Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program: F_1 Generation

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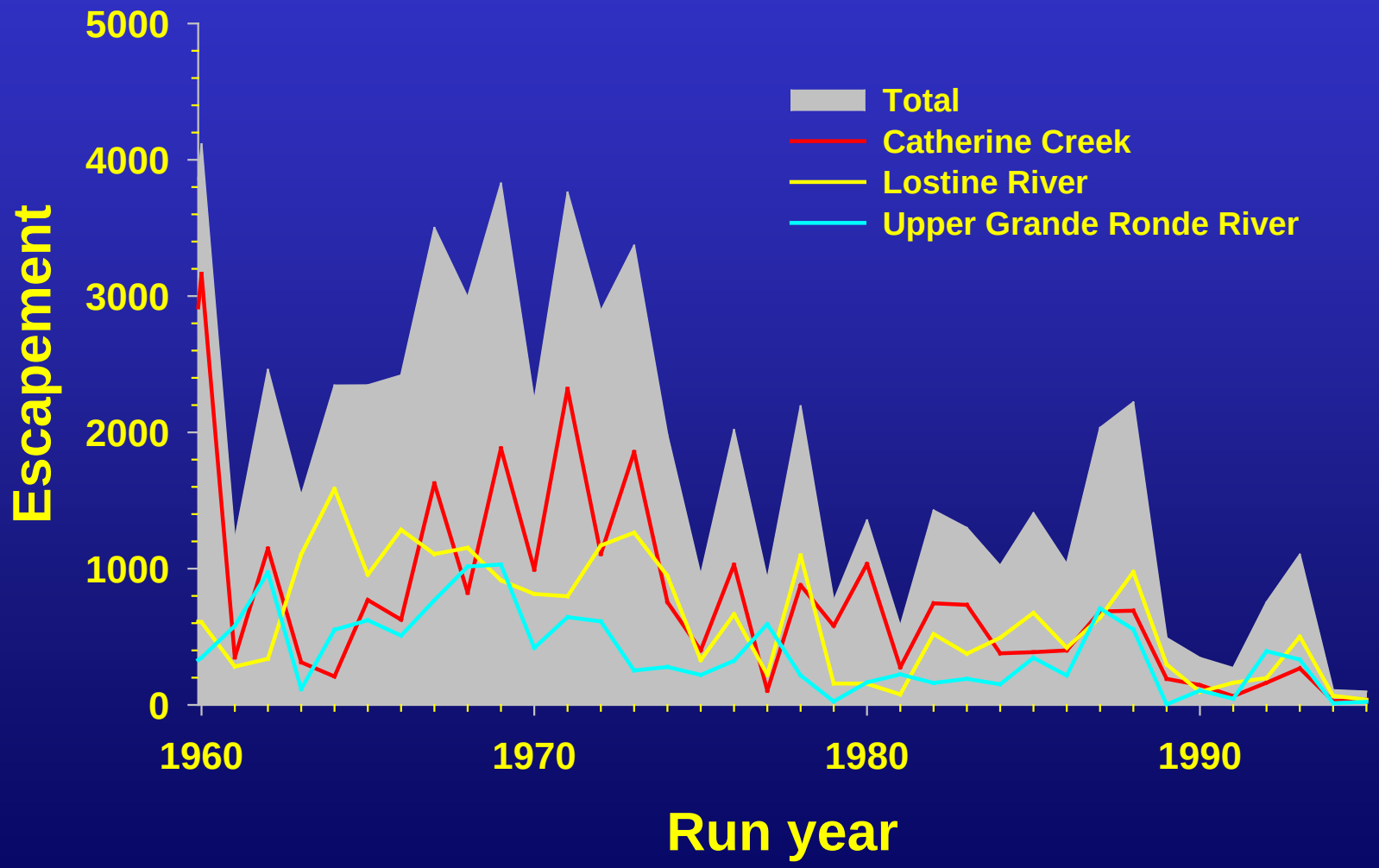
Adult Returns 1960-1995



History

- Steady decline in abundance since the late 1950's.
- Lower Snake River Compensation Plan (LSRCP) was initiated in Oregon in the late 1970s - hatchery supplementation began with the 1982 cohort
  - Carson stock - 1982-1987 cohorts
  - Rapid River stock - 1986-1996 cohorts
  - Neither stock performed well in the Grande Ronde Basin.
- Snake River spring Chinook salmon were listed as threatened in 1992.
- ODFW began to manage for native stocks.
  - Grande Ronde Basin streams still had genetically distinct populations.
- Captive Broodstock Program began in 1995 with collection of the 1994 cohort.
- Conventional Hatchery Program began in Lostine River in 1997 (skipping 1998 and 1999) and in Catherine Creek and the Upper Grande Ronde River in 2001.

LSRCP Management Objectives

- Establish adequate broodstock to meet annual production needs.
- Restore and maintain natural spawning populations of spring Chinook salmon in the Grande Ronde Basin.
- Reestablish historic tribal and recreational fisheries.
- Mitigation goals for the Grande Ronde Basin:
  - Release 900,000 smolts annually
  - 0.65% smolt-to-adult survival
  - Establish an annual return of 5,820 hatchery fish.
- Minimize impacts of the hatchery program on resident stocks.
- Maintain endemic wild populations of spring Chinook salmon in the Minam and Wenaha rivers.

Captive Broodstock Program Objectives

- Prevent extinction of the native Catherine Creek, Lostine River and upper Grande Ronde River Chinook salmon populations.
- Maintain genetic diversity of indigenous artificially propagated Chinook salmon populations.
- Maintain the genetic diversity in wild, endemic Chinook salmon populations in the Minam and Wenaha rivers.
- Provide a future basis and methodologies to reverse declines in stock abundance and ensure a high probability of population persistence until causes of population declines have been addressed.
- Establish an annual supply of spring Chinook salmon broodstock capable of meeting annual hatchery production goals.
- Restore and maintain naturally spawning populations of spring Chinook salmon.

Captive Broodstock offspring (F_1 generation) would be incorporated into the LSRCP production.

Monitoring and Evaluation Objectives

- Monitor, assess and compare the effects of pre- and post-smolt rearing treatments.
- Develop and evaluate the effectiveness of innovative methodologies for rearing, spawning and disease treatment and prevention.
- Monitor and compare aspects of life history and production performance between Captive and Conventional broodstock programs.
- Monitor and assess the performance of captive broodstock offspring in captivity (pre-smolt) and in nature (post-smolt) and their offspring.
- Assess our ability to achieve the genetic conservation goals and production benchmarks.
- Develop and maintain a comprehensive database for the program.

Life History of Captive Broodstock

Collect Wild Parr

↓

Rear to Smolt (accelerated or natural growth)

↓

Post-smolt Rearing (Freshwater or Saltwater)

↓

Spawn Within Stocks

↓

Rear F_1 Generation to Smoltification

↓

Release F_1 Generation in Parent's Natal Stream

↓

Returning Adults Allowed to Spawn in Nature

Grande Ronde River Basin

Captive Broodstock Results

Assumptions/Targets - Production

Collection		500	Yes, except GR 1994, 1995, 1999
Sex ratio		1F:1M	1F:1.08M
Growth		Similar to natural	~35% smaller
Survival	Parr-smolt	90%	97%
	Smolt-adult	55%	55%
	Overall	50%	53%
BKD was the greatest cause of mortality			

Assumptions/Targets - Spawning

Age at maturation	2	3	4	5
Females	0 / 0	6 / 1	78 / 88	16 / 11
Males	2 / 20	35 / 69	48 / 10	15 / 1

