Size at Release of Imnaha River Smolts: Does Size Matter?

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Imnaha River Spring Chinook LSRCP Program Objectives

1. Prevent extinction of Imnaha River salmon populations
2. Maintain genetic and life-history characteristics of natural Chinook salmon population
3. Meet LSRCP mitigation goal of 3,210 hatchery adults in the Imnaha Basin
4. Re-establish historic tribal and recreational fisheries.
5. **Operate hatchery program so that the genetic and life history characteristics of hatchery fish mimic those of wild fish, while achieving mitigation goals.**
6. Minimize impacts of hatchery programs on resident stocks of game fish.
7. Provide a future basis to reverse the decline in abundance of endemic Chinook salmon populations in the Imnaha and Grande Ronde River basin

Program + Research & Monitoring Objectives

Program Objective

Hatchery salmon mimic natural salmon

Research and Monitoring

1. **Compare life history characteristics of hatchery and natural origin salmon**
   - Juvenile/adult migration survival and run timing
   - age and size of maturity

2. **Identify optimum rearing and release strategies that will produce maximum survival to adulthood for hatchery-produced Chinook salmon smolts**
   - Smolt-to-adult survival (SAS) and return (SAR) rates
   - Number of adults produced per 10 kilograms, or lb, of smolts released

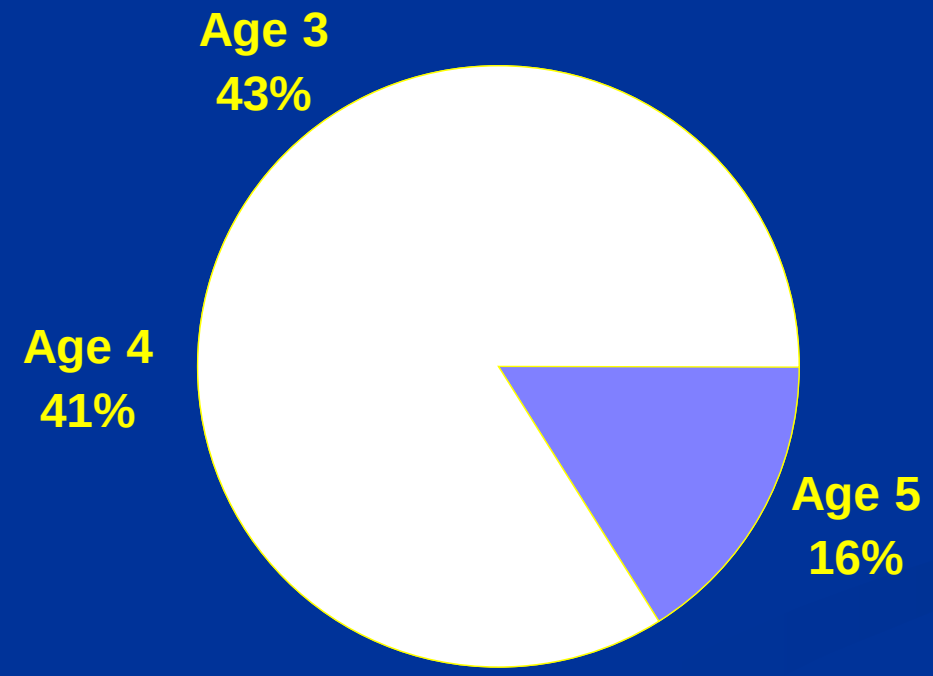
The Problem
Age structure differences

1982-1987 Imnaha River Brood Year returns

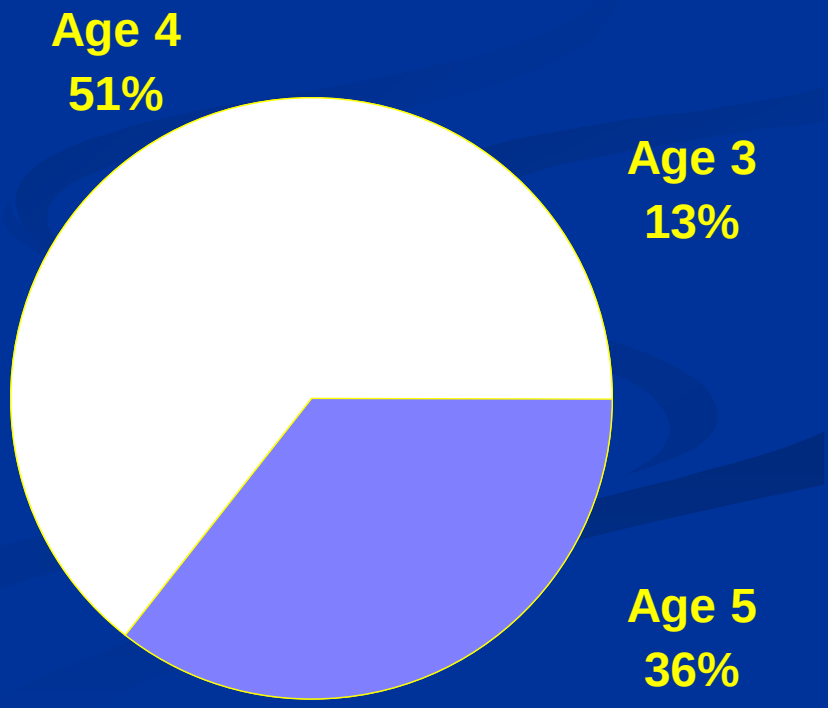
- **Age 3: H > N**
- **Age 4: H < N**
- **Age 5: H < N**

Hatchery rearing practices (e.g. size at release) to blame?

