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

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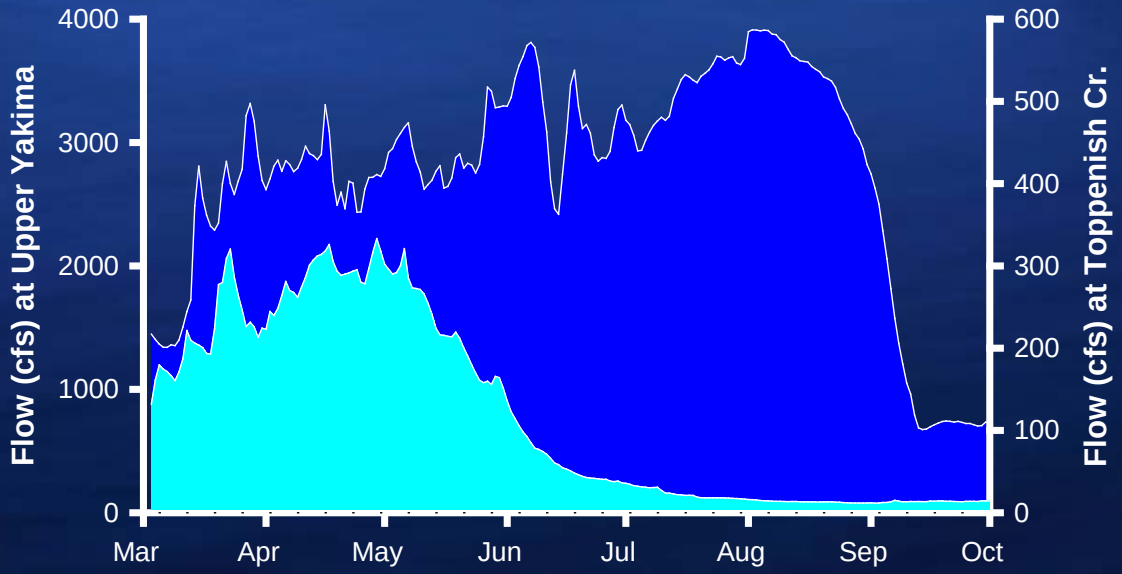
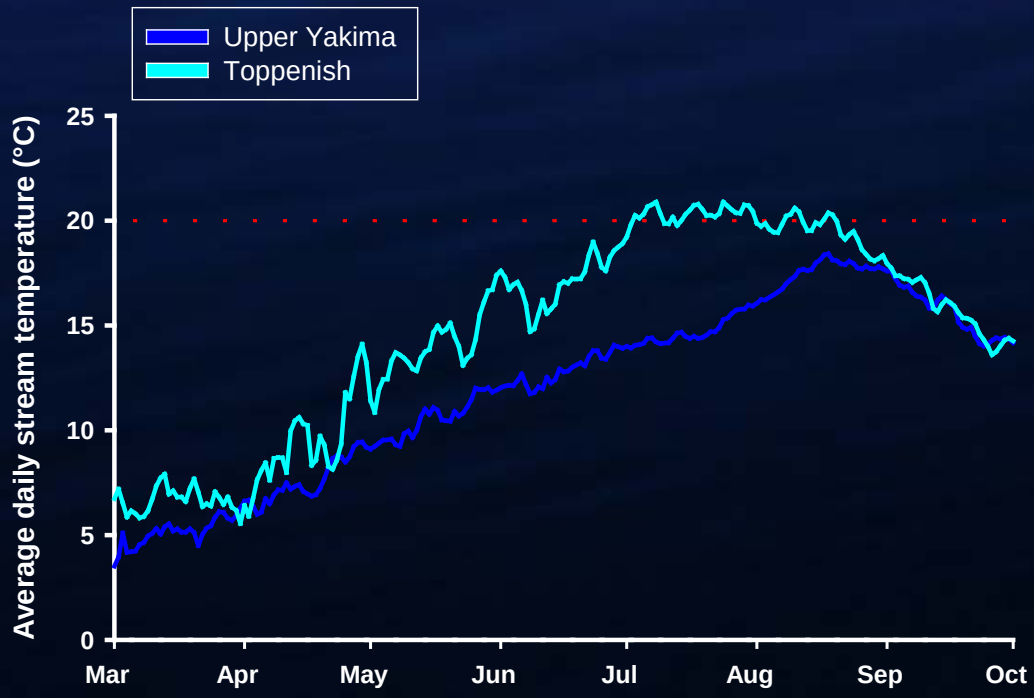
Project Objective

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


Flow (cfs) at Upper Yakima
4000
3000
2000
1000
0
Flow (cfs) at Toppenish Cr.
600
500
400
300
200
100
0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct


Upper Yakima
Toppenish
Average daily stream temperature (°C)
25
20
15
10
5
0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct

Yakima River
(near Cle Elum)

Taneum Creek
(tributary)

Key Model Components

Carrying Capacity

Survival

Juvenile Life-History Response

Fecundity

Growth (bioenergetics)