Spawn timing	August-September	September-October

Fecundity	Age 3	Age 4	Age 5
Predicted	1200	3000	4000
Actual	1232	1715	1588

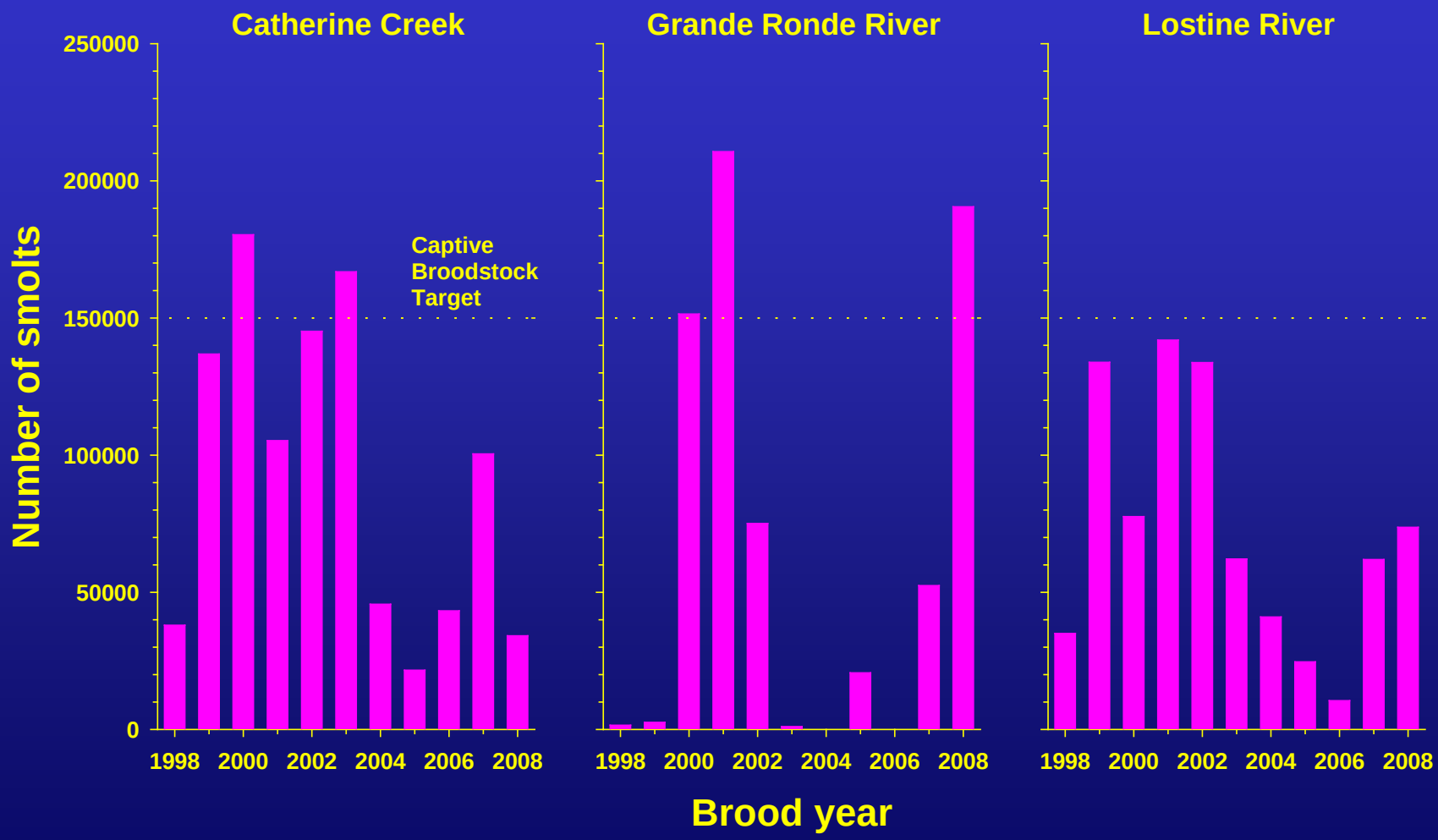
20% (0-77%) of collected eggs were culled for BKD prevention.

Assumptions/Targets – F_1 Generation

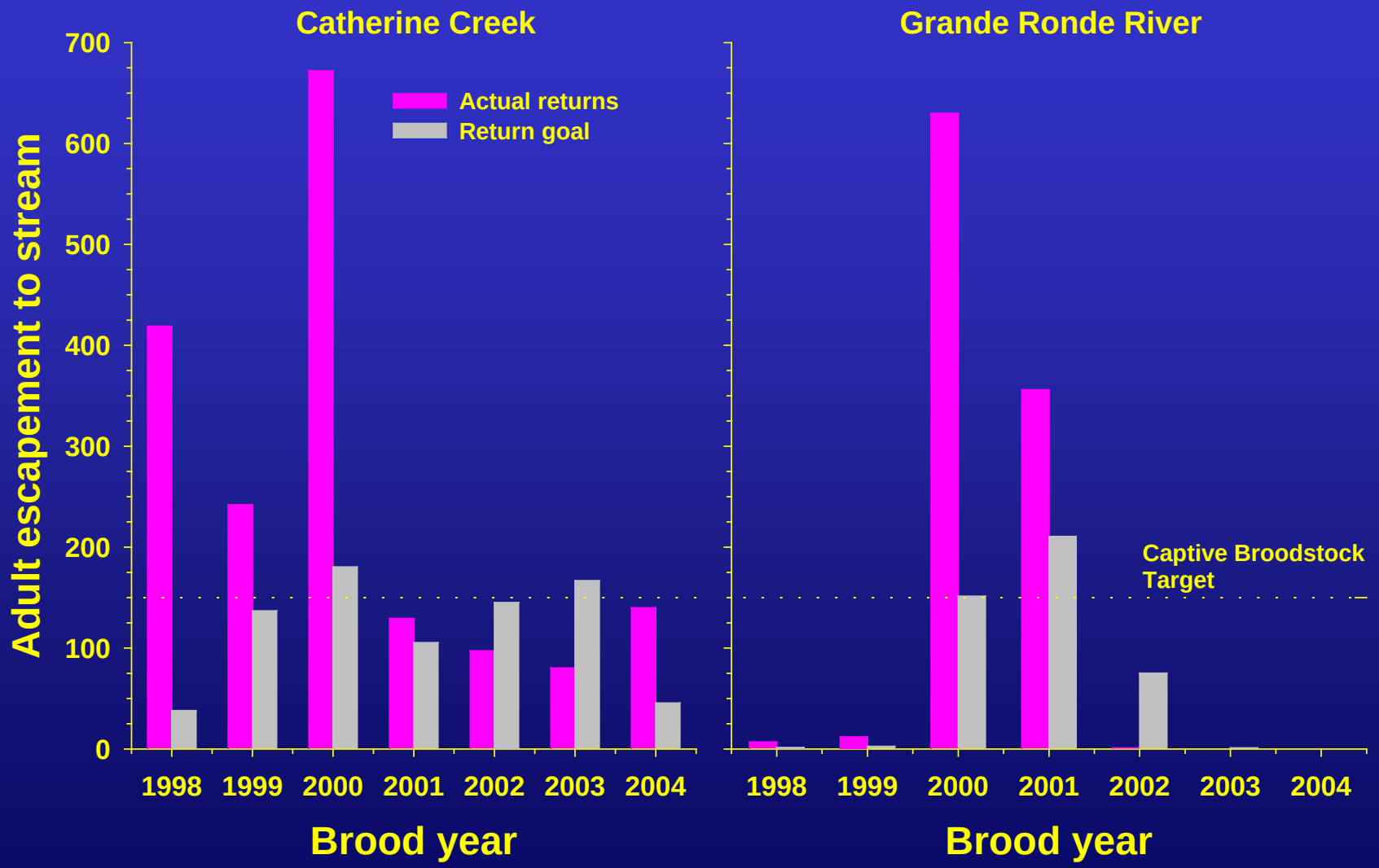
Fertility	75%	85%
Eyed egg-smolt survival	80%	83%
Return Rate	0.1%	0.35%

Age Composition	Age 3	Age 4	Age 5
Predicted	10	60	30
Actual	15	71	14

F_1 Smolt Production



F_1 Returns


Catherine Creek
Grande Ronde River
Actual returns
Return goal
Captive Broodstock Target
Adult escapement to stream
0
100
200
300
400
500
600
700
1998
1999
2000
2001
2002
2003
2004
Brood year
Brood year