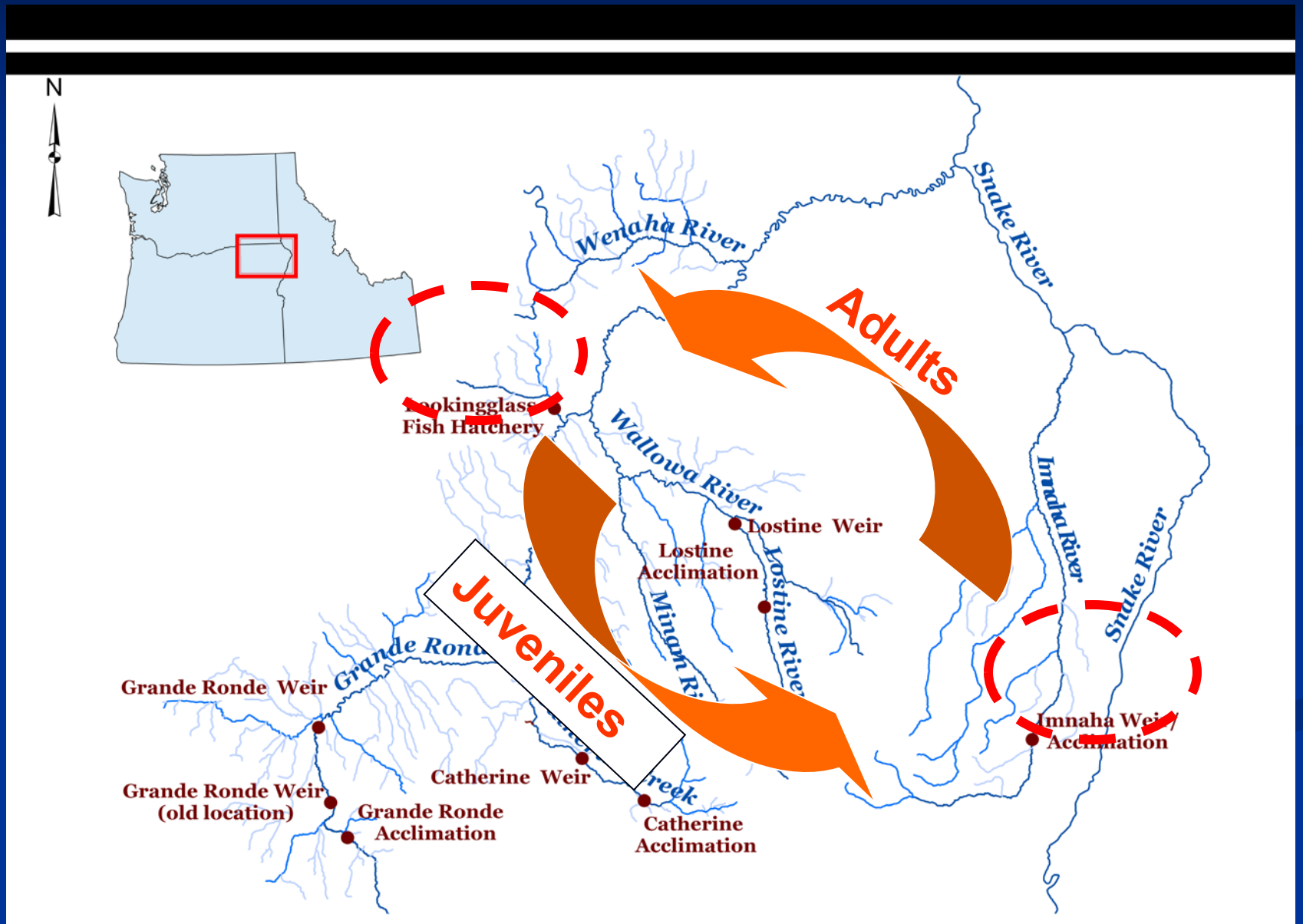
Hatchery (H)



Natural (N)



Lookingglass Fish Hatchery and the Imnaha River Acclimation pond



Study Design

Smolts reared at Lookingglass Fish Hatchery - released at the Imnaha River Acclimation Pond

10 Brood years (BY) 1988-1998
BY 1991 removed (sick fish)

Large Smolts
12-15 fish/lb
30-38 g/fish

Small Smolts
20-25 fish/lb
18-23 g/fish

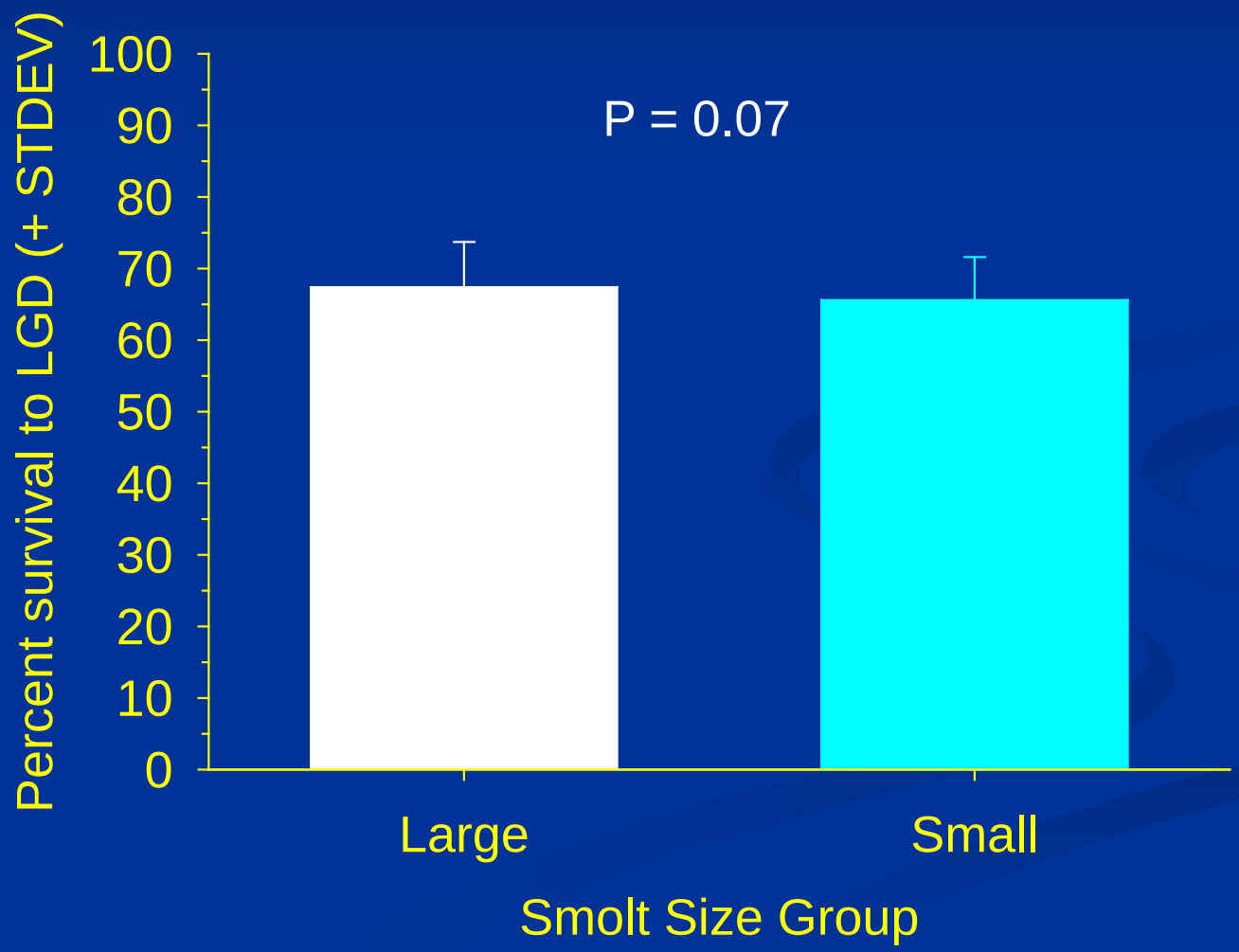
Dependent Variables

Juvenile survival to Lower Granite Dam (PIT tags BY 1992-1998)
Age composition and survival of age 3-5 adult returns
Smolt-to-Adult return (SAR), Survival (SAS), harvest, and stray rates
Adult returns/10 kg of smolts released

