

*Genetic and Life-History Traits of Wild Origin
Yakima River Basin Spring Chinook*

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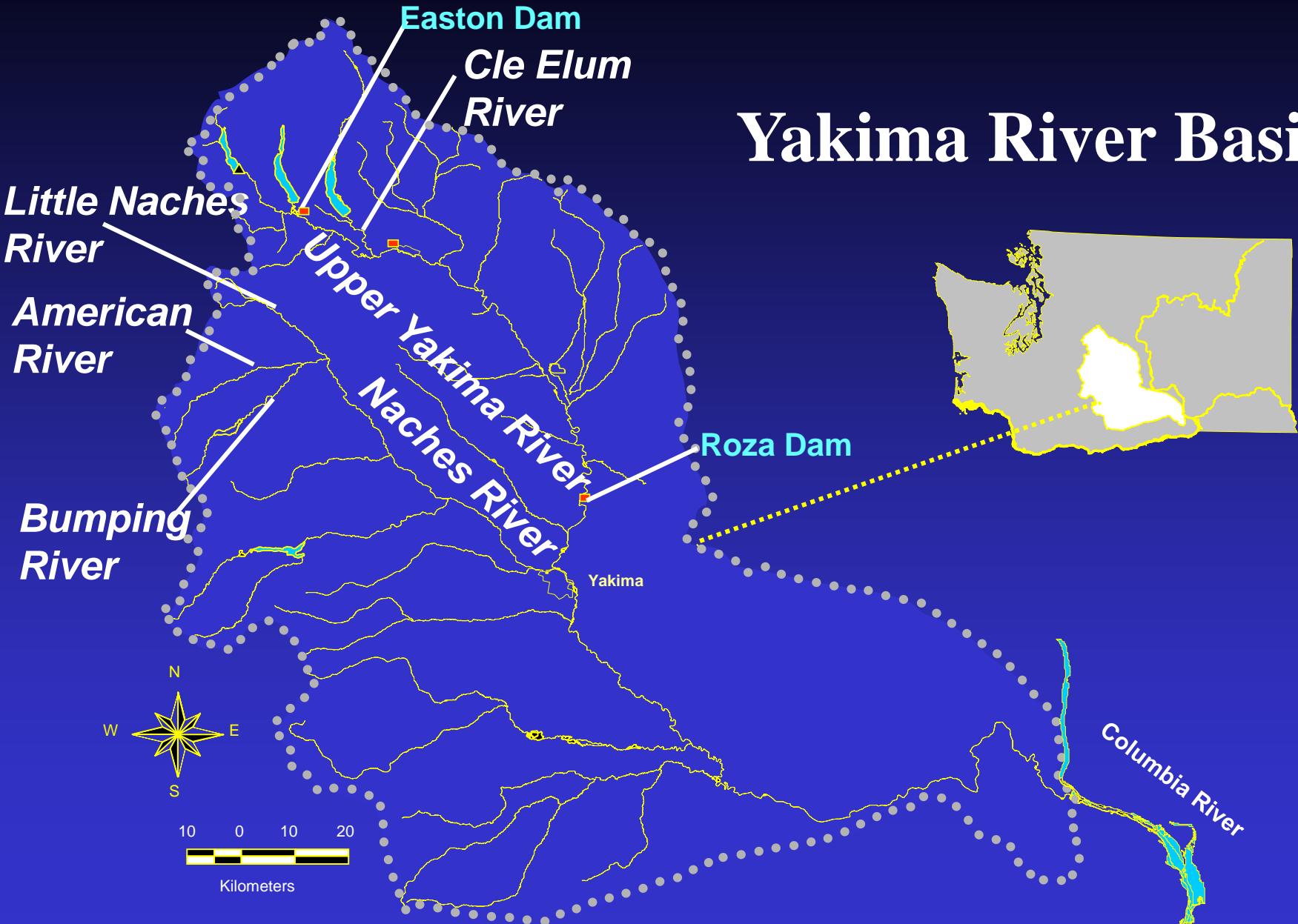
Acknowledgements

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- **WDFW allozyme and DNA sampling crews**
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Objectives:

- **Synthesize existing genetic data to determine putative populations of spring chinook within the Yakima River Basin (reproductive isolation)**
- **Compare the putative populations to other spring and fall chinook in the Yakima and Columbia River basins**
- **Compare the life-history traits of putative Yakima River spring chinook populations and identify where populations diverge**
- **Compare components of their environments and infer which are likely driving local adaptation and divergence**