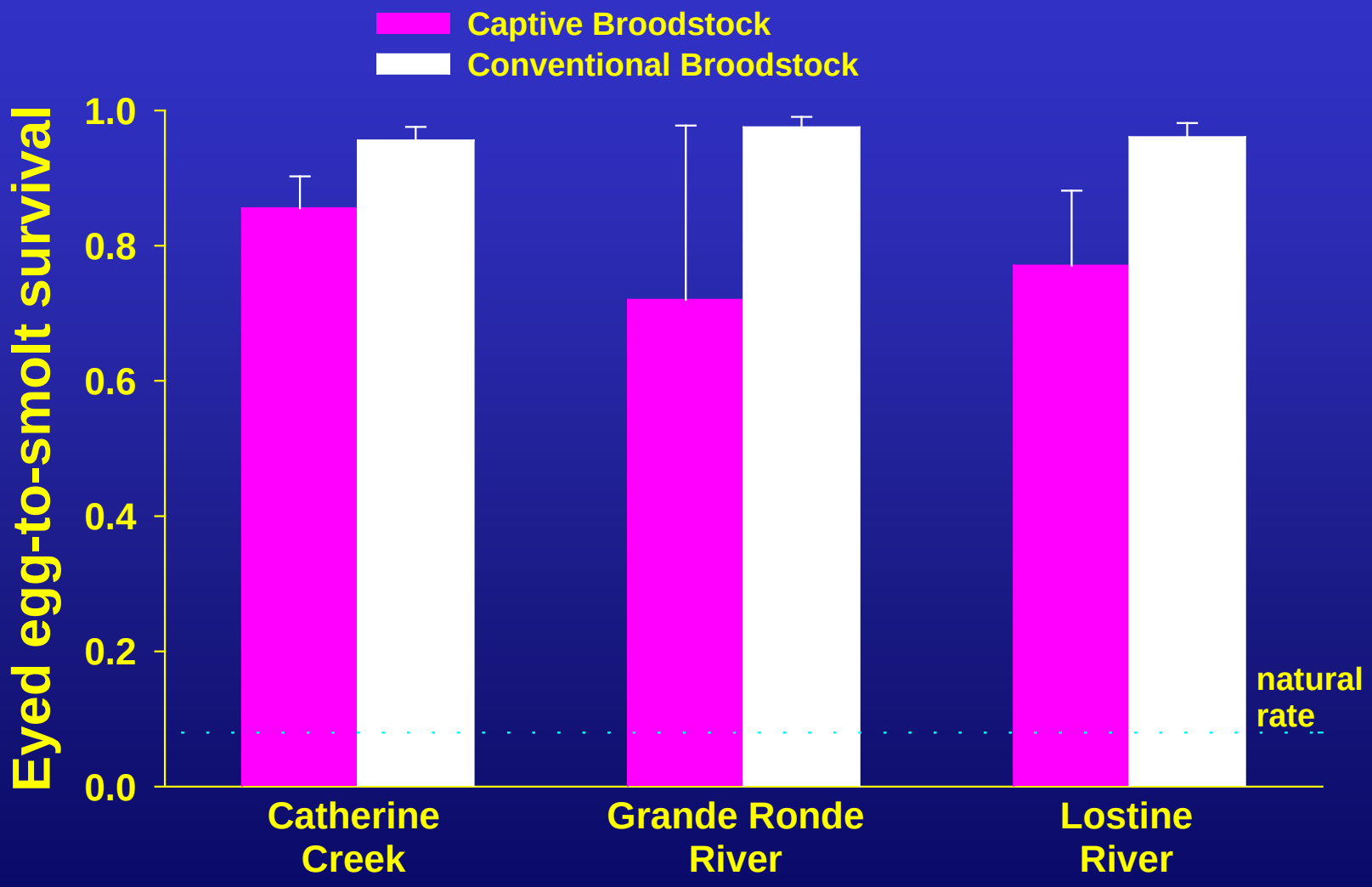
Program Challenges

- Inability to collect 500 parr each year in the Grande Ronde River
- Reduce BKD-caused mortality
- Reduce BKD culling
- Improve growth of saltwater fish
- Synchronize maturation timing with wild fish
- Early detection of maturing fish
- Improve egg-to-smolt survival of F_1 generation
- Disposition of excess F_1 fish in years of overproduction

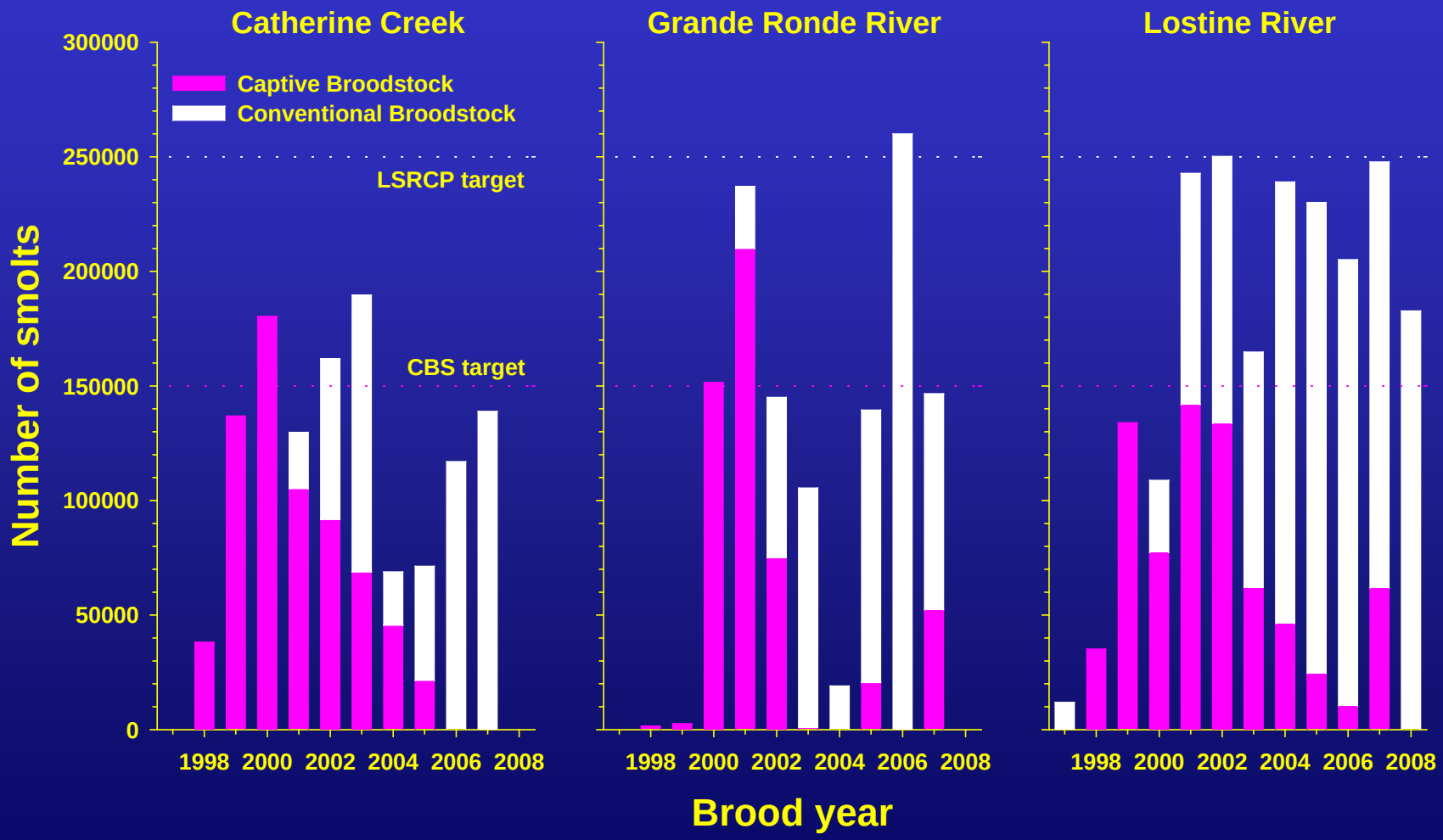
➔ Success of program will be determined by returns of F_2 generation