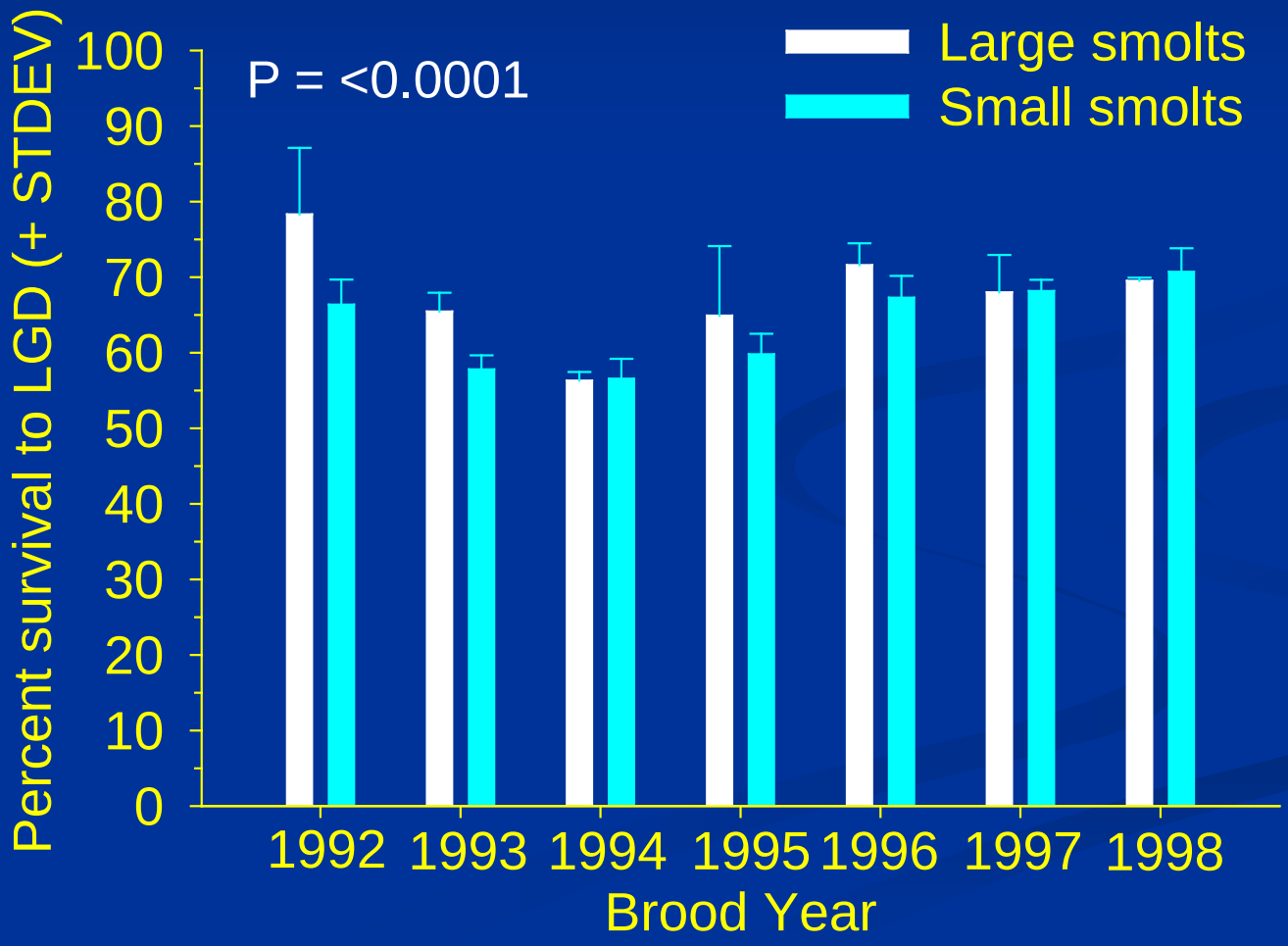
Independent Variables

Size Group + Brood Year + Size*Brood Year

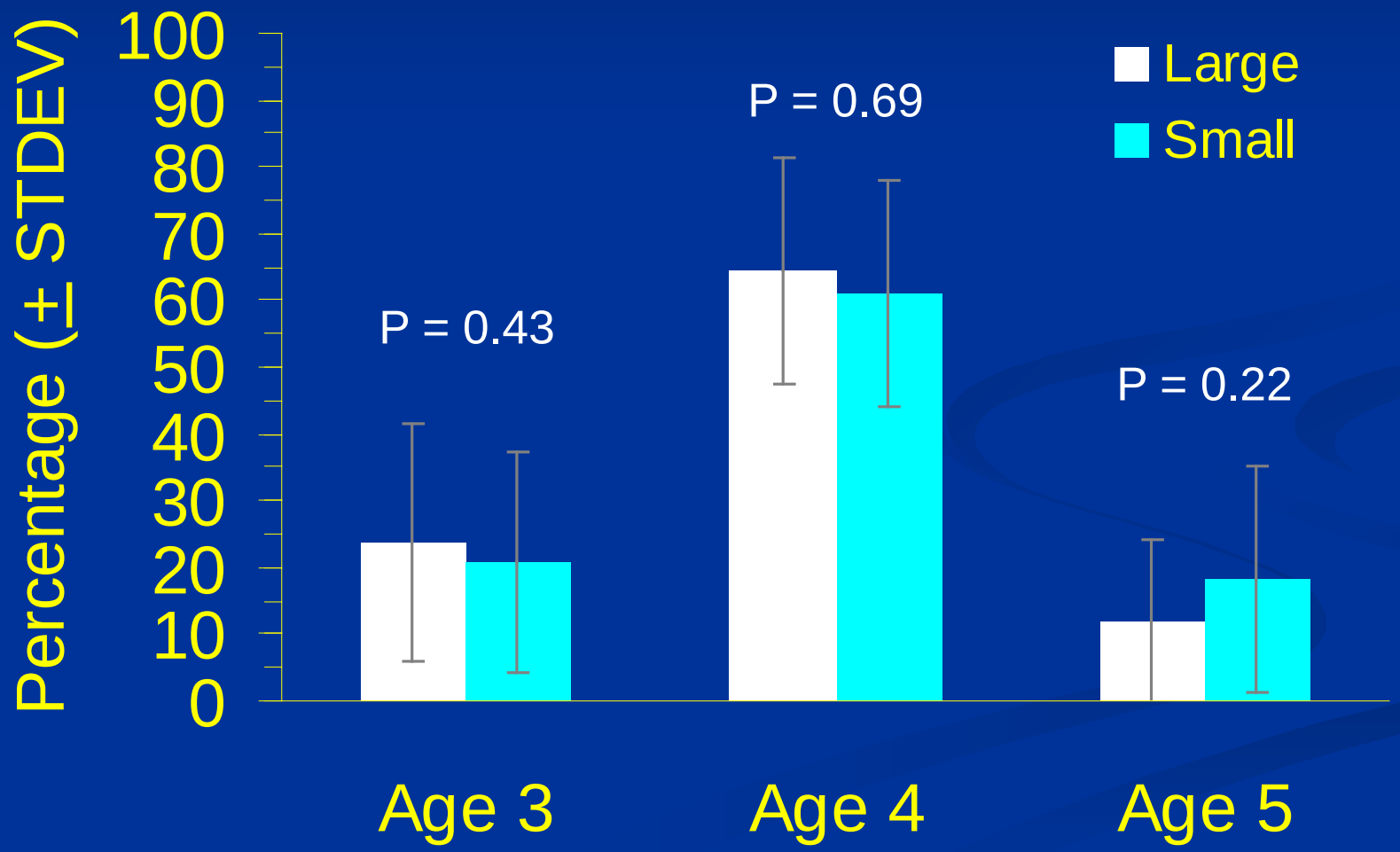
Large vs. Small Smolt Survival to Lower Granite Dam (LGD) PIT Tags BY 1992-1998