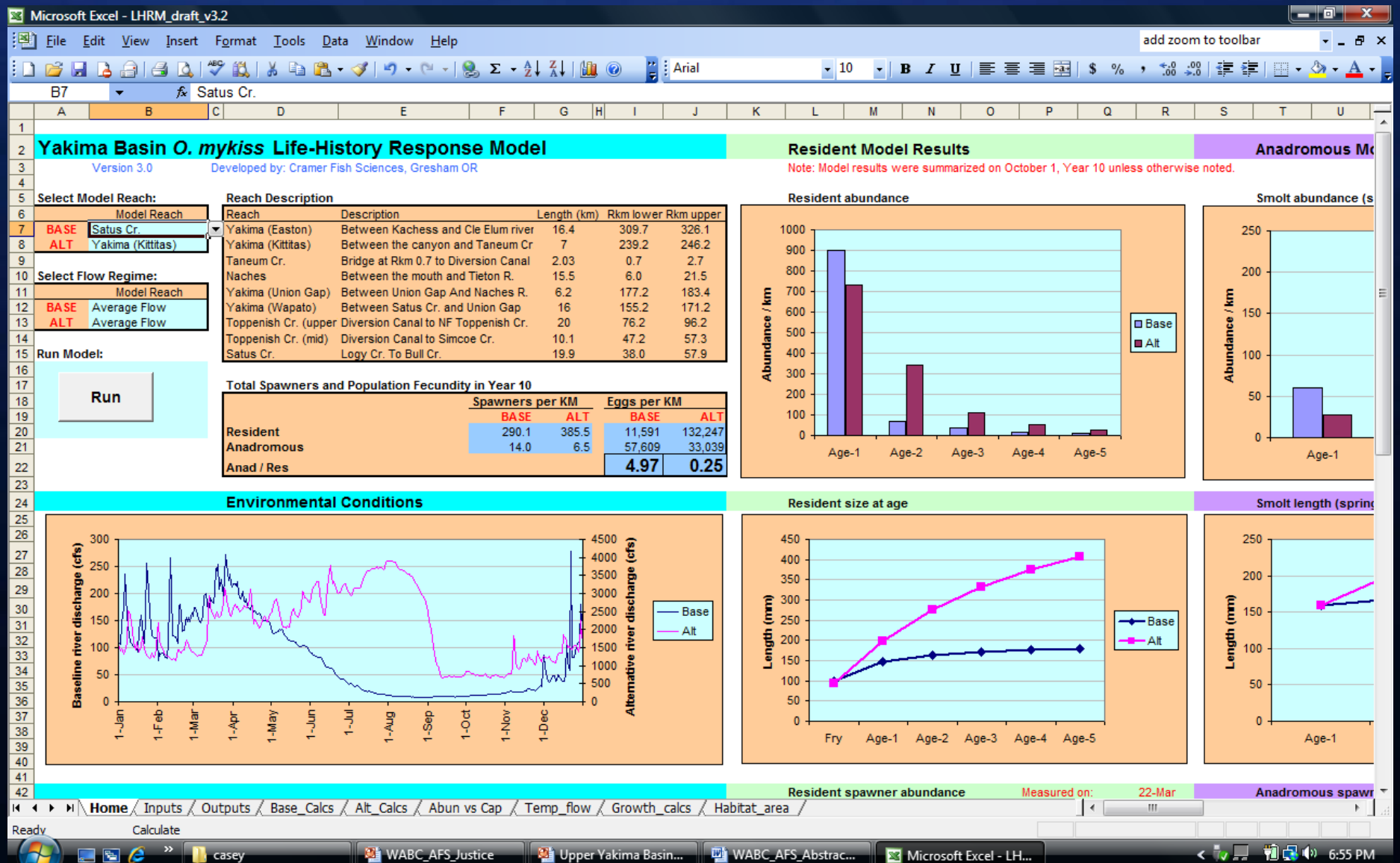
Genetics

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

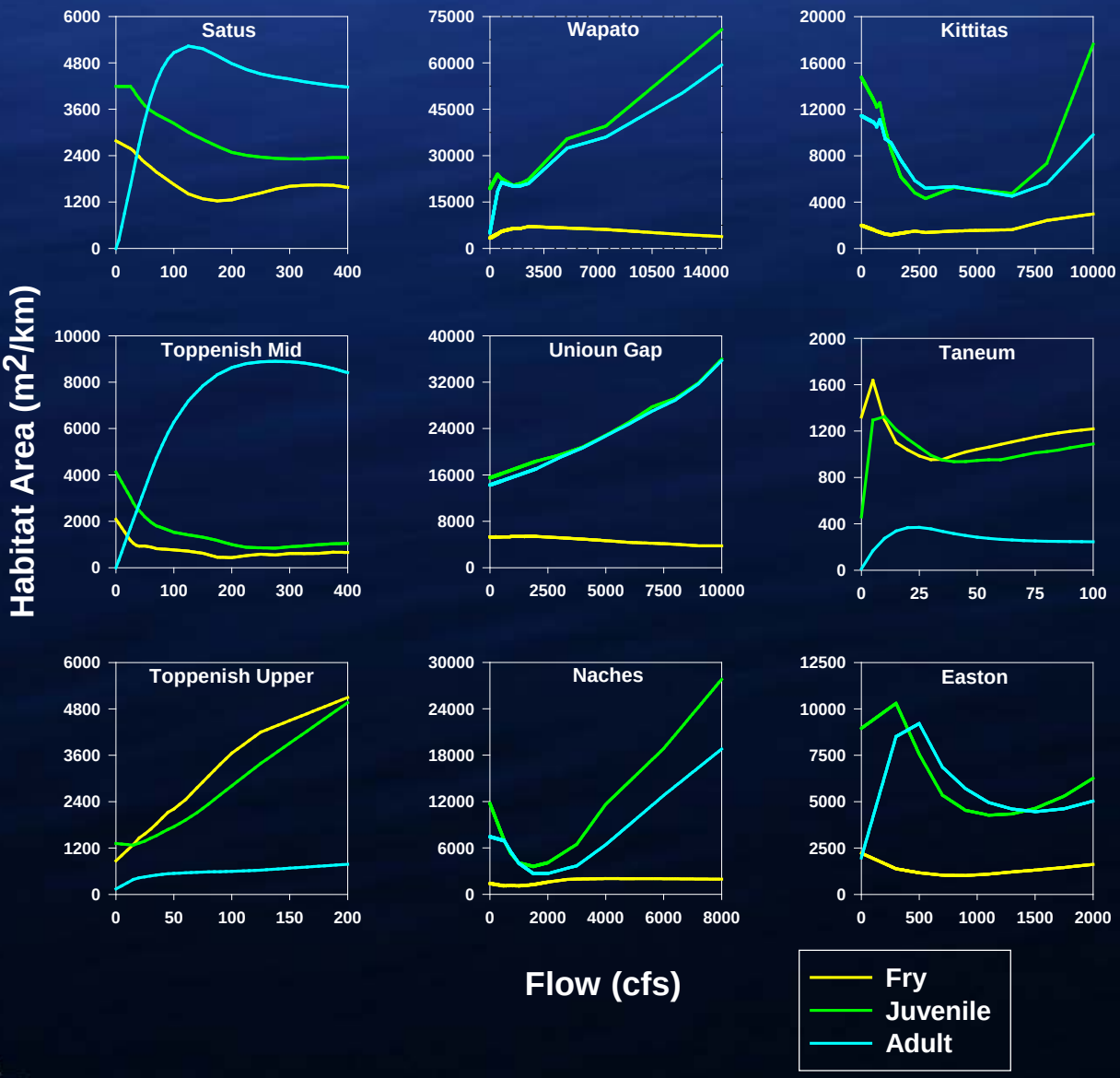
Model Framework (Excel Spreadsheet)