Yakima River Basin



Little Naches River

American River

Bumping River

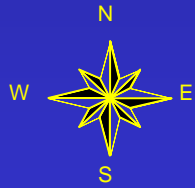
Easton Dam
Cle Elum River

Upper Yakima River
Naches River

Roza Dam

Yakima

Columbia River



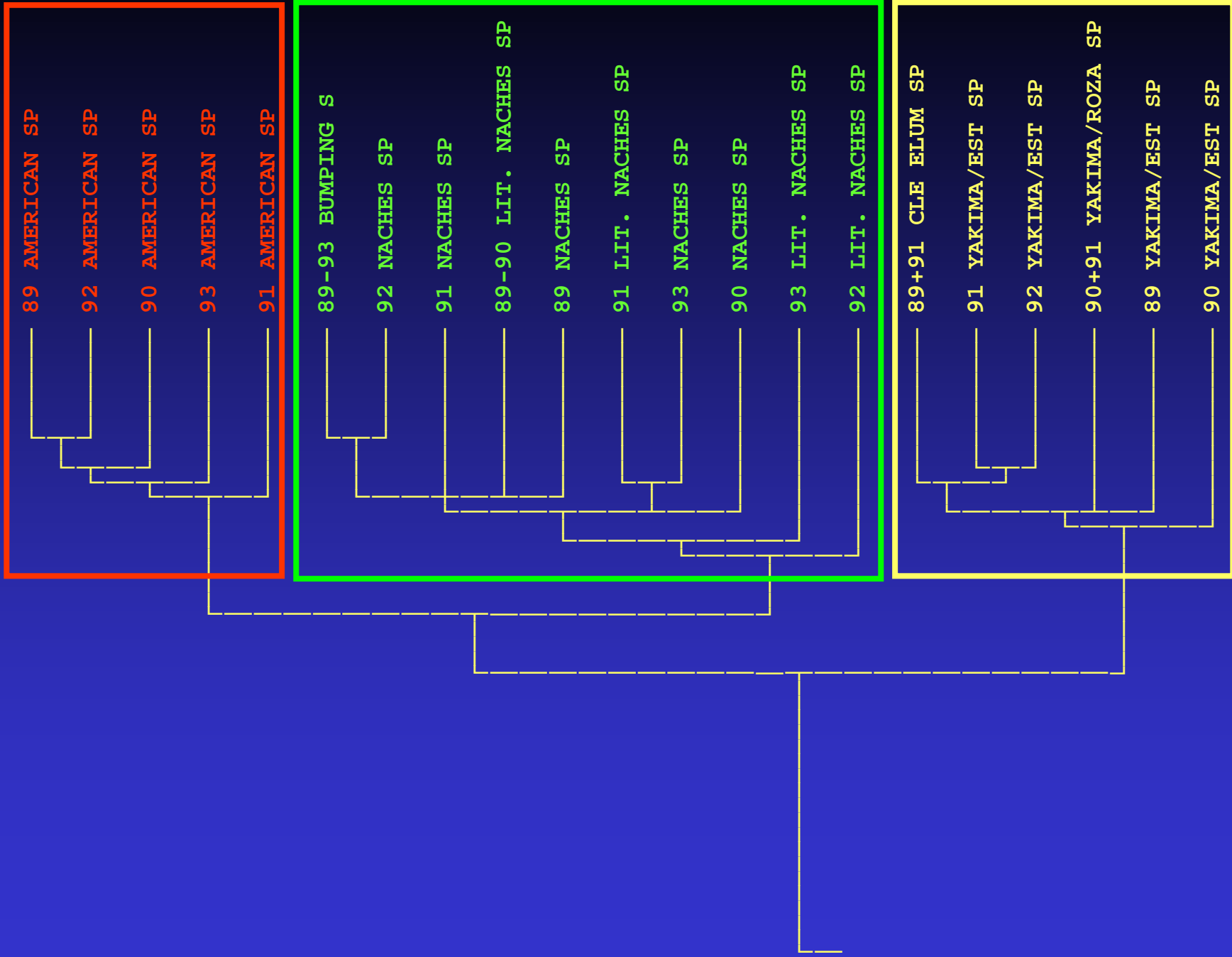
Kilometers

Yakima River Spring Chinook Spawning Areas Genetically Sampled - Allozymes

- **American River – 1989-1993**
- **Naches River - 1989-1993**
- **Little Naches - 1989-1993**
- **Bumping River - 1989-1993**
- **Cle Elum River – 1989, 1991**
- **Upper Yakima R (Easton) - 1989-1993**
- **Upper Yakima R (below Roza Dam) – 1990, 1991**

Yakima River Spring Chinook Spawning Areas Genetically Sampled - DNA

- **American River – 1989, 1991, 1993**
- **Naches River – 1989, 1993**
- **Little Naches - 1993**
- **Bumping River - 1989**
- **Cle Elum River – none**
- **Upper Yakima R (Easton) – 1992, 2003**
- **Upper Yakima R (below Roza Dam) – none**



Reproductively Isolated Populations Identified

- **American River**
- **Naches River and tributaries**
- **Upper Yakima River and tributaries**

Natural Populations

- **In order for local adaptation to occur populations must be isolated temporally and/or spatially, e.g. reproductively**
- **Local adaptation can be expressed in:**
 - **Size-at-age**
 - **Age composition**
 - **Sex ratios**
 - **Spawn timing (redd surveys)**

Comparisons of Yakima River Spring Chinook Populations 1988-2004

- Life-history Traits

- Age composition
- Size-at-age
- Sex ratio
- Spawn timing (redds surveys)

Comparisons of Little Naches and upper Yakima River 2004

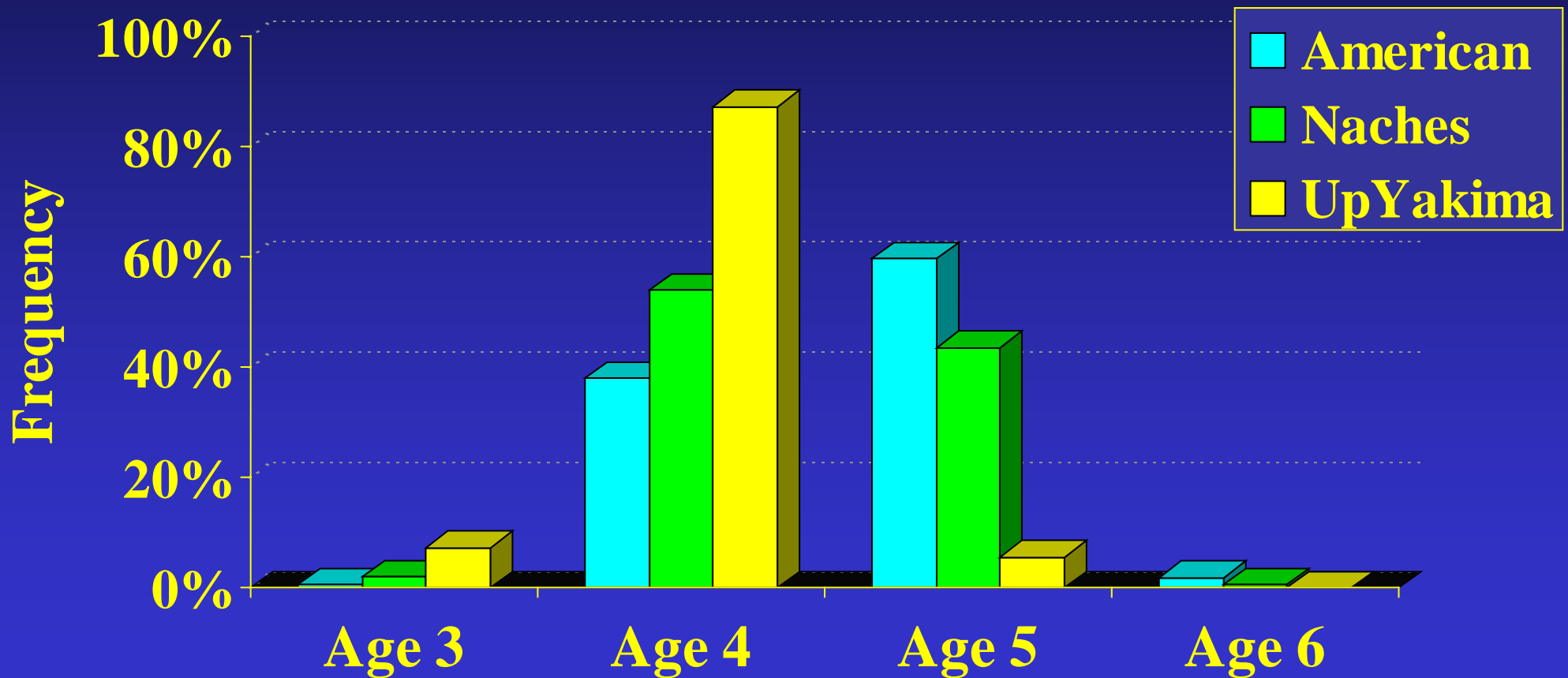
- Gametes
 - Egg size
 - Fry size



Age Composition

Mean Age Composition: 1988-2004

(YN Carcass recoveries)