Survival Variation Between Brood Years to Lower Granite Dam



Age Composition



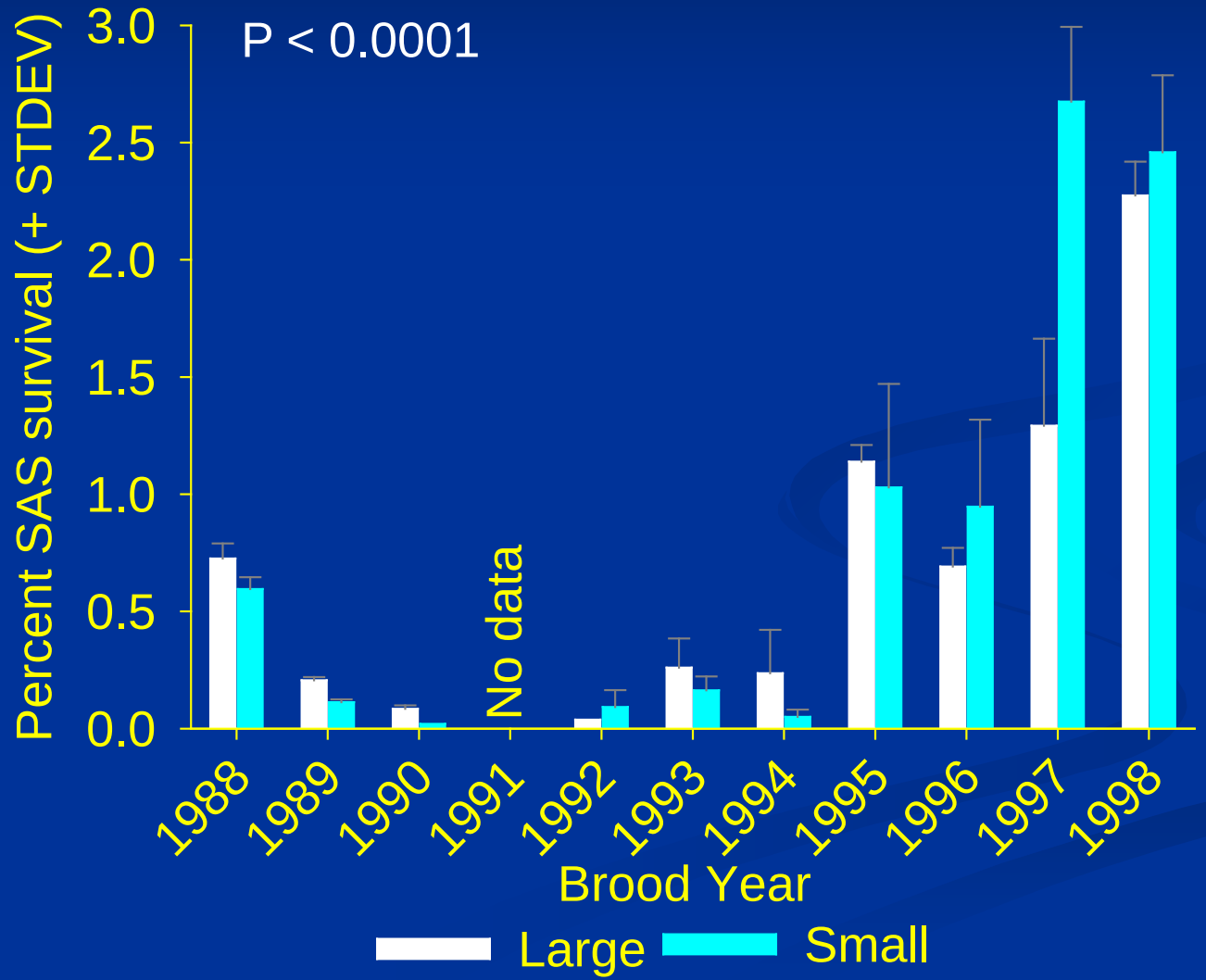
Smolt-to-Adult Survival (SAS)

	Large Smolts (avg 30 g/fish)	Small Smolts (avg 21 g/fish)	P Value
Age 3	0.18%	0.25%	0.50
Age 4	0.56%	0.70%	0.70
Age 5	0.08%	0.23%	0.05
Total SAS	0.82%	1.17%	0.43