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

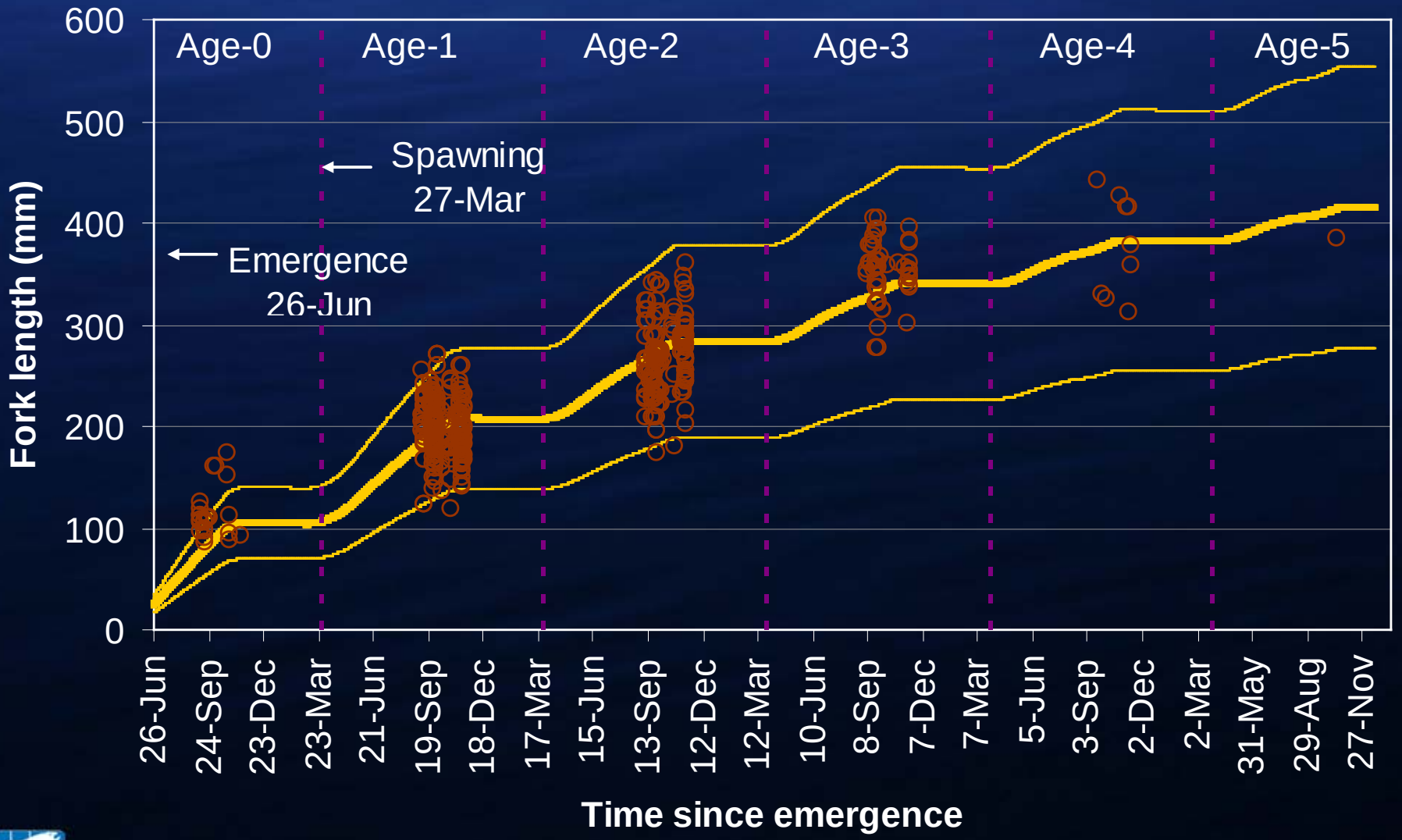



N
Legend
Dams
Cities
Population Boundaries
Spatial Structure
Keechelus
Kachess
Cle Elum
Easton
Taneum Creek
Upper Yakima
Yakima River
Taneum
Ellensburg
Kittitas
Naches R.
Bumping Lake
Naches