Sex Ratios

Sex Ratio by Population

- **Estimated from carcass recoveries (recovery bias assumed equal across populations)**
- **Differences can reflect male life history strategies**
 - **Jacks (age-3)**
 - **Non-anadromous precocious males (age-1 and age-2)**
- **Sex specific mortality, i.e. selective fishery**

Sex Ratios of Adult Returns: 1988-2004

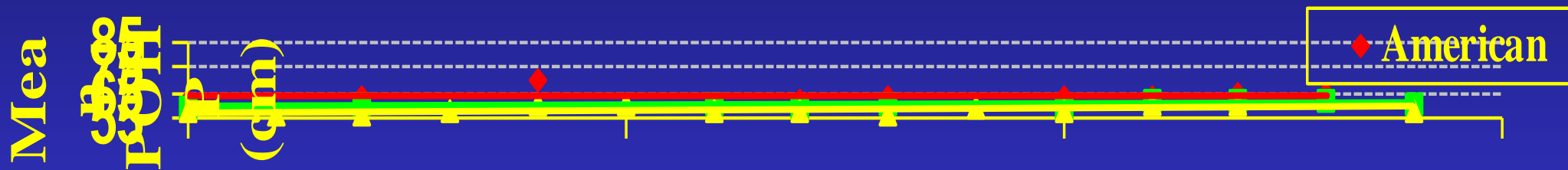
(YN Carcass recoveries)