Results

No significant difference between large and small smolts

SAS variation between brood years



Smolt-to-Adult Return (SAR), Harvest, & Stray Rates

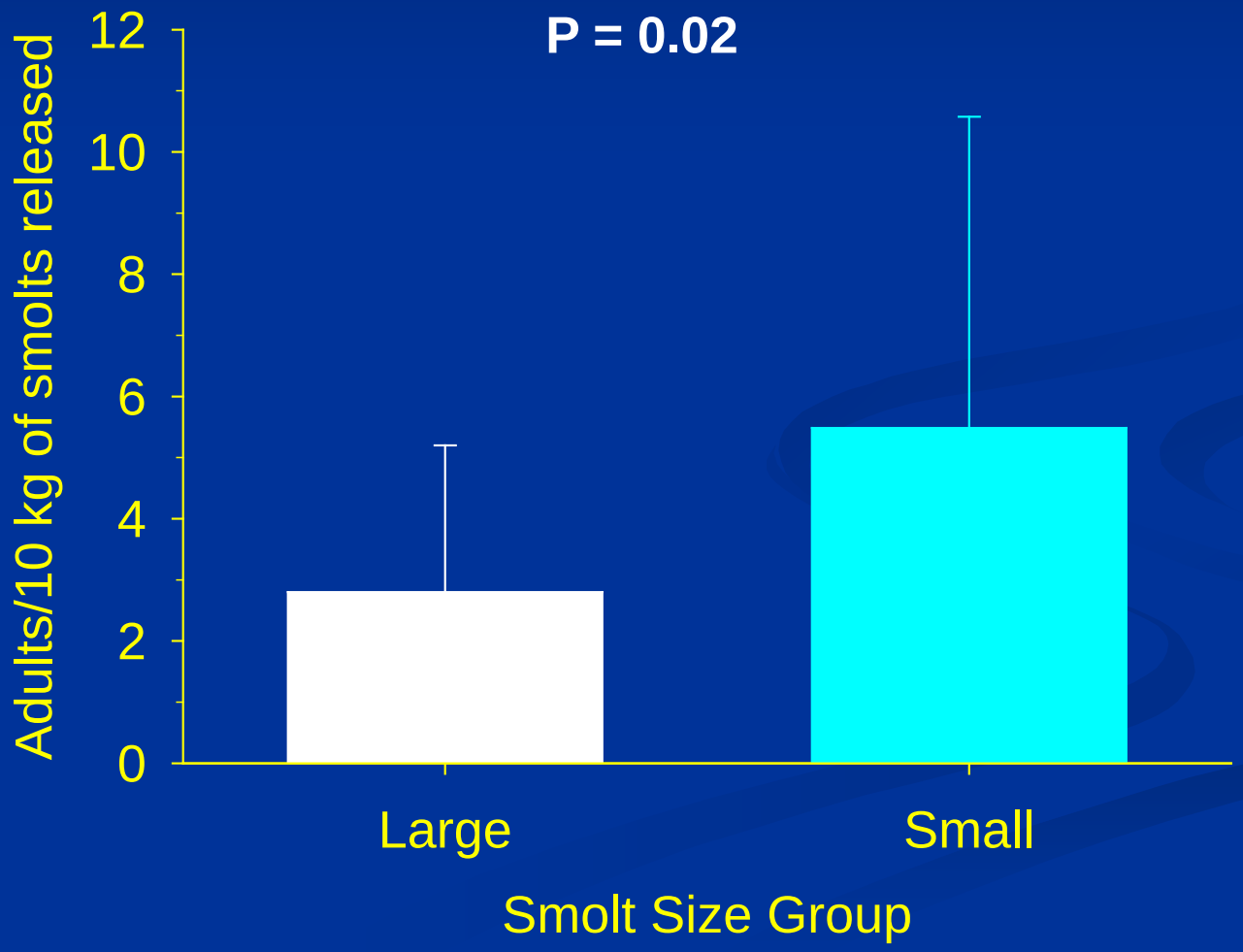
	Large Smolts (avg 30 g/fish)	Small Smolts (avg 21 g/fish)	P Value
SAR	0.78%	1.10%	0.42
Harvest	0.027%	0.06%	0.23
Stray	0.013%	0.016%	0.97

Results

1. **No significant difference between large and small smolts**

2. **Significant (P<0.001) differences between brood years**

Adults/10 kg of Smolts Released



Study Design: Size Group and Density

1988, 1989, 1990, 1992, 1993		1994, 1995, 1996, 1997, 1998	
High Density 44,346 - 85,796 smolts		Low Density 6,613 – 26,796 smolts	
Large Smolts 26-40 g/fish	Small Smolts 18-25 g/fish	Large Smolts 26-33 g/fish	Small Smolts 18-25 g/fish

Dependent Variables

Juvenile survival to Lower Granite Dam (PIT tags BY 1992-1998)

Age composition and survival of age 3-5 adult returns

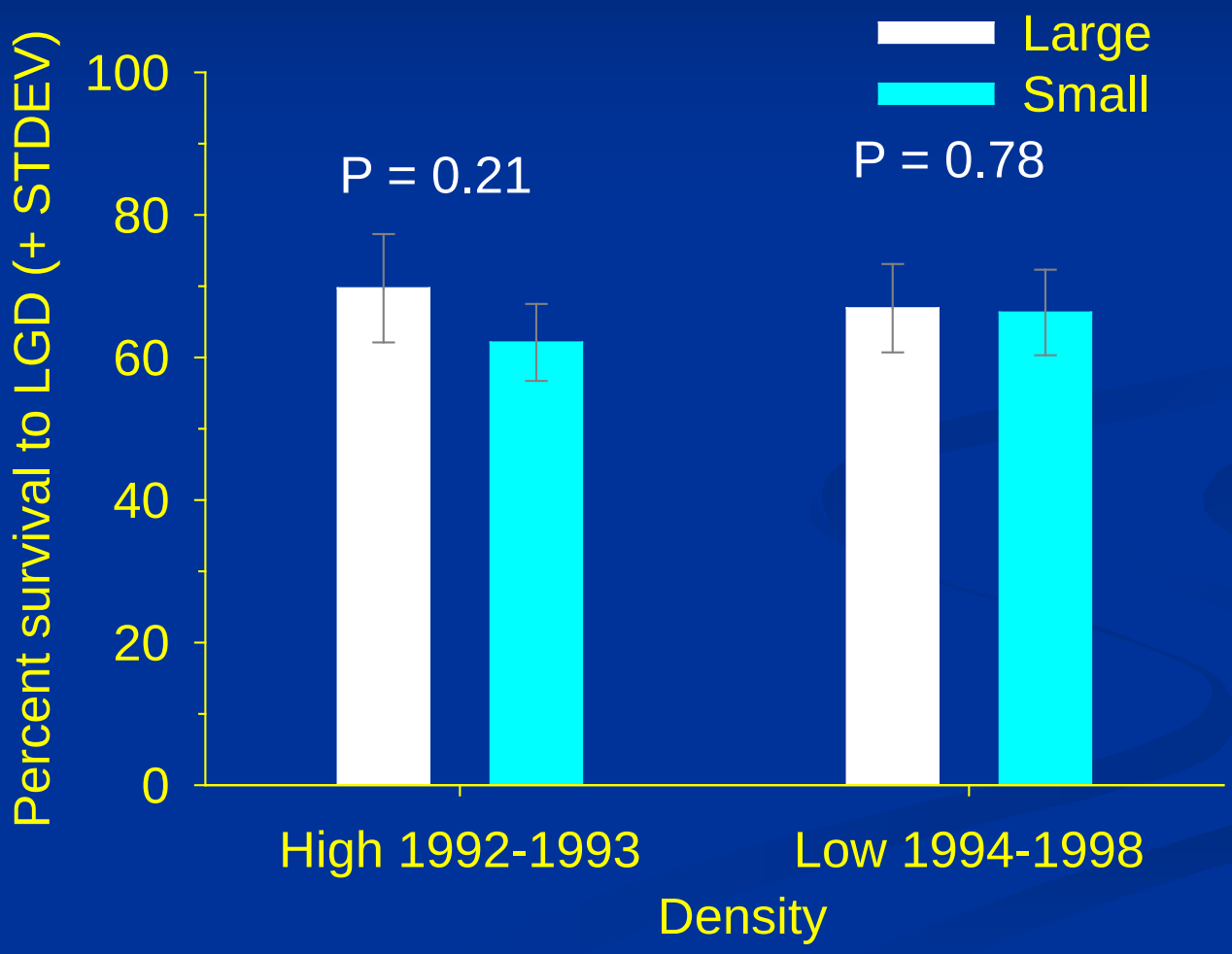
Smolt-to-Adult return (SAR), Survival (SAS), harvest, and stray rates