Roza
Tieton
Naches
Yakima
Union Gap
Wapato
Toppenish Creek
Mid Toppenish
Toppenish Cr.
Upper Toppenish
West Richland
Yakima River
Prosser
Satus Creek
Satus
Satus Creek
0 5 10 20 30 40
Kilometers

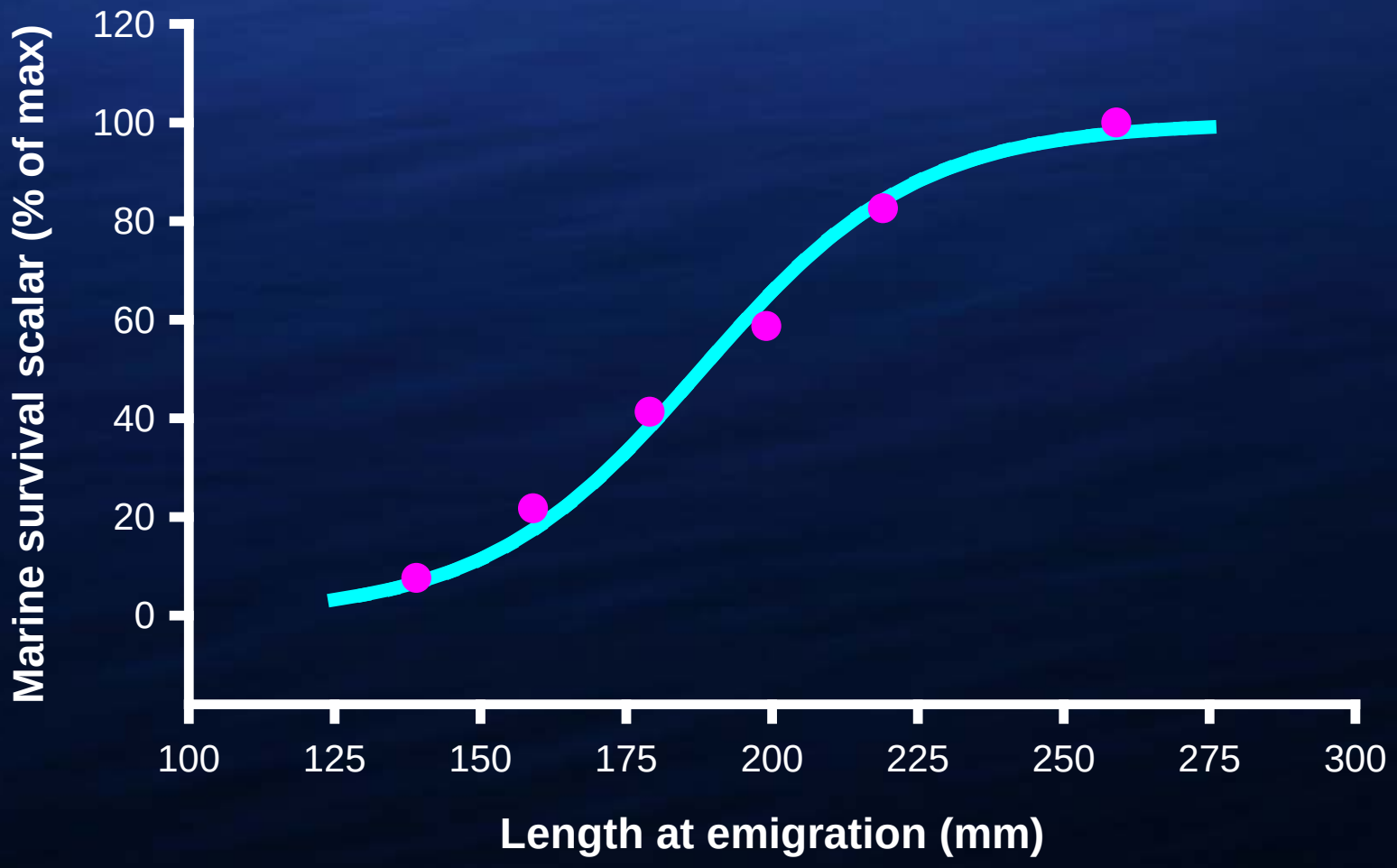
Modeling Effects of Flow on Carrying Capacity



