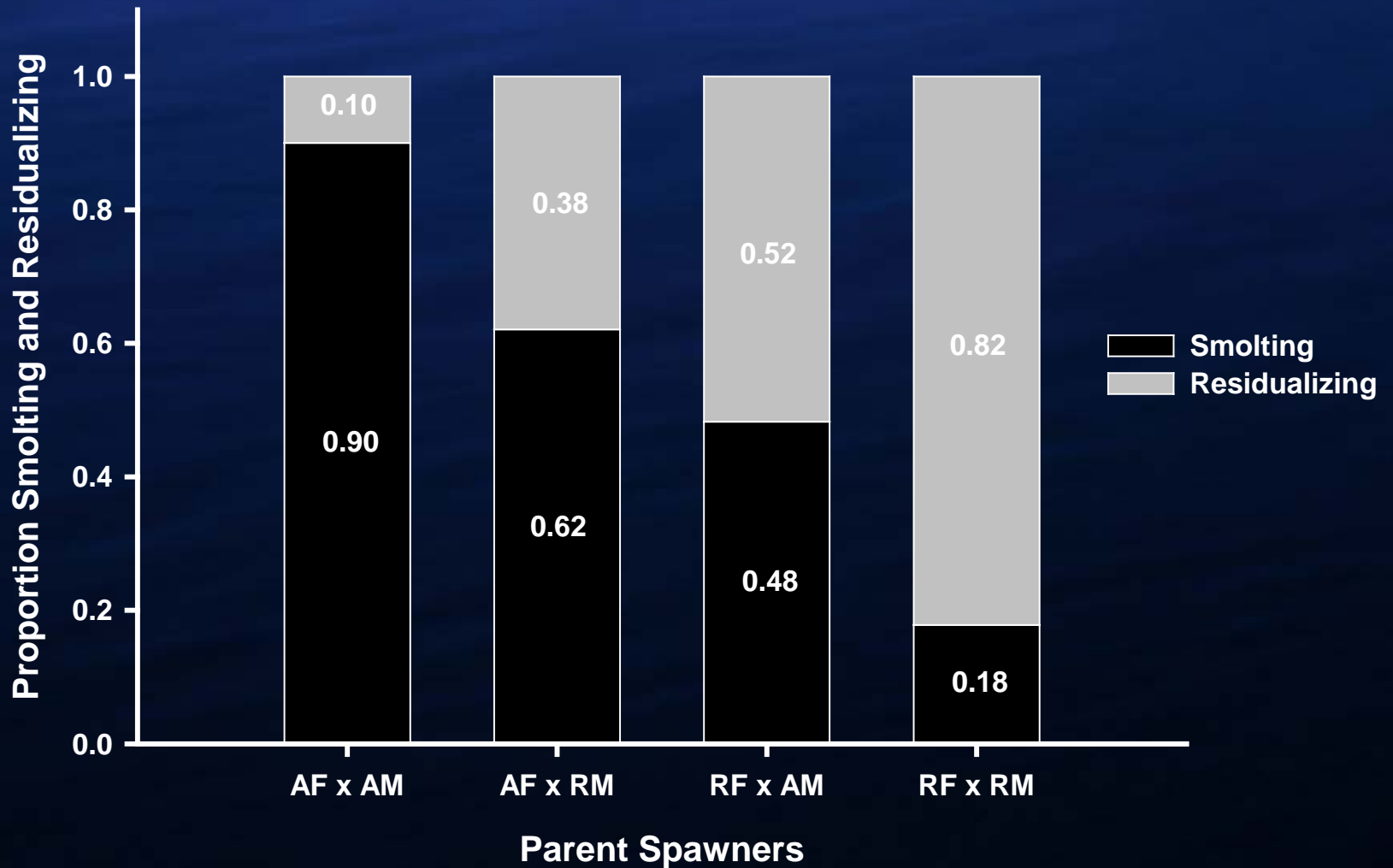
Age-Dependent Resident Maturation



Fecundity vs Body Size



Cross-Ecotype Production





Legend

- Dams
- Cities
- Population Boundaries
- Anadromous
- Resident



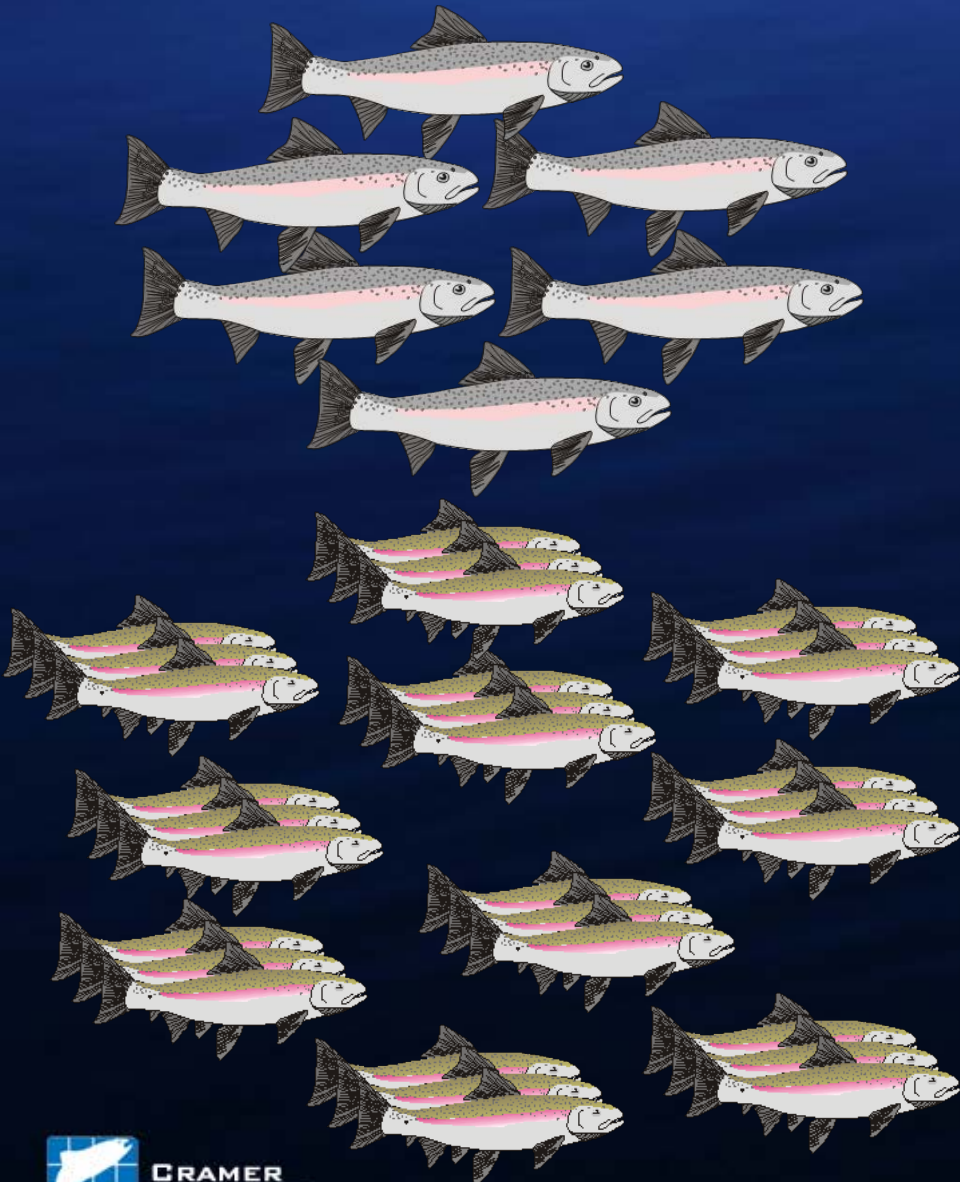
0 5 10 20 30 40 Kilometers

Conclusions

- Distribution of ecotypes appears to be a function of flow and temperature conditions, stream size and population location within the watershed.
- Increases in flow and decreases in stream temperature during summer create conditions that favor a resident life-history.
- Tributaries represent the best opportunity for increased production of anadromous *O. mykiss* in the Yakima Basin.



A



B