Adult returns/10 kg of smolts released

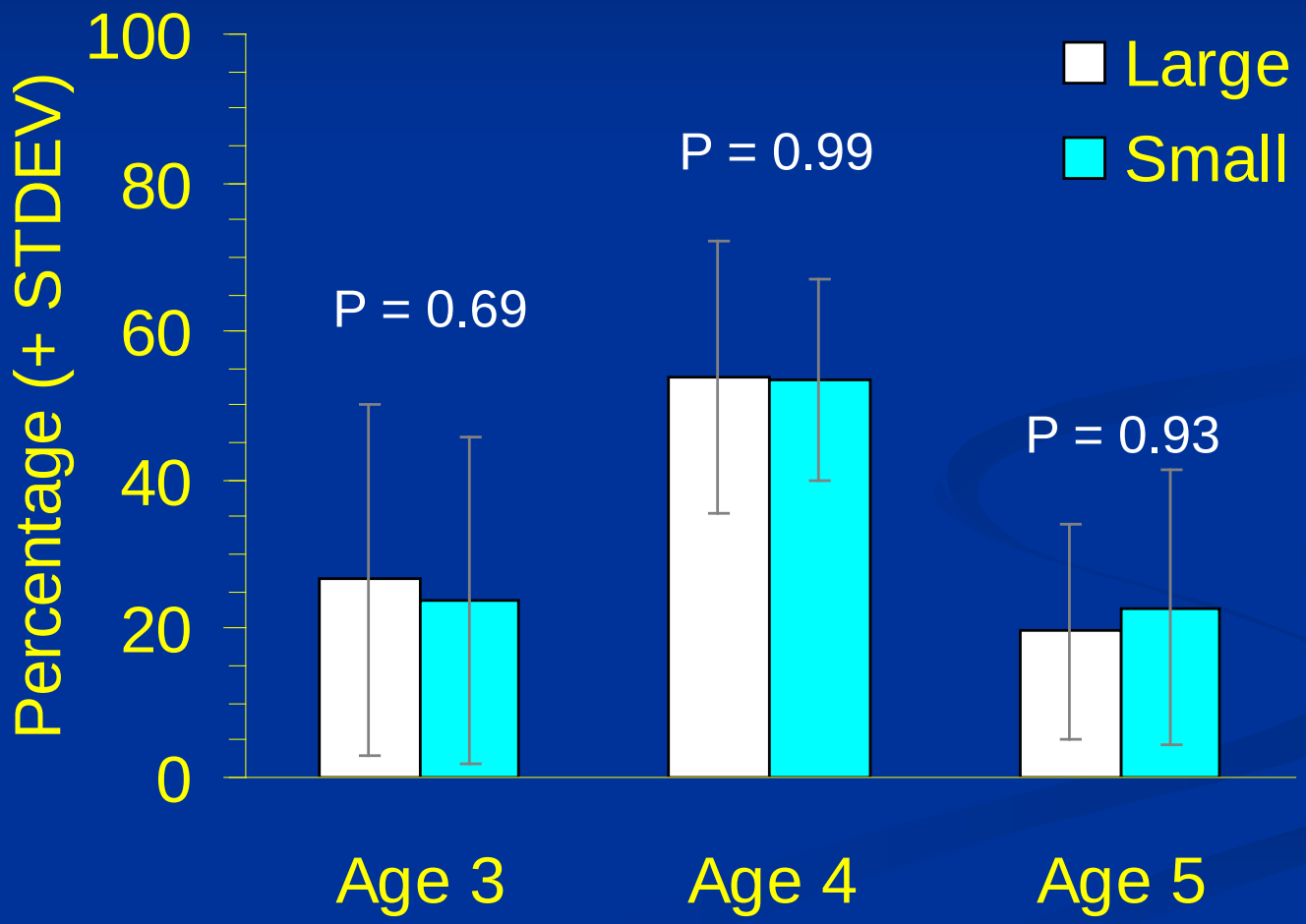
Independent Variables

Size Group + Brood Year + Size*Brood Year

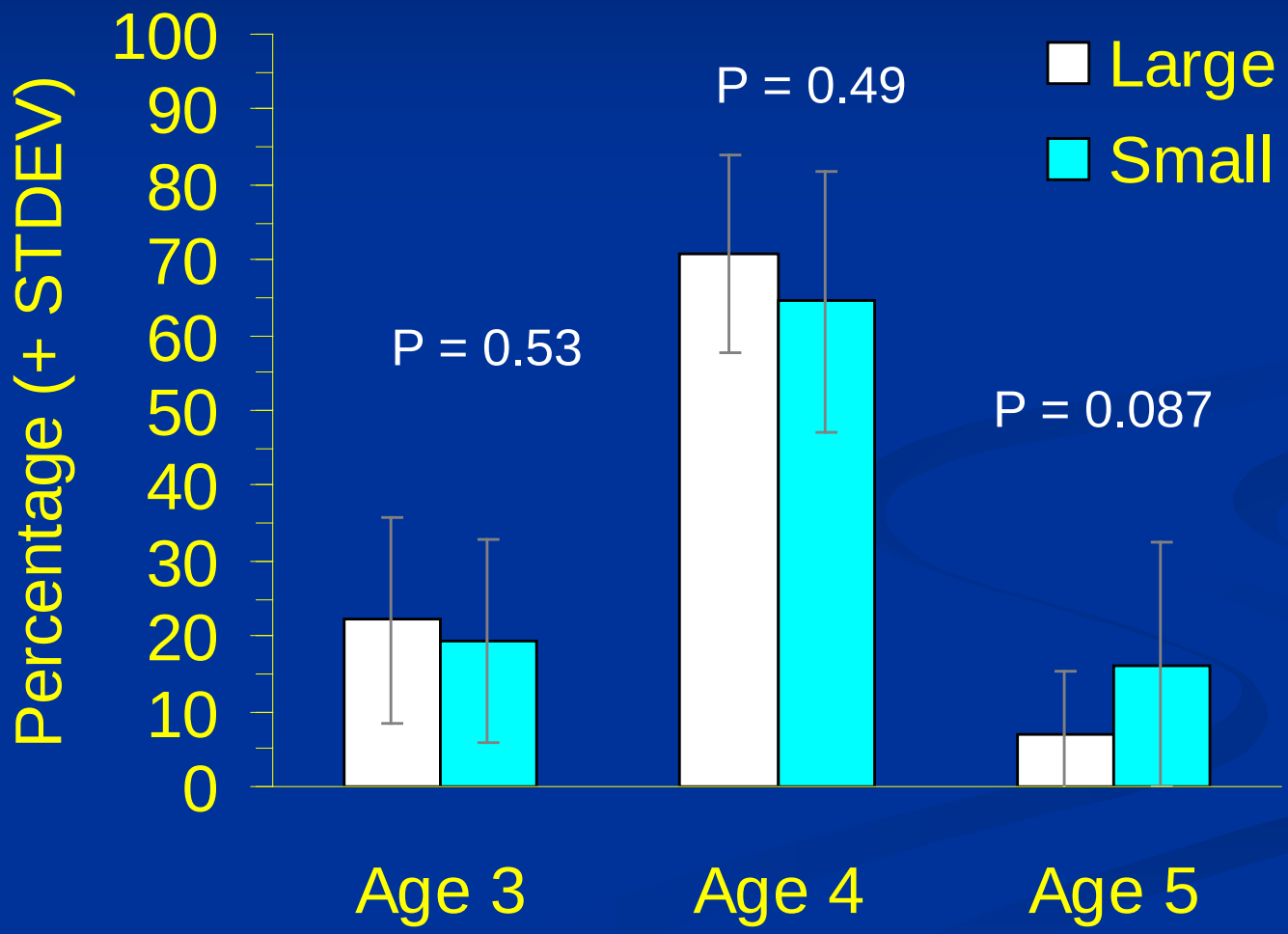
Smolt Size + Density
Survival to LGD BY 1992-1998