Modeling Growth in Freshwater

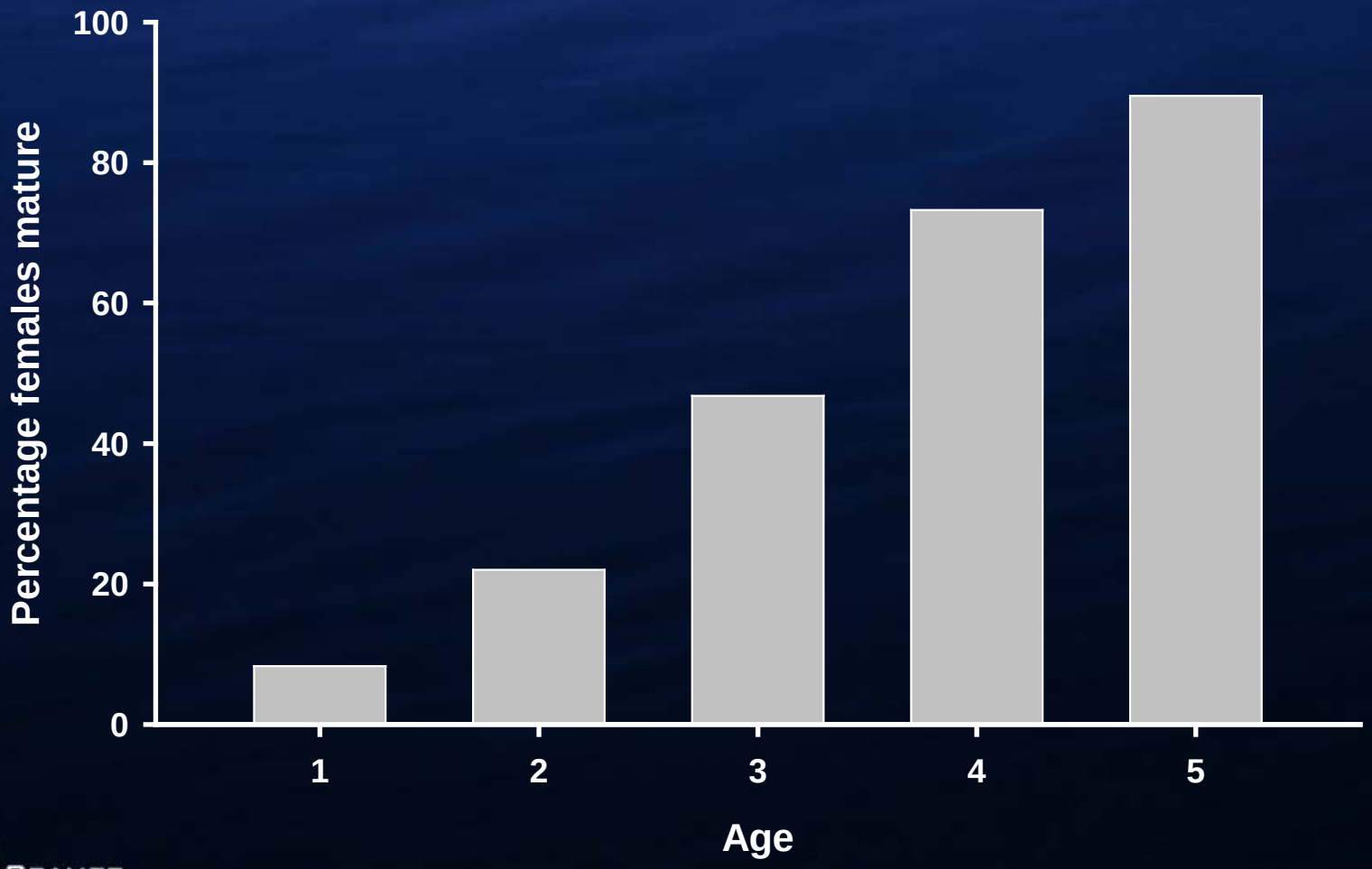


Smolt-to-Adult Return