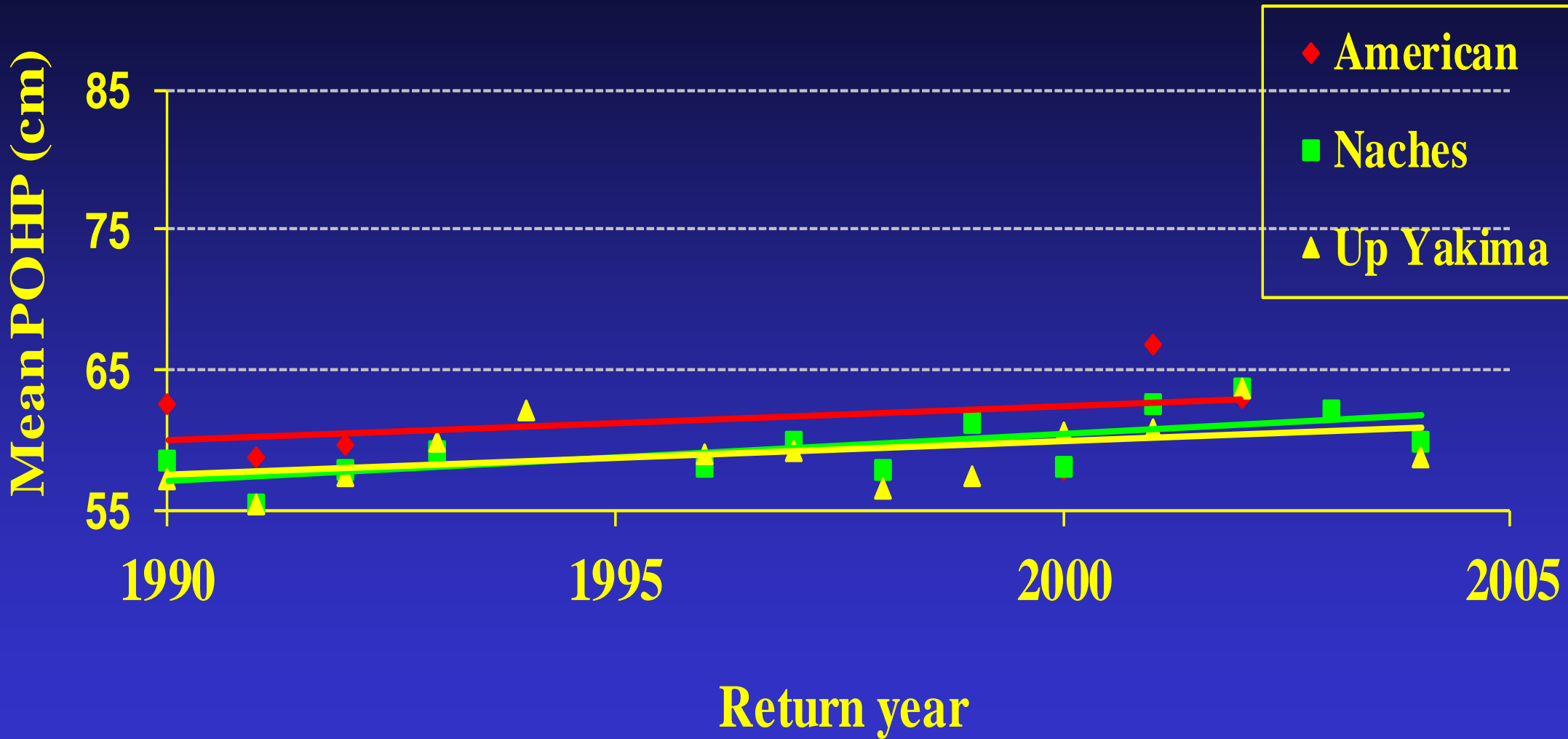


Size-at-Age

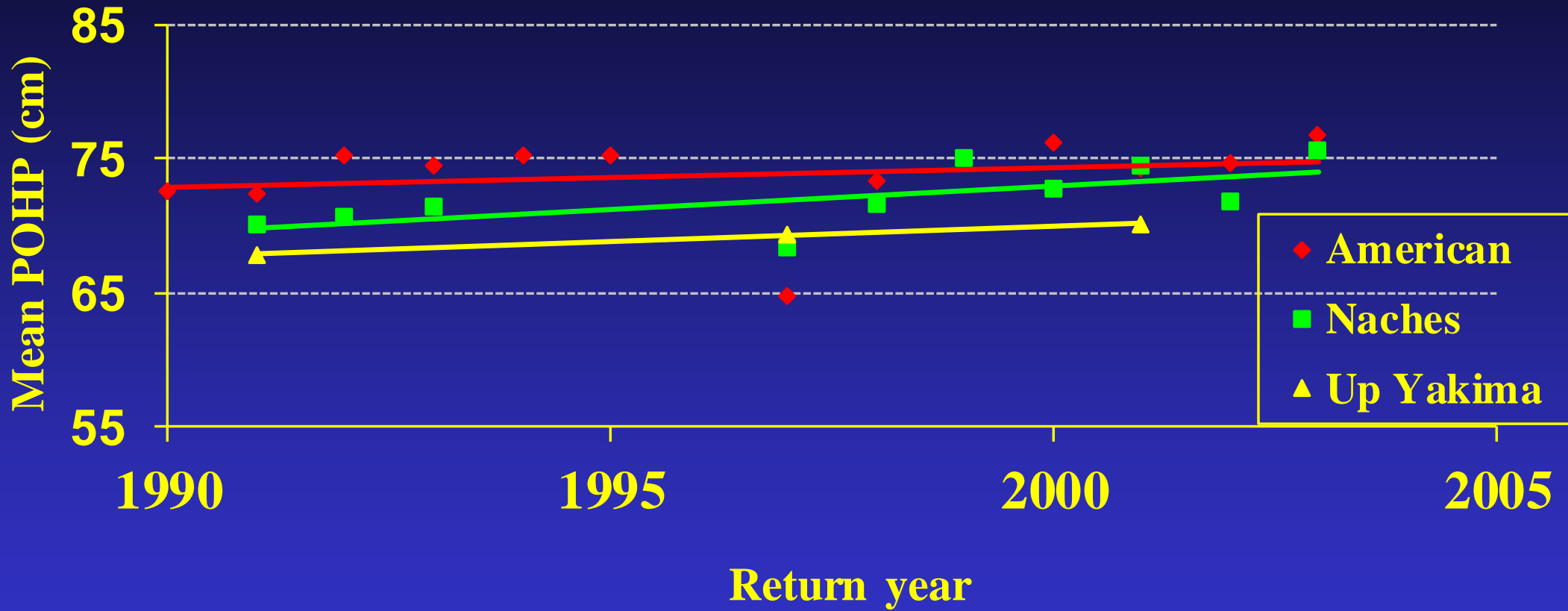
Age 4 Females



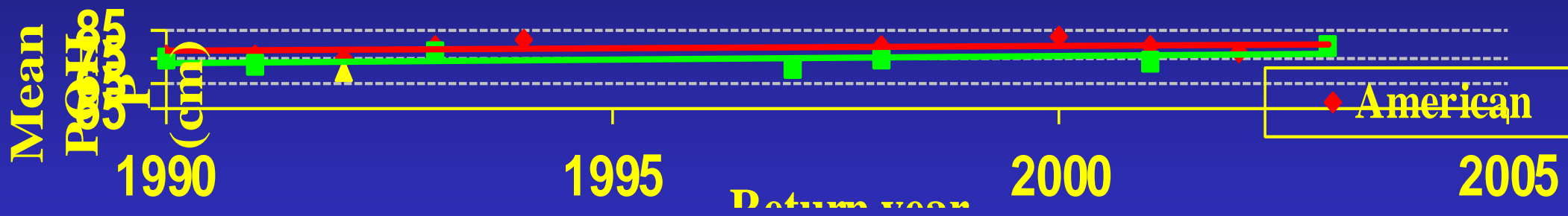
Age 4 Males



Age 5 Females



Age 5 Males

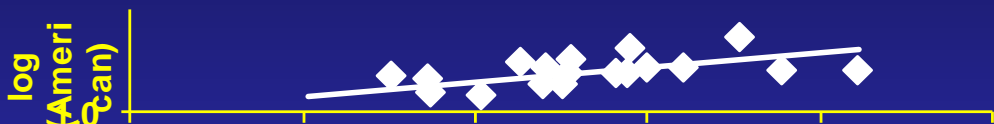