Captive Broodstock Program
vs.
Conventional Hatchery Program

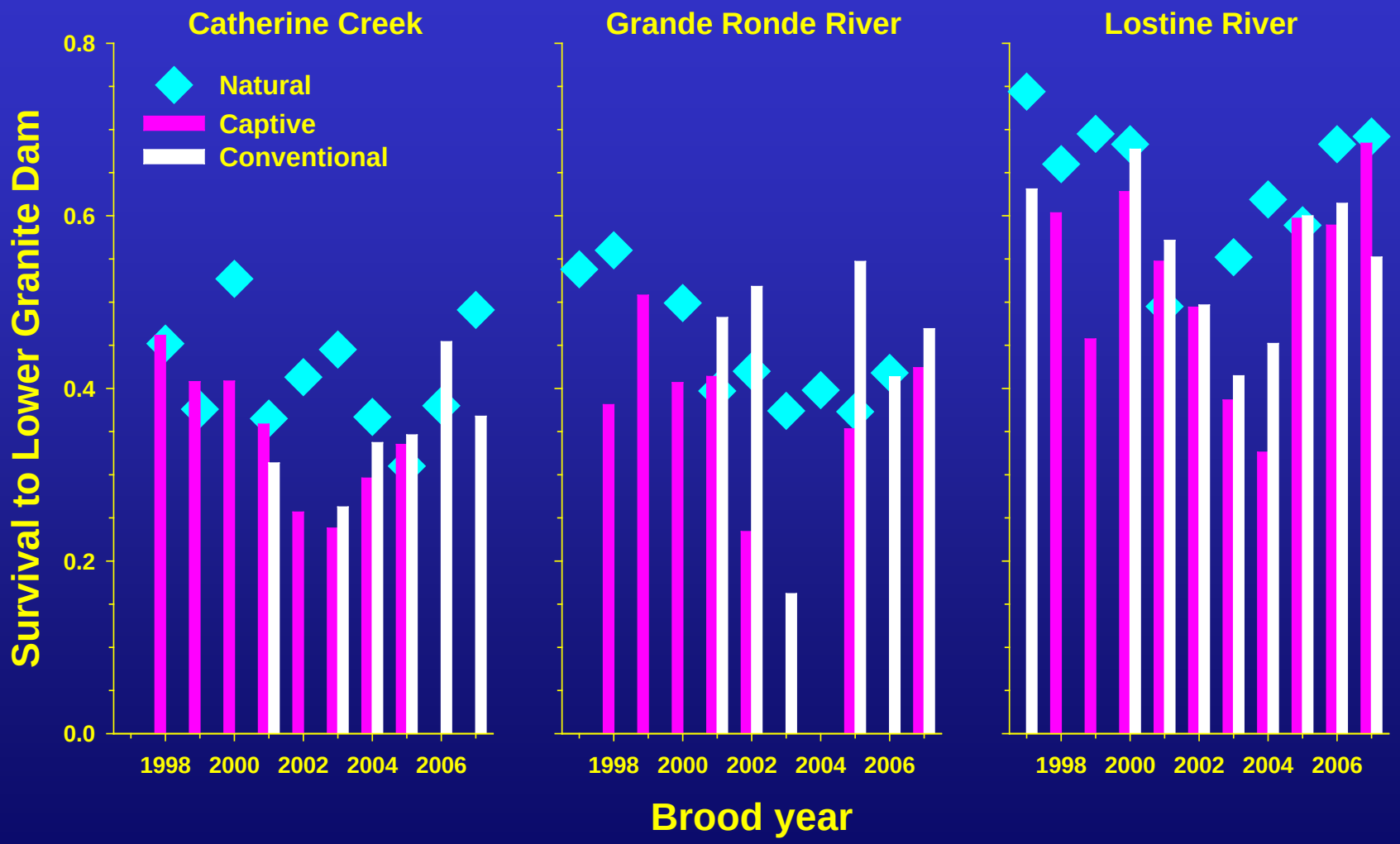
Eyed Egg-to-Smolt Survival



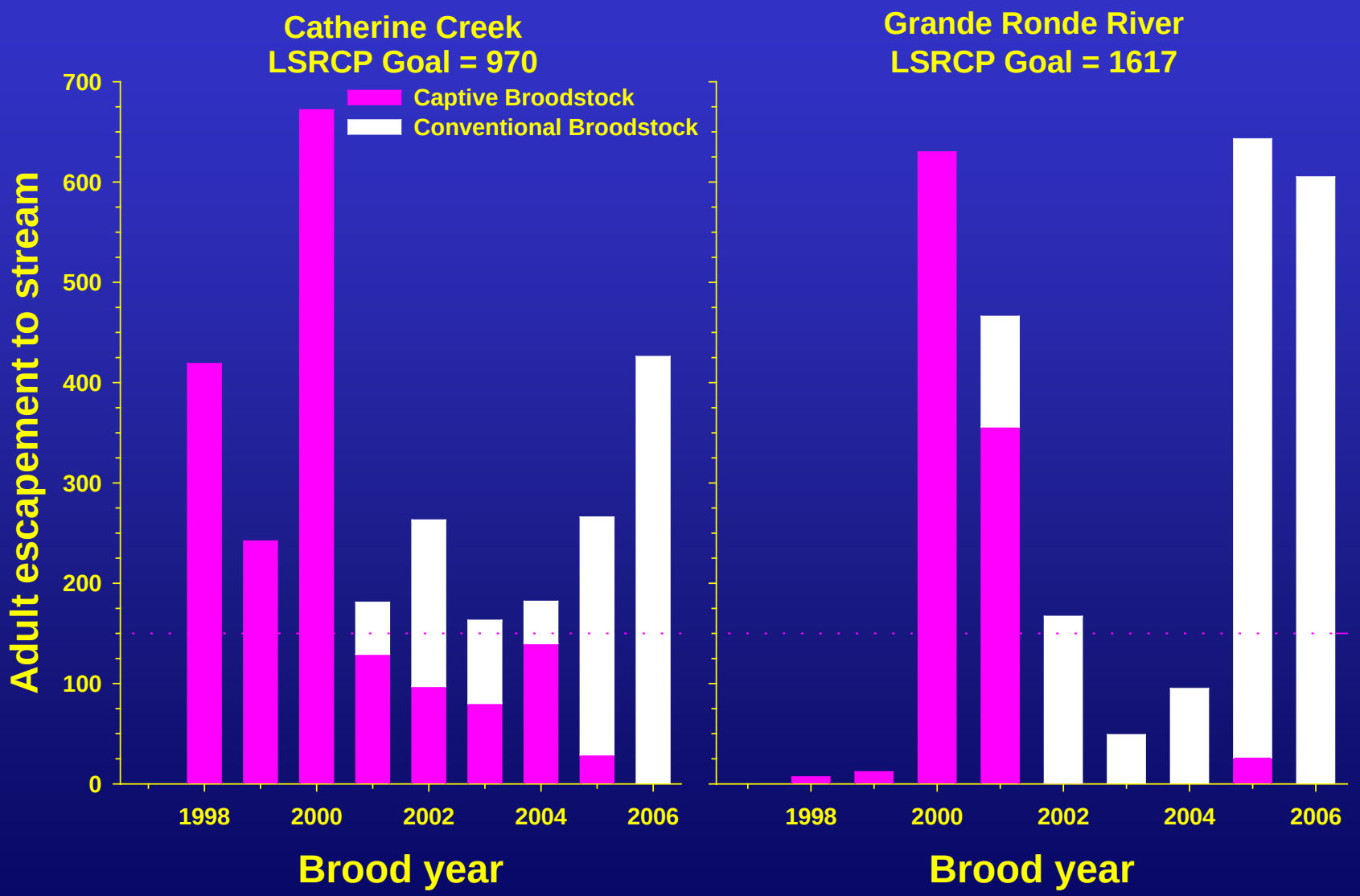
Smolt Release