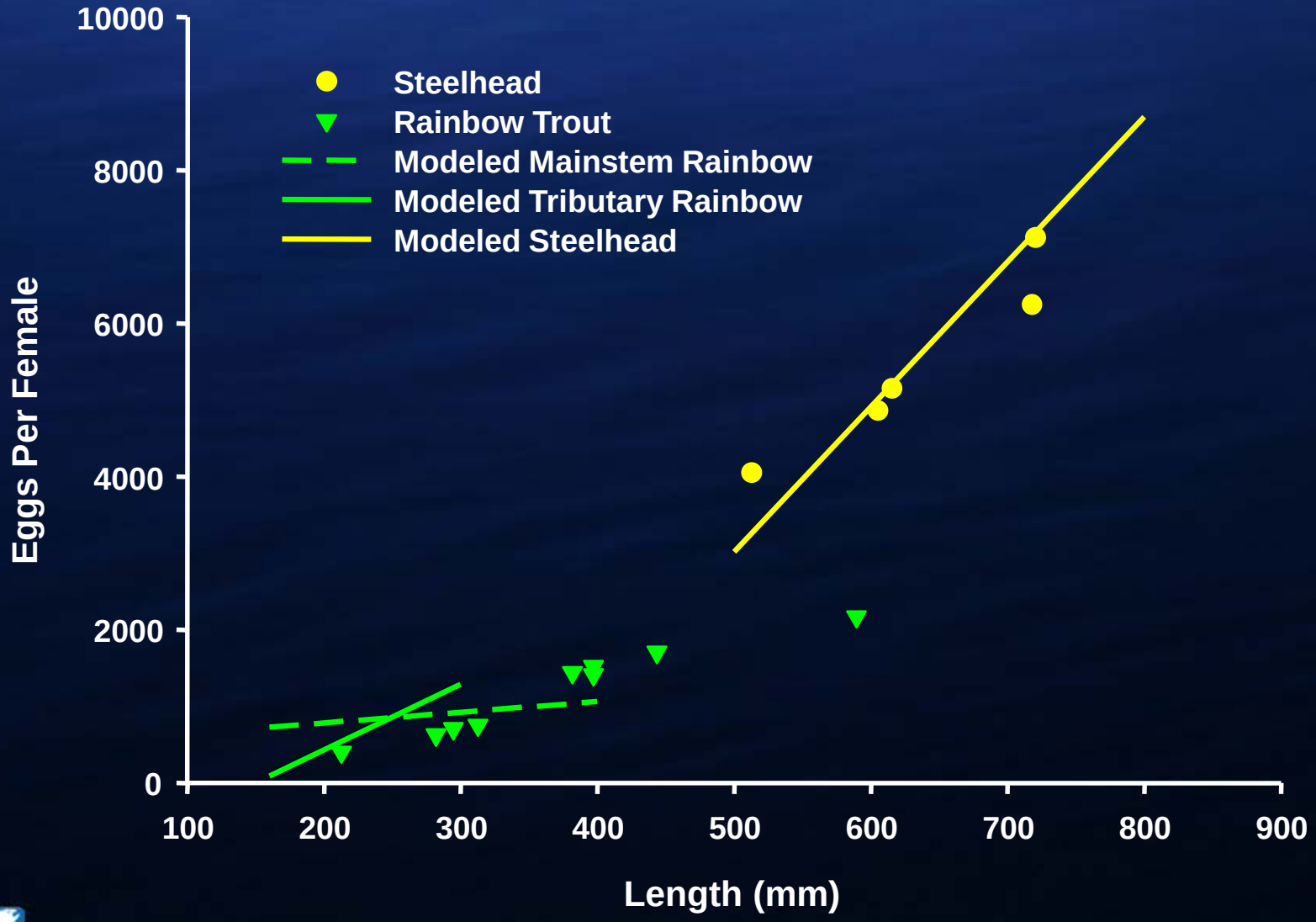


Data from Ward and Slaney (1989)