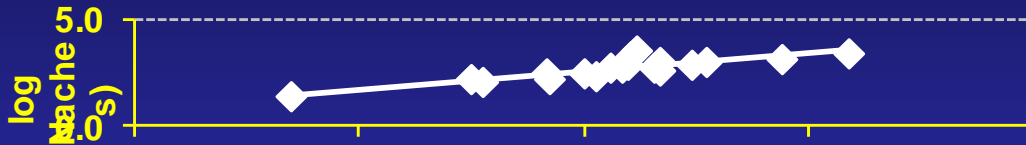
Run Size Correlations of Age 4 Returns

Log Transformed Age 4 Returns

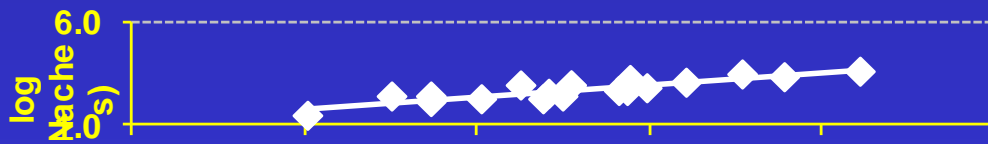
$r^2 = 0.418$



$r^2 = 0.730$

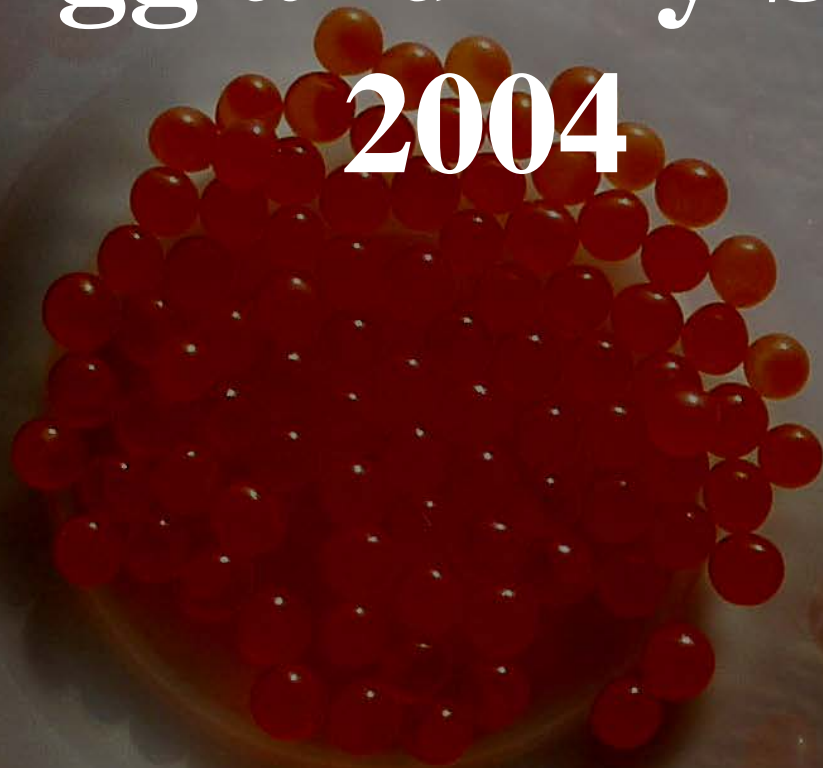


$r^2 = 0.804$

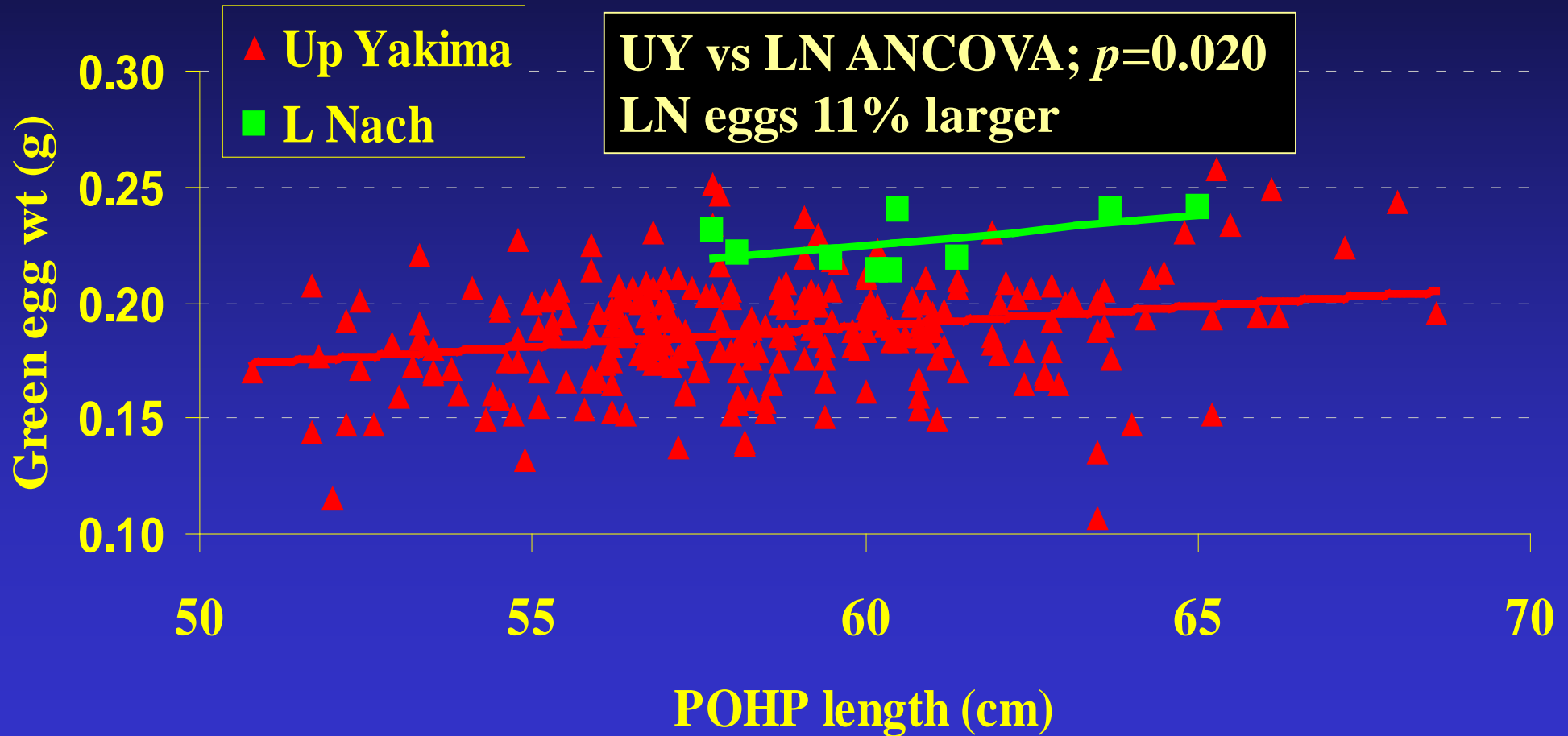