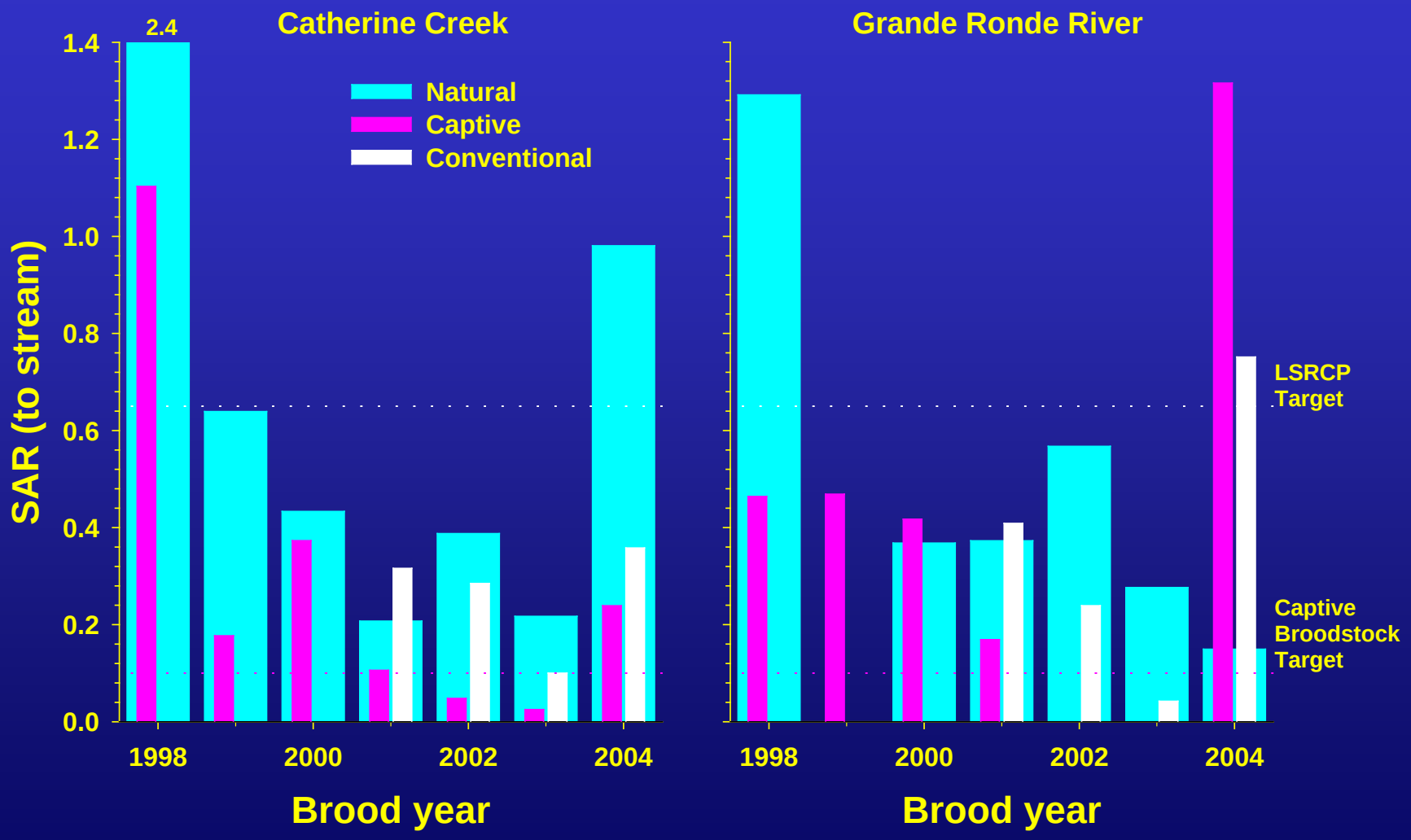
Juvenile Survival to LGD



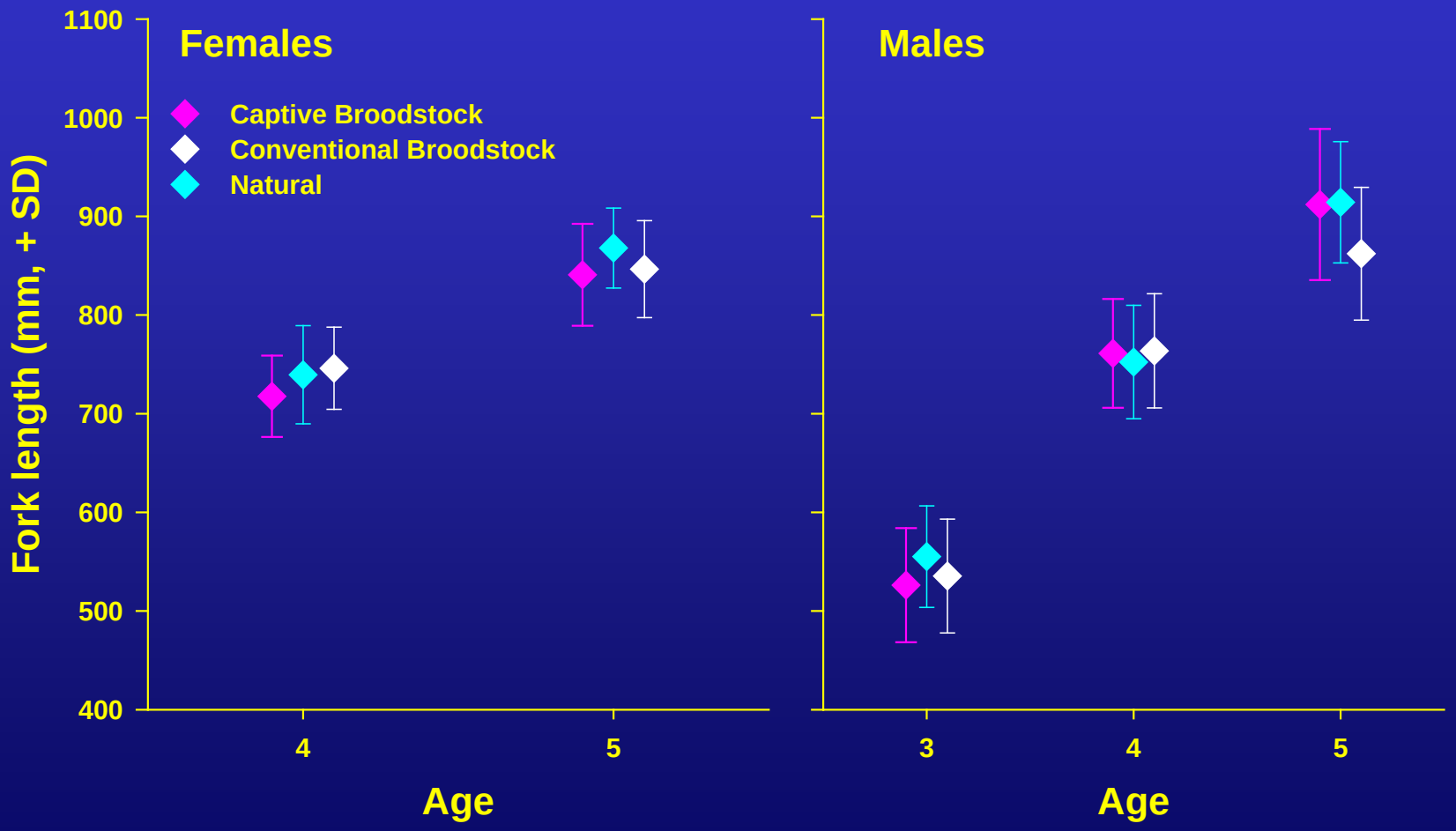
Adult Returns



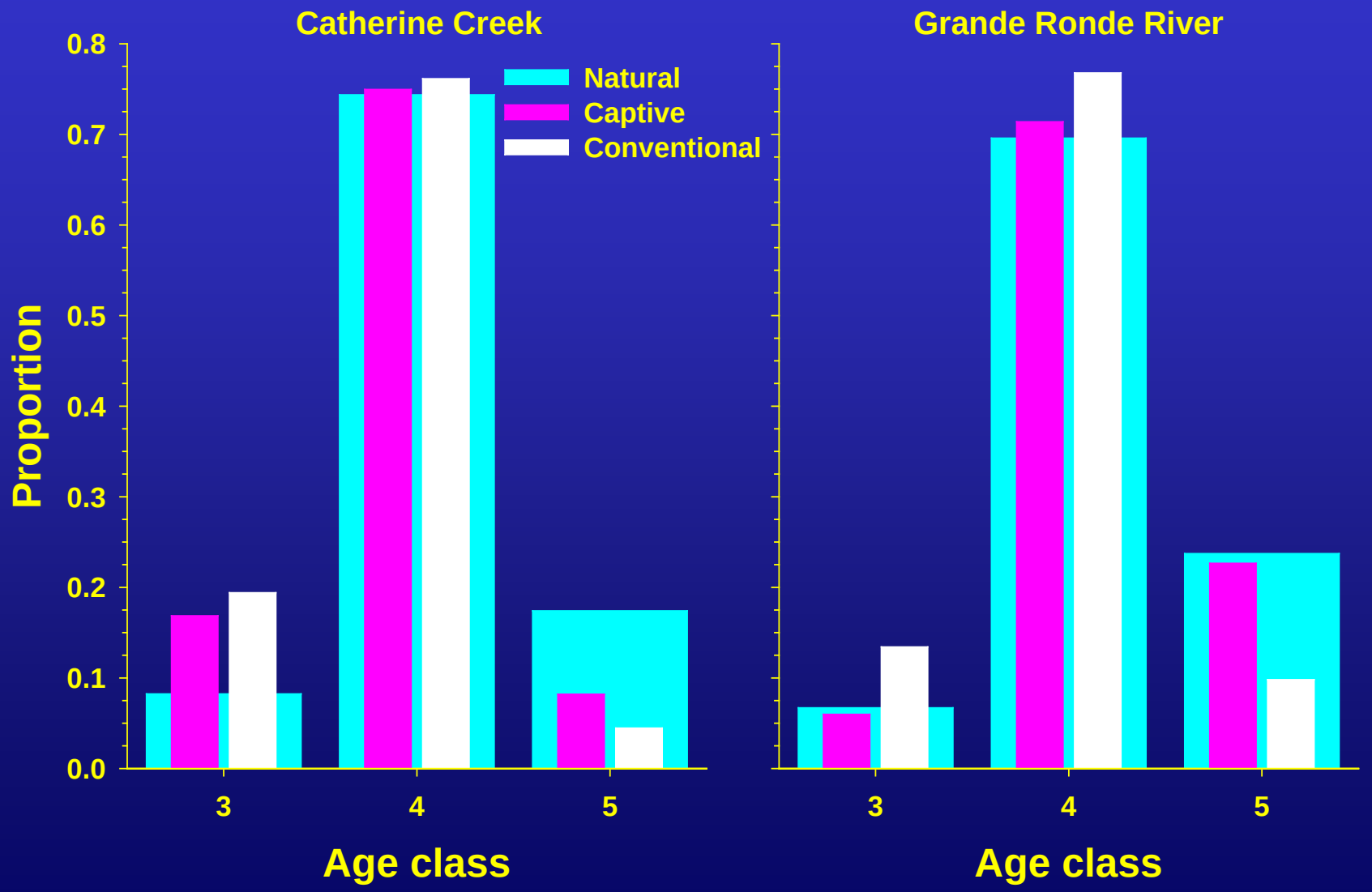
Smolt-to-Adult Survival (SAR)