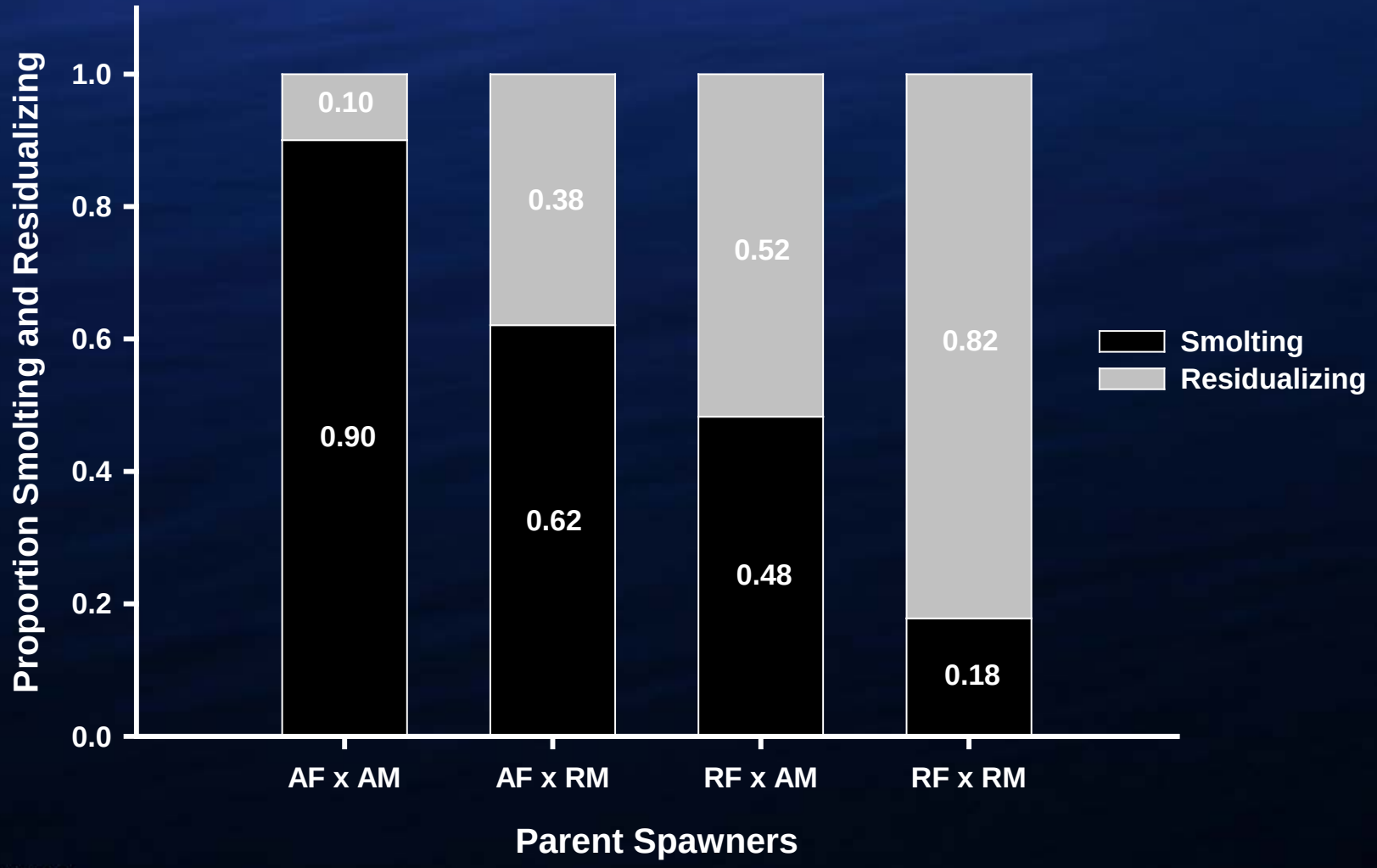
Age-Dependent Resident Maturation

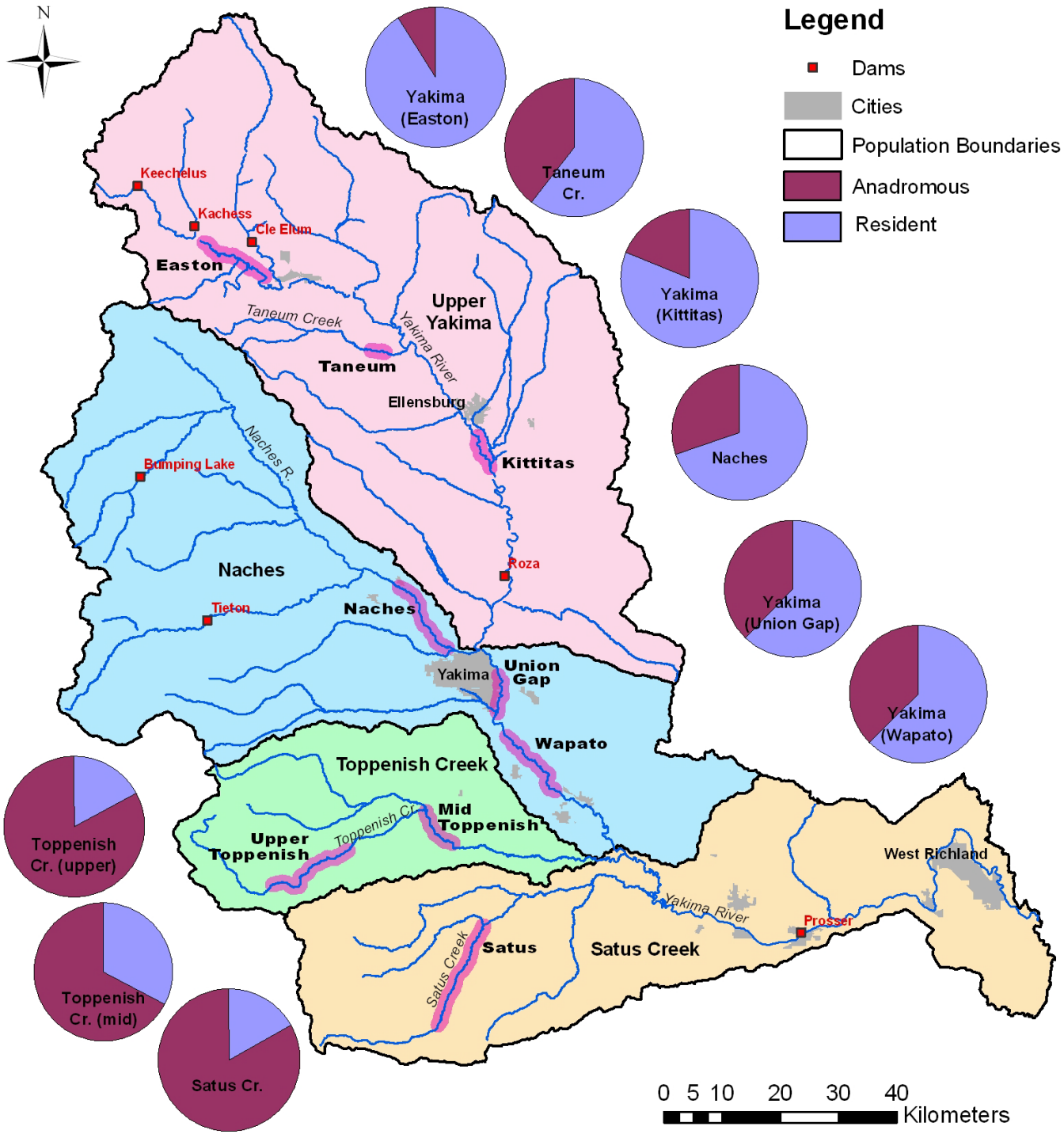


Fecundity vs Body Size



Cross-Ecotype Production




N
Legend
Dams
Cities
Population Boundaries
Anadromous
Resident
Yakima (Easton)
Taneum Cr.
Yakima (Kittitas)
Naches
Yakima (Union Gap)
Yakima (Wapato)
Toppenish Cr. (upper)
Toppenish Cr. (mid)
Satus Cr.
Keechelus
Kachess
Cle Elum