Egg and Fry Size

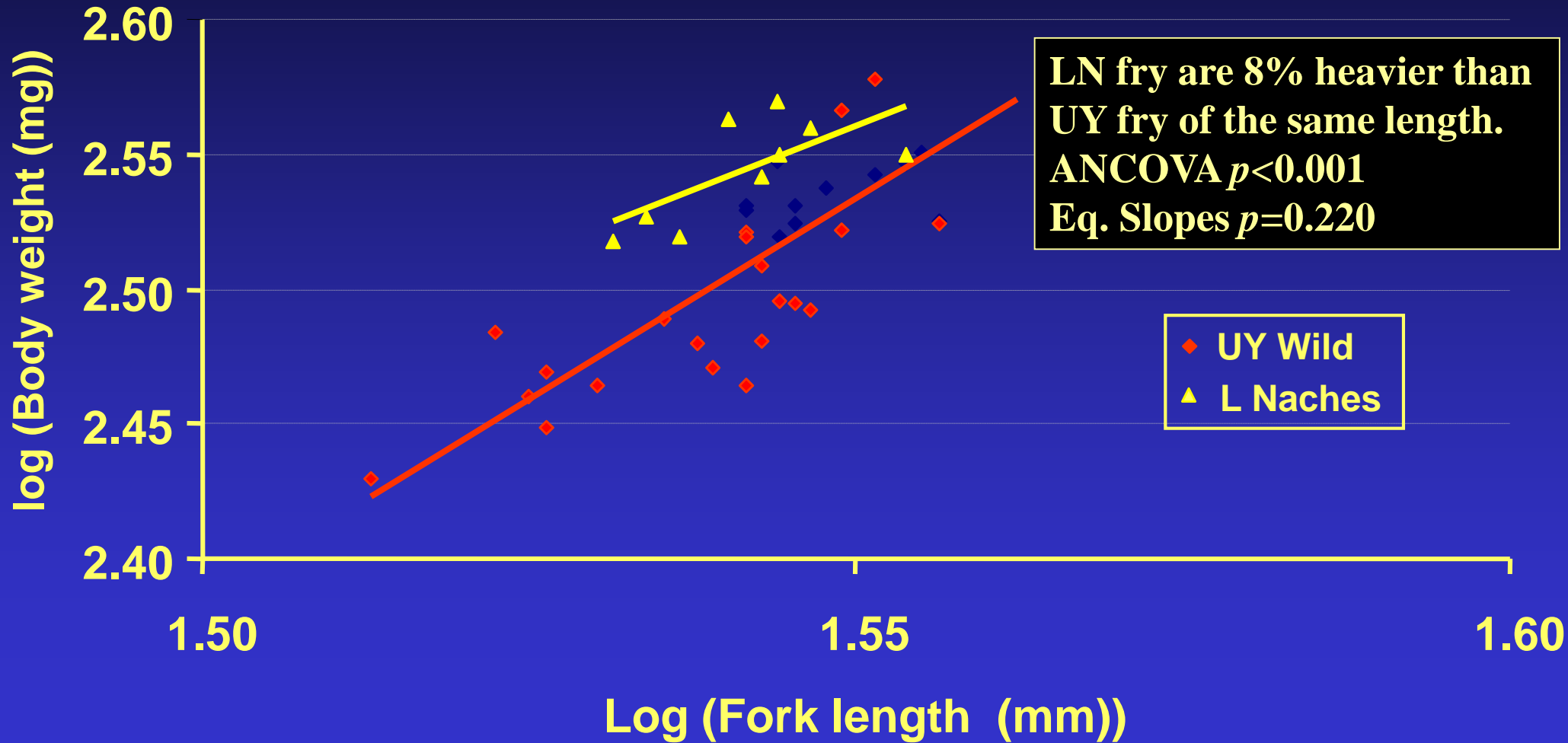
2004



Little Naches vs Up Yakima Egg weights vs Female Length



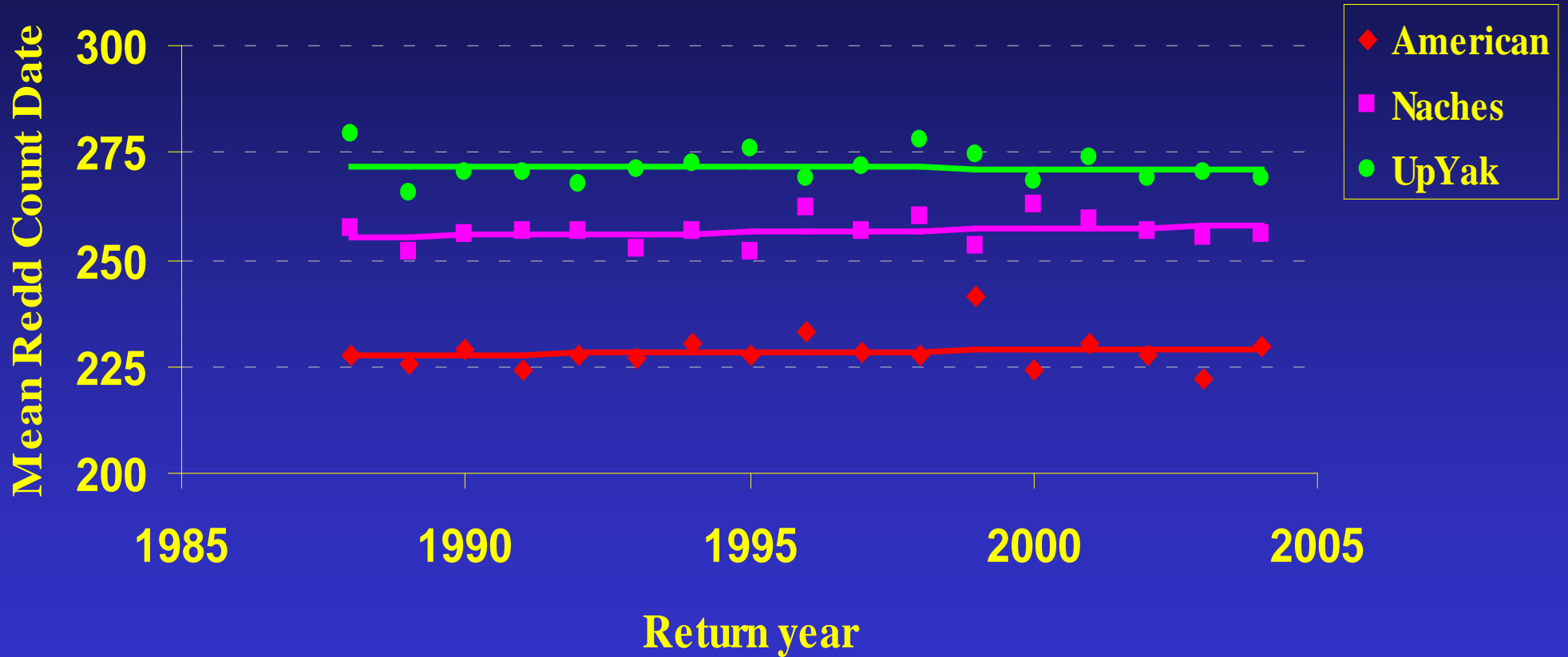
Little Naches and Up Yakima Emergent Fry Length vs Fry Weight