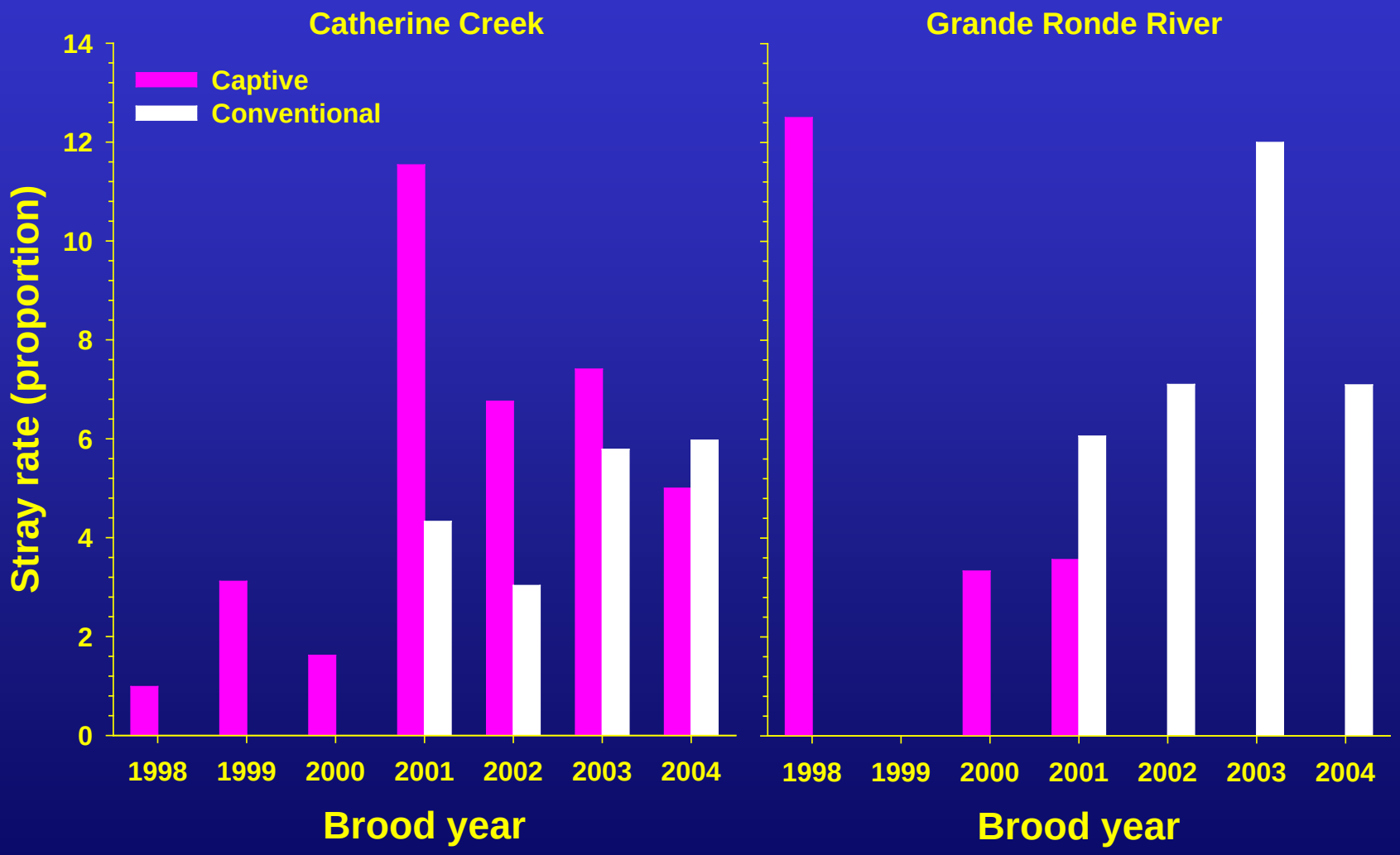
Size at Maturity



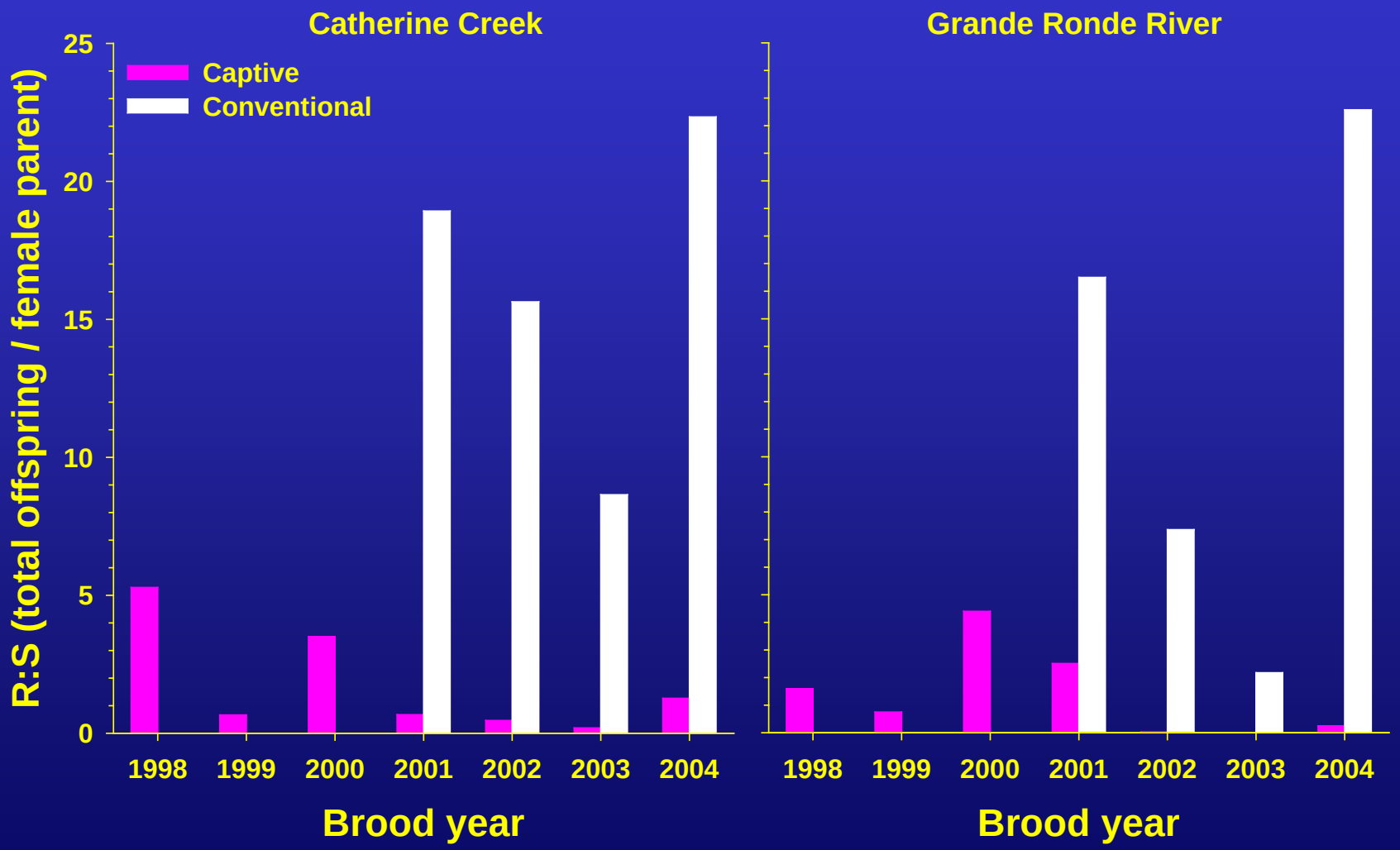
Age Composition



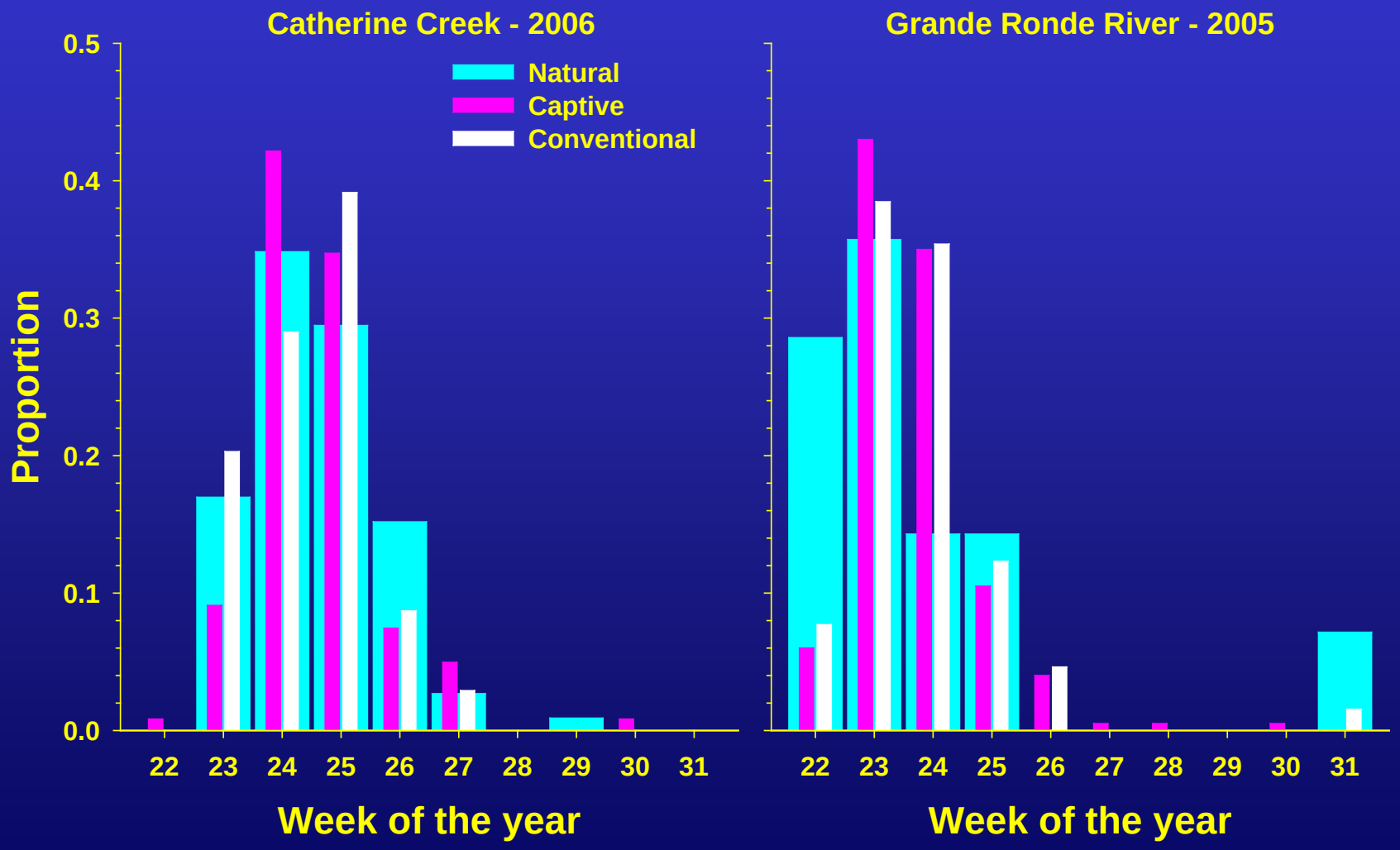
Stray Rate


Catherine Creek
Grande Ronde River
Captive
Conventional
Stray rate (proportion)
0
2
4
6
8
10
12
14
1998
1999
2000
2001
2002
2003
2004
Brood year
1998
1999
2000
2001
2002
2003
2004
Brood year

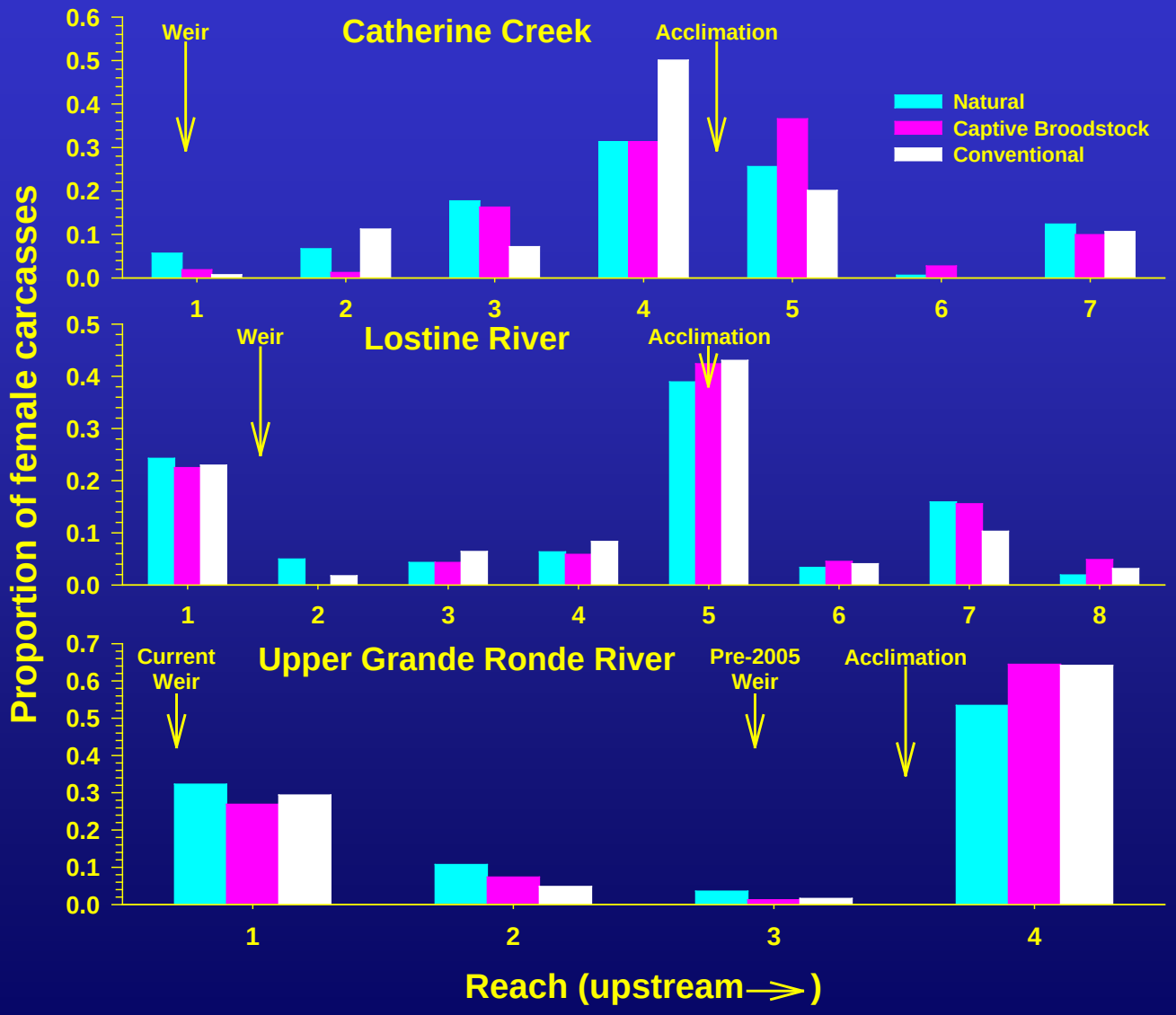
Recruits per Spawner



Run Timing


Catherine Creek - 2006
Natural
Captive
Conventional
Proportion
0.5
0.4
0.3
0.2
0.1
0.0
22 23 24 25 26 27 28 29 30 31
Week of the year
Grande Ronde River - 2005
22 23 24 25 26 27 28 29 30 31
Week of the year

Spawning Distribution



Summary – F_1 Generation

- Egg-to-smolt survival better in Conventional Program
- Smolt production – rarely achieved CBS or LSRCP goals
- Survival to LGD better for Conventional Program
- Adult returns – often met Captive Broodstock goal but not LSRCP
- SAR – met Captive Broodstock but not LSRCP
- Size at maturity – similar among programs and with Natural
- Age composition similar between programs but younger than Natural
- Stray rate higher in Captive Broodstock
- Run timing similar between program and with Natural
- Spawning distribution – hatchery fish tend to spawn near acclimation site
- Recruits per spawner higher in Conventional Program. CBS low due to low fecundity and fertility.