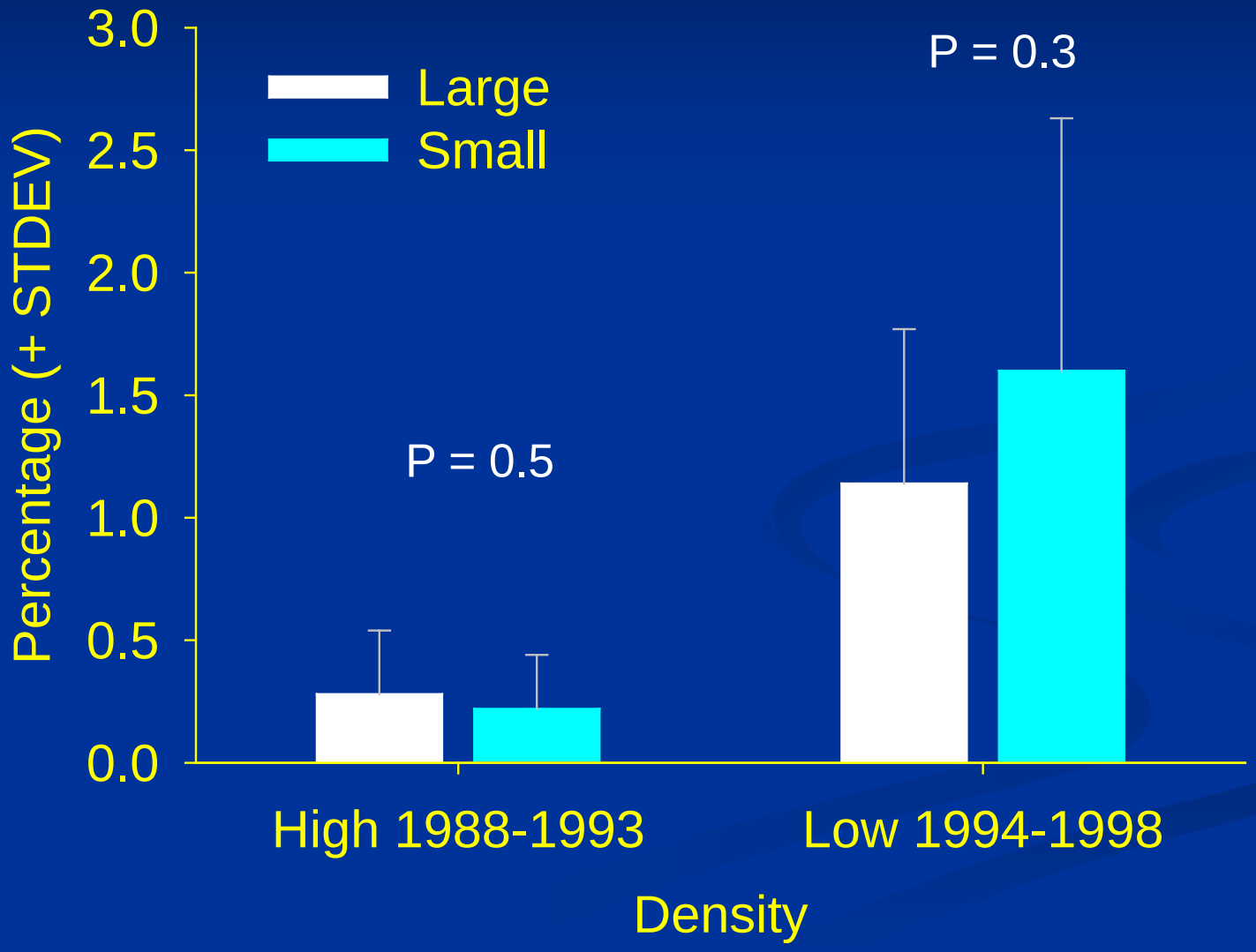
Returning Age Composition
High Density BY 1988-1993



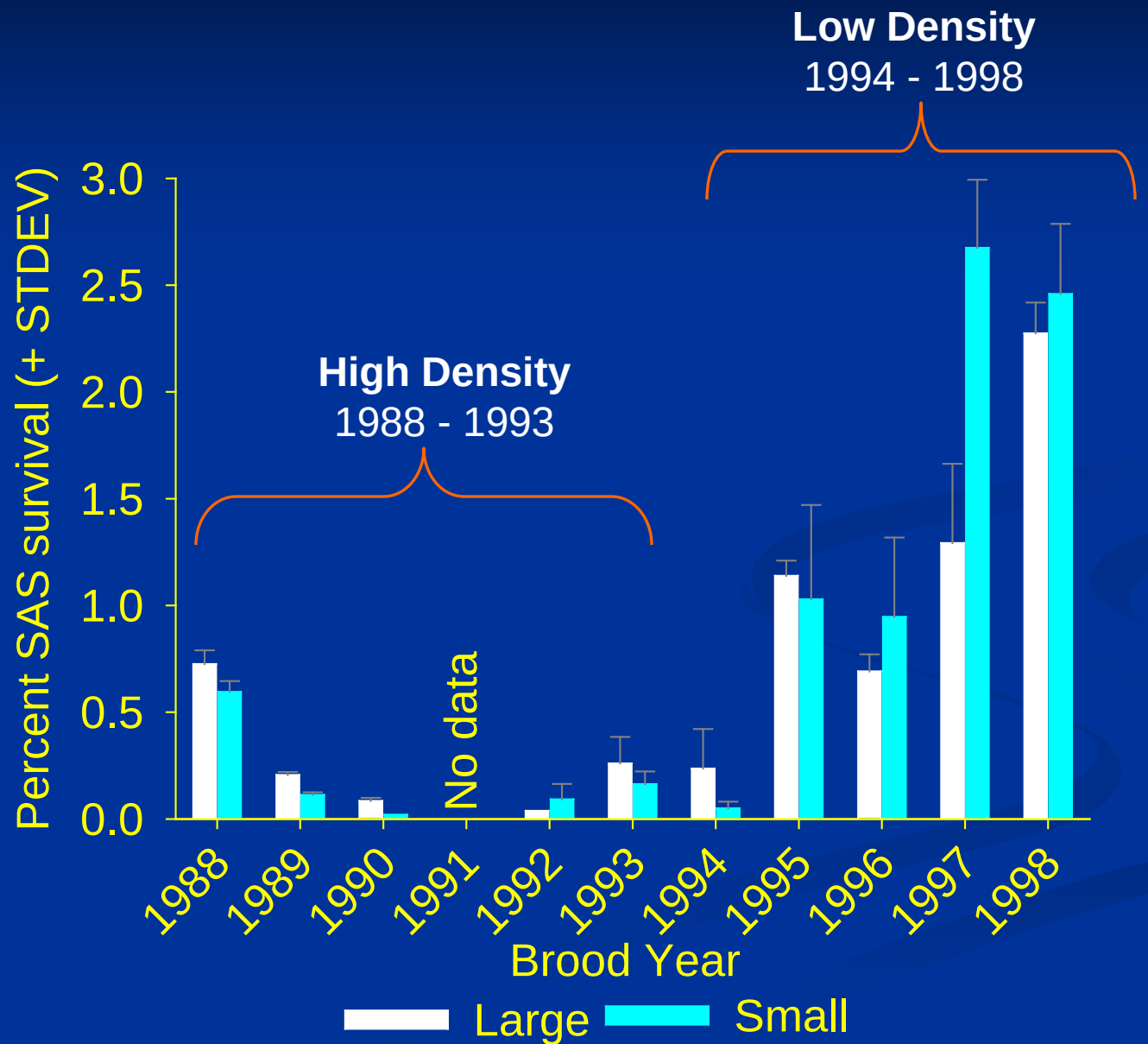
Returning Age Composition
Low Density BY 1994-1998