Spawn Timing

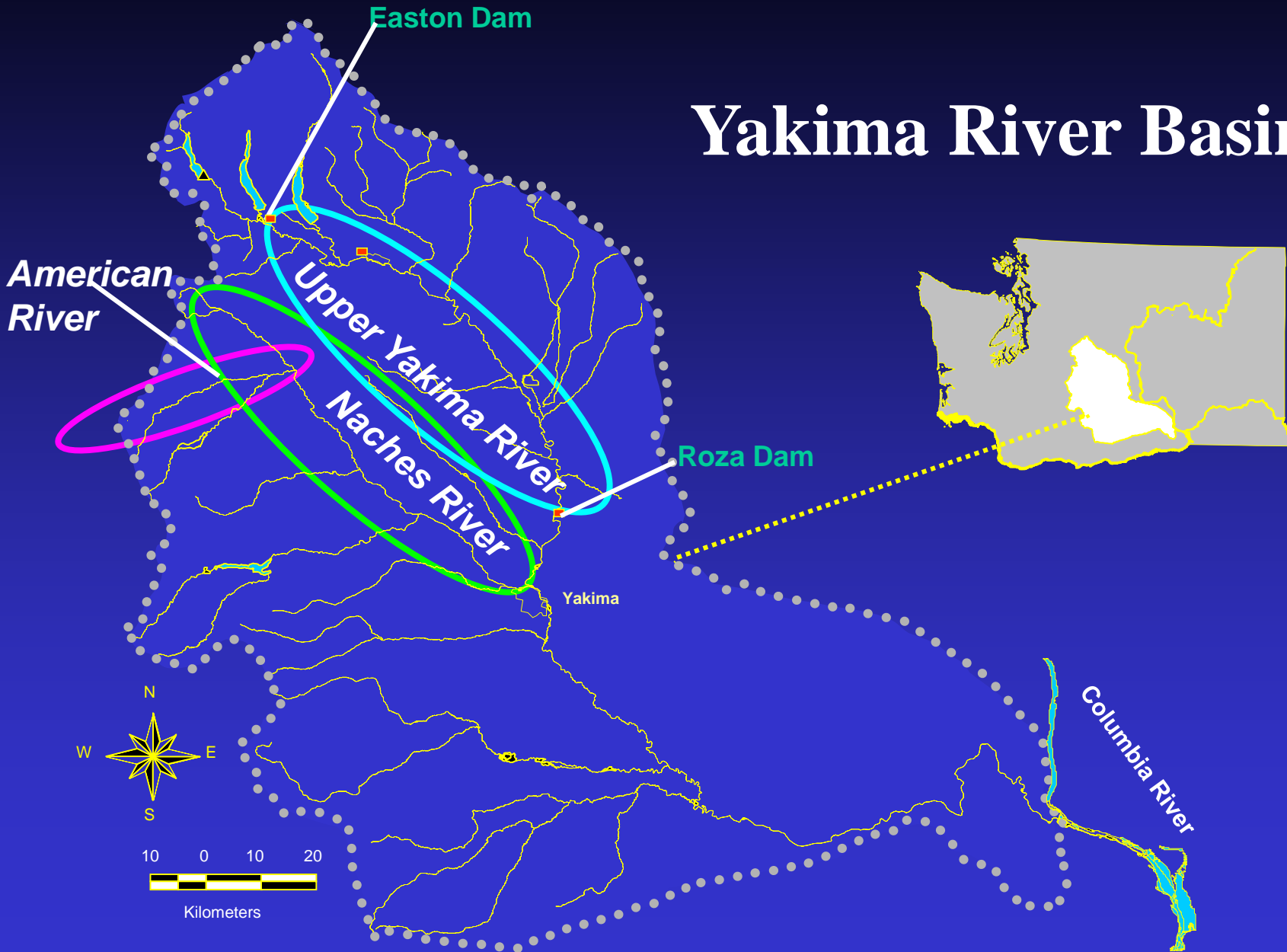
Mean Redd Count Date 1988-2004

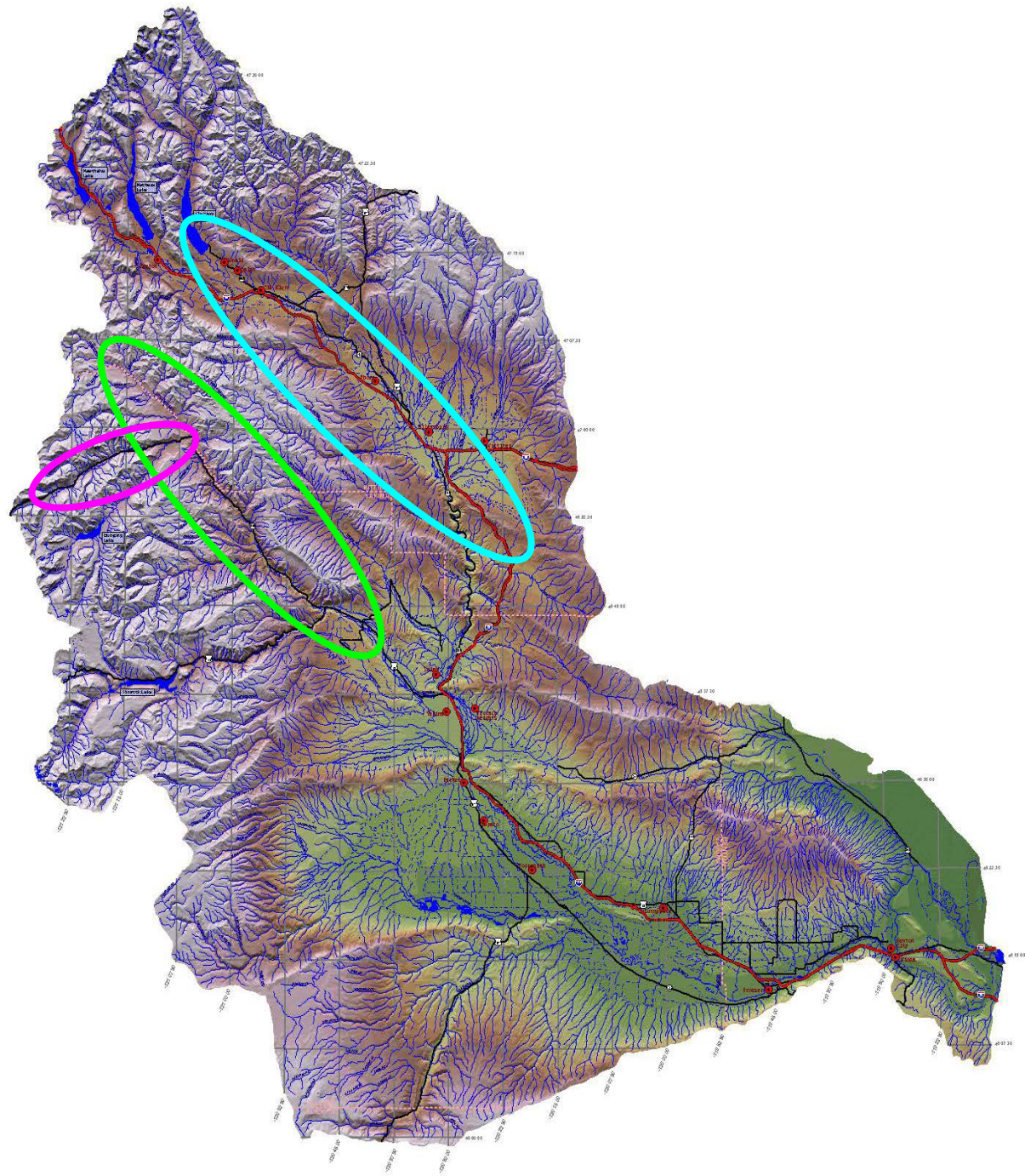


Selection Pressures

- **Adult migration difficulty** – slope/gradient and distance
- **Water temperature** - during adult holding, spawning, egg incubation and juvenile rearing
 - **Water source** – snow melt, storage reservoir
 - **Solar input** – river compass orientation and shading (tree canopy and mountains)
- **Flows** - Gravel scouring during incubation and juvenile rearing