Easton
Taneum Creek
Yakima River
Upper Yakima
Taneum
Ellensburg
Kittitas
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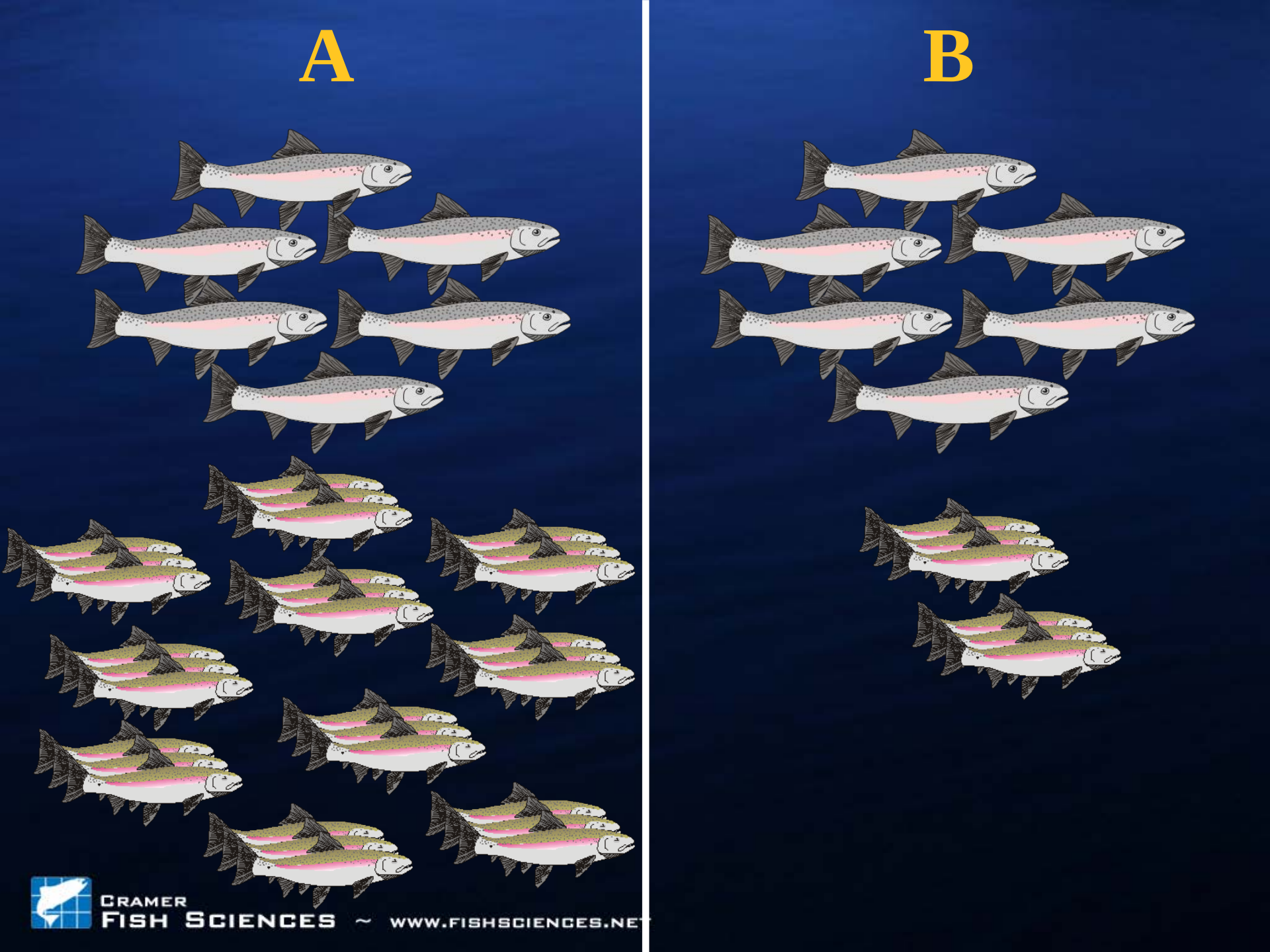
Prosser
Satus Creek
Satus
Satus Creek
0 5 10 20 30 40
Kilometers

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.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B
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