Smolt-to-Adult Survival (SAS)



SAS variation between brood years



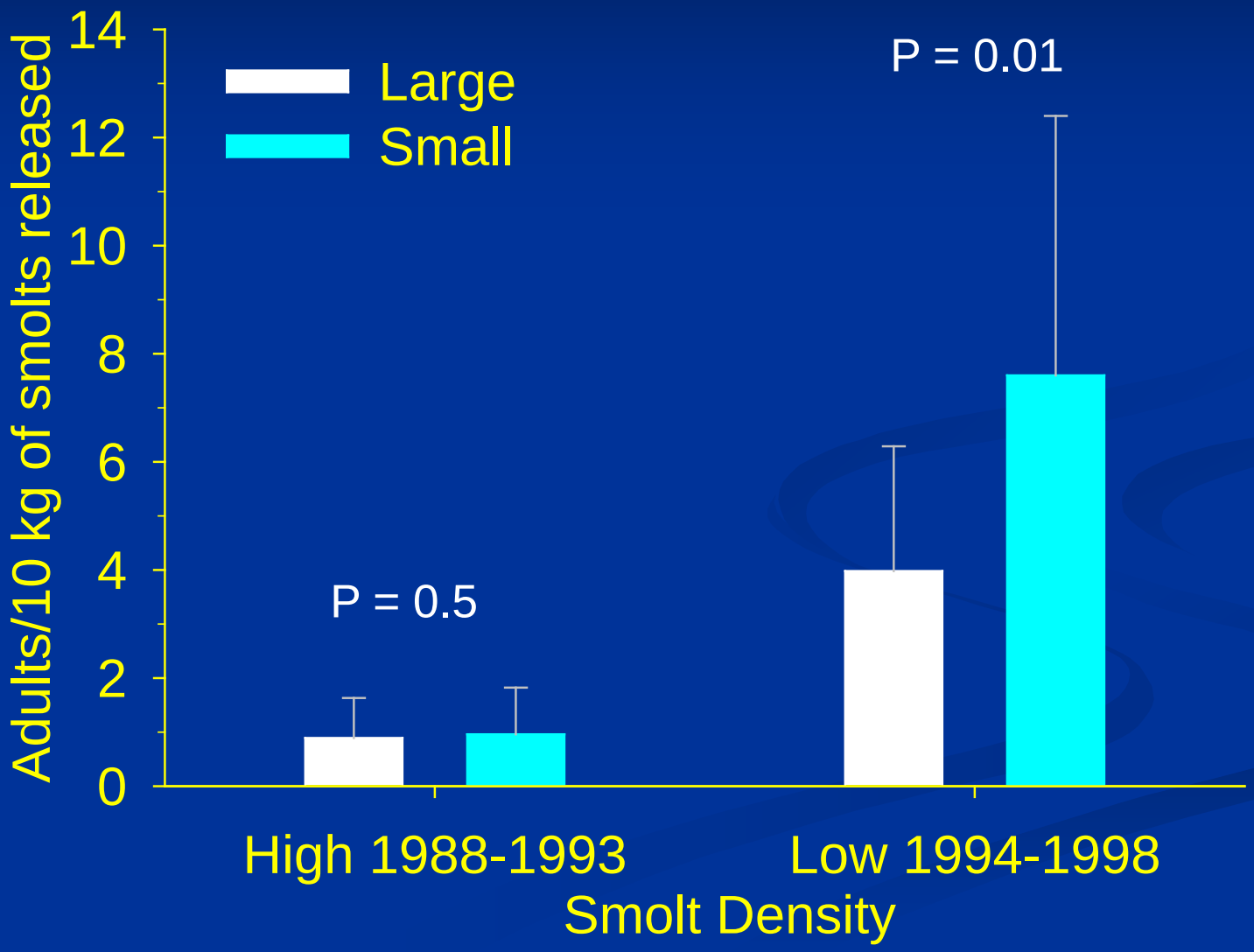
Smolt-to-Adult Return (SAR), Harvest, & Stray Rates

	1988, 1989, 1990, 1992, 1993		1994, 1995, 1996, 1997, 1998	
	High Density		Low Density	
	Large Smolts	Small Smolts	Large Smolts	Small Smolts
SAR	**0.28%**	**0.21%**	**1.08%**	**1.5%**
Harvest	**0.0007%**	**0.002%**	**0.04%**	**0.087%**
Stray	**0.007%**	**0.005%**	**0.017%**	**0.02%**

Results

1. Within density, no difference ($P>0.30$) between large and small smolts
2. Within high and low density → brood years ($P< 0.001$)

Adults/10 kg of Smolts Released



Evaluation Summary

- Smolts survived at similar rate to LGD, regardless of release size or density
- Size-at-release did not result in different age composition, or increased SAS, SAR, Harvest, or Stray Rates
- Imnaha River spring Chinook have a very low stray rate
- Brood year/migration year variation is more important than smolt size
- Small smolt resulted in a 2X increase in the number of returns compared to large smolts

Management Implications

- The yearly environmental challenges encountered during migration are more important than smolt size (i.e. brood year effect).
- In a space poor and egg rich environment (e.g., Lookingglass Fish Hatchery), to maximize the number of adult returns/ gram of smolt released→ release smaller smolts
- This study occurred with brood years experiencing “Max Transportation”
- With changing operations in the Columbia River Hydrosystem (e.g., barged vs. in-river, & flow requirements), a new pattern may emerge!
- Spread the risk→ release both large and small smolts

Acknowledgments & Questions?