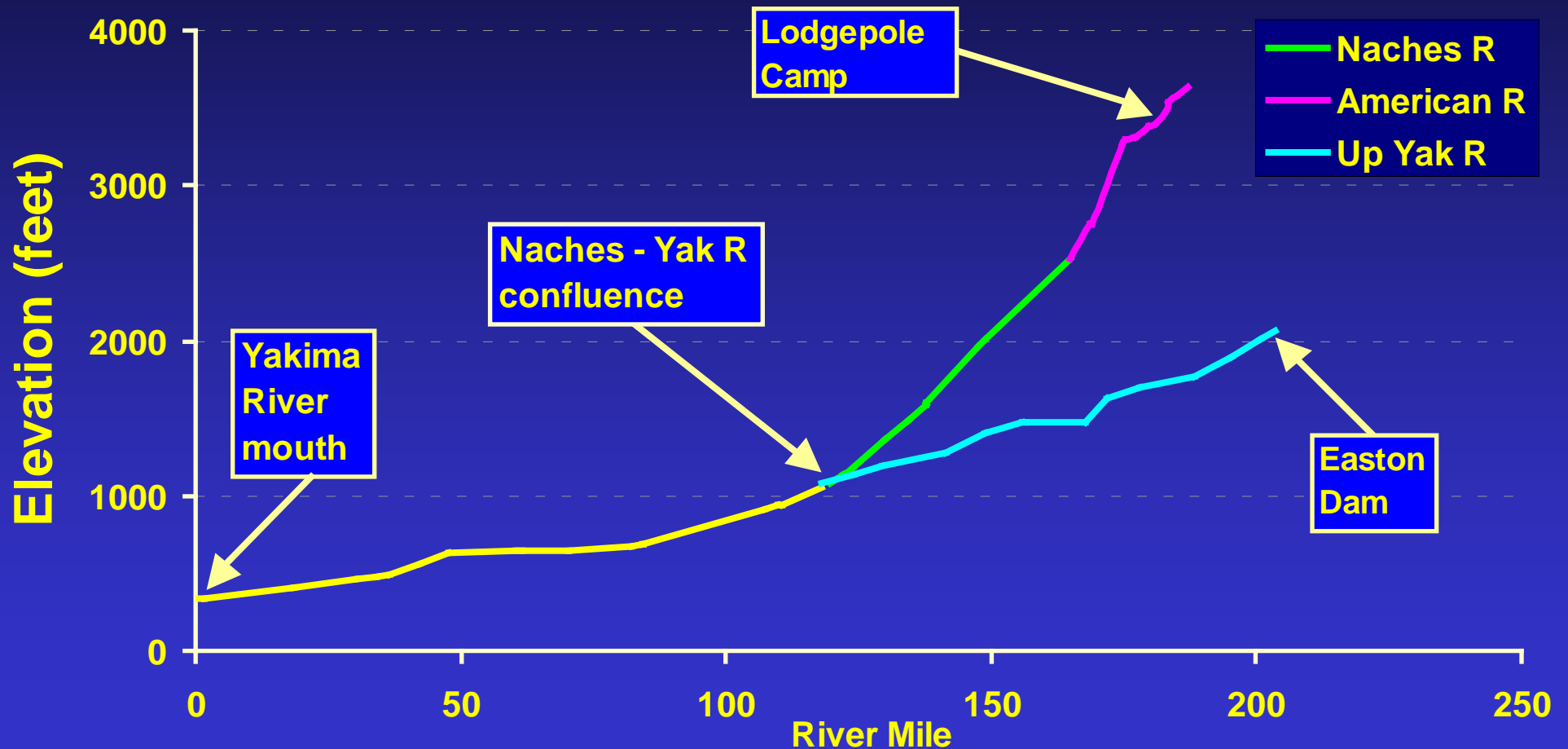
Yakima River Basin



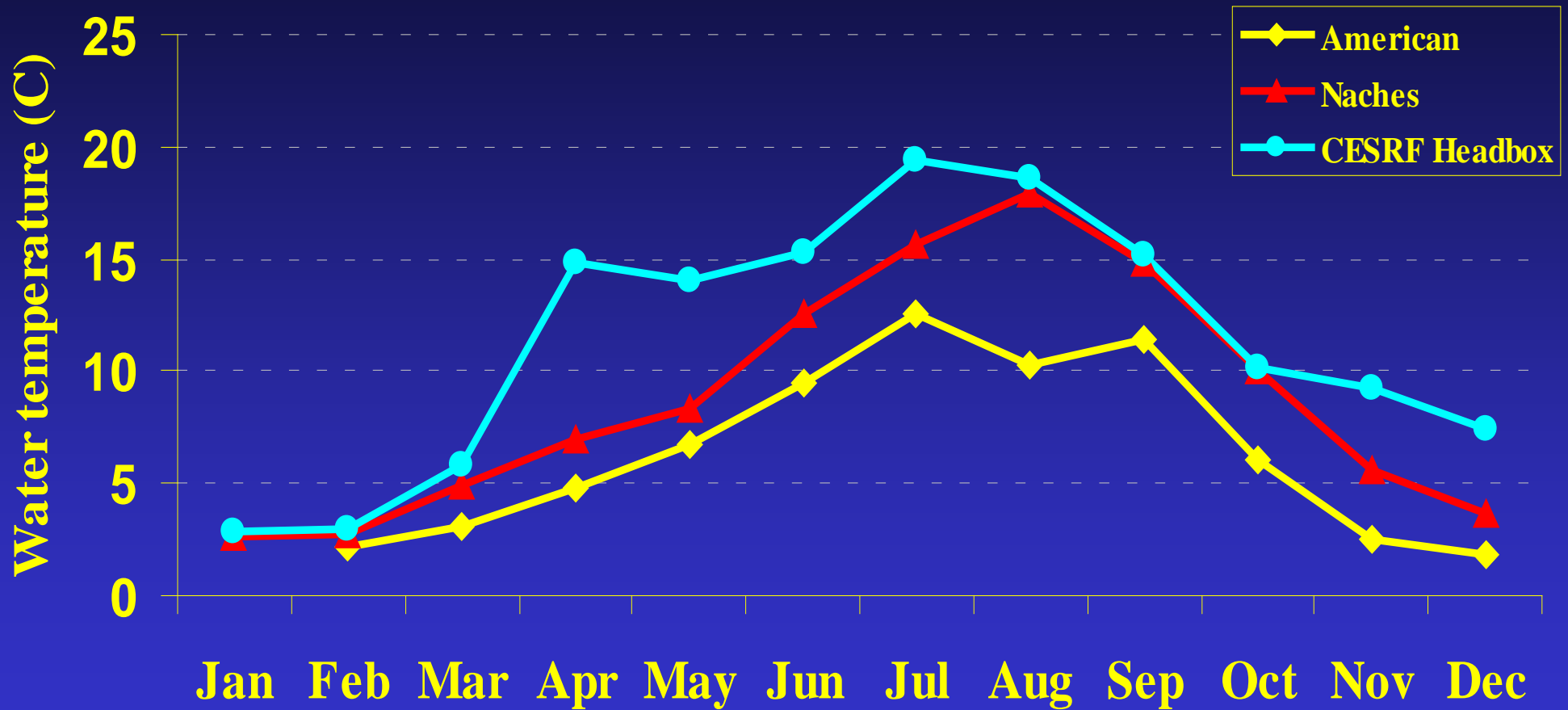


Yakima River Basin

Elevation and Distance



Mean Monthly Water Temperatures



Conclusions: Wild Population Genetic and Life-History Traits

- **Confirmed that the three populations, American, Naches and UY, are reproductively isolated.**
- **Size-at-age of American returns was largest, UY smallest, and Naches intermediate.**
- **No trend in size over time in 9 of 11 comparisons.**

Conclusions: Wild Population Genetic and Life-History Traits – cont'd

- UY sex ratios were more highly skewed toward females than either American or Naches.**
- Spawn timing of American fish was earliest, UY latest, and NR intermediate in all years**
- No trend over time in spawn timing.**
- Average age was greatest in the American, lowest in the UY and intermediate in the Naches.**

Conclusions: Upper Yakima vs Little Naches Gametic Traits

- **Little Naches females had significantly larger eggs than UY females, even after correcting for body size differences.**
- **LN emergent fry were significantly heavier than UY fry of the same length (more yolk at emergence).**
- **LN females would be less fecund than UY females of the same size, if the populations have equivalent reproductive effort.**