CBS vs. CHP vs. Natural Production

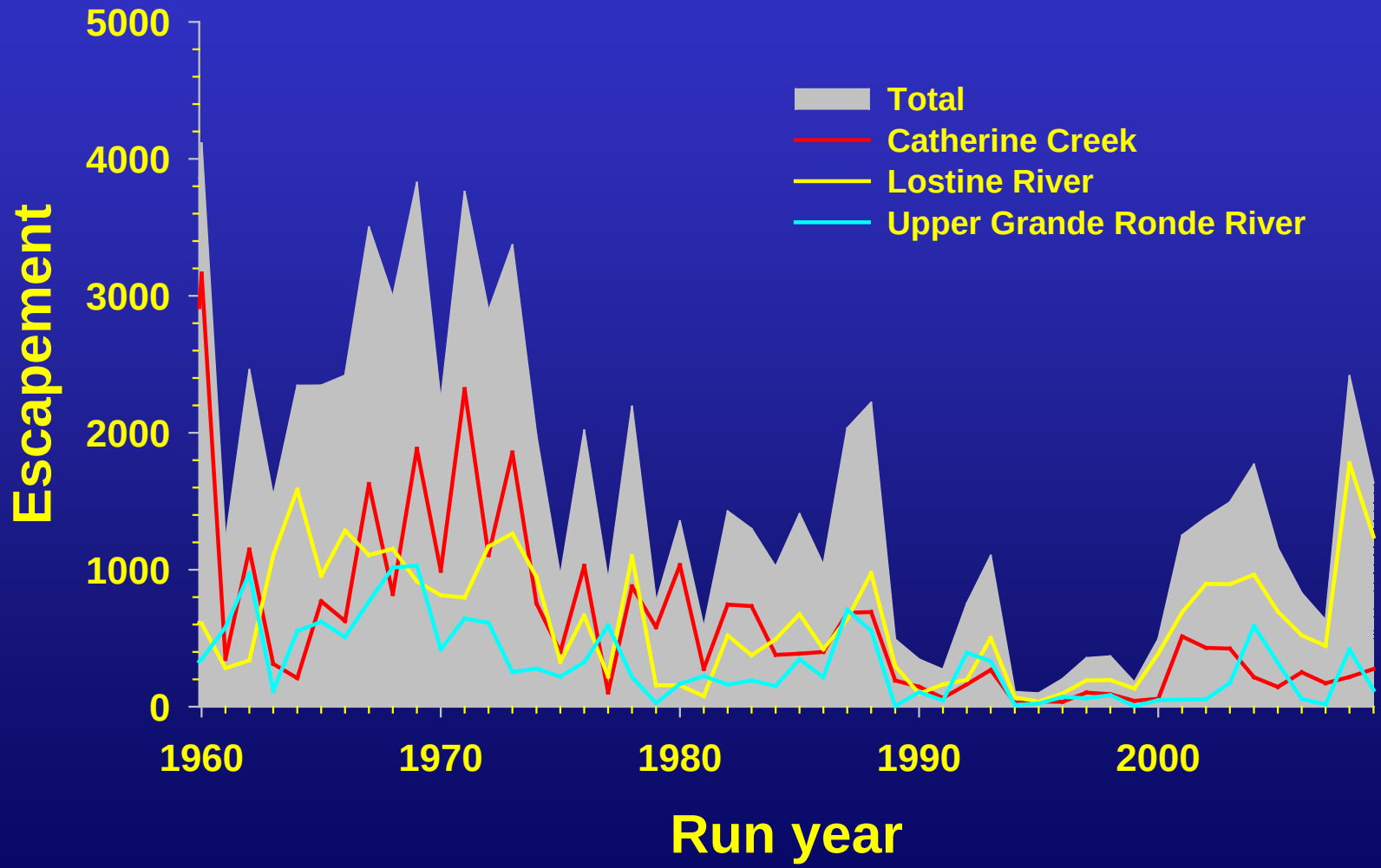
	Natural		CHP		CBS		
Parameter	Rate	Number	Rate	Number	Rate	Number	Units
Fecundity	4,141	0.44	3,977	0.14	4,141	0.44	Females
Fertility	0.906	1,840	0.891	570	0.906	1,840	Green
Eyed-to-Parr	0. 3	1,667	0.965	508	0.3	1,667	Eyed
Number of parr		**500**		**500**		**500**	**Parr**
Parr-to-Smolt	0.13	65	0.98	490	0.97	485	Smolts
Smolt-to-Adult	0.019	1.2	0.005	2.3	0.55	266.8	Adults
Sex Ratio	0.5	0.6	0.5	1.1	0.5	133.4	Females
Fecundity	4,141	2,492	3,977	4,492	1,795	239,408	Eggs
Fertility	0.906	2,258	0.0891	4,002	0.811	194,160	Eyed
BKD Culling	1	2,258	0.99	3,962	0.8	155,328	Eyed
Eyed-to-Smolt	0.039	88	0.965	3,824	0.688	106,866	Smolts
Smolt-to-Adult	0.019	**2**	0.005	**18**	0.003	**370**	Adults

Conclusions

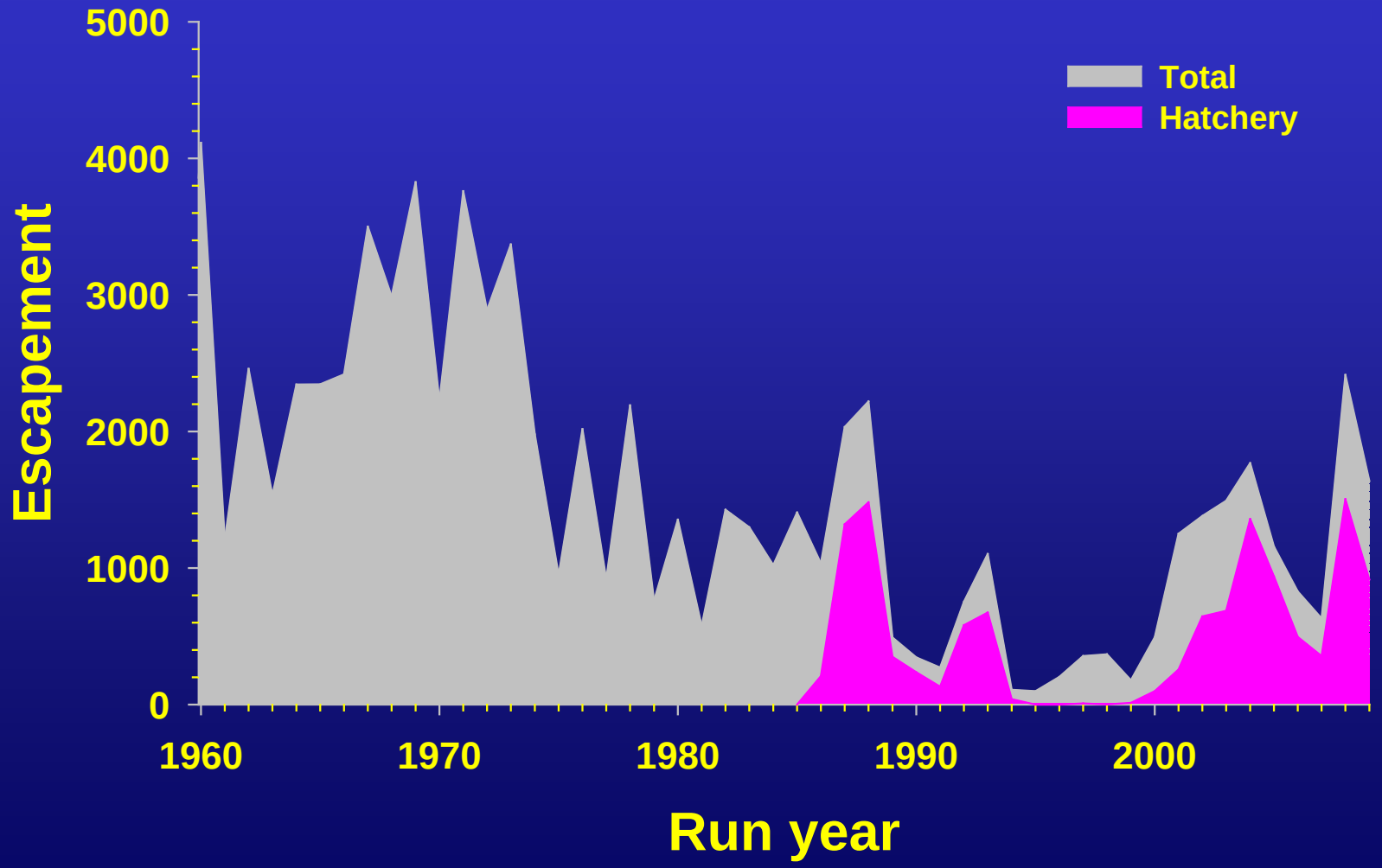
Captive Broodstock can rapidly increase numbers of returning adults but has issues to address:

- Growth / Fecundity
- Disease / Culling
- F_1 performance in hatchery
- Amplifying genes in population?

Adult Returns 1960-2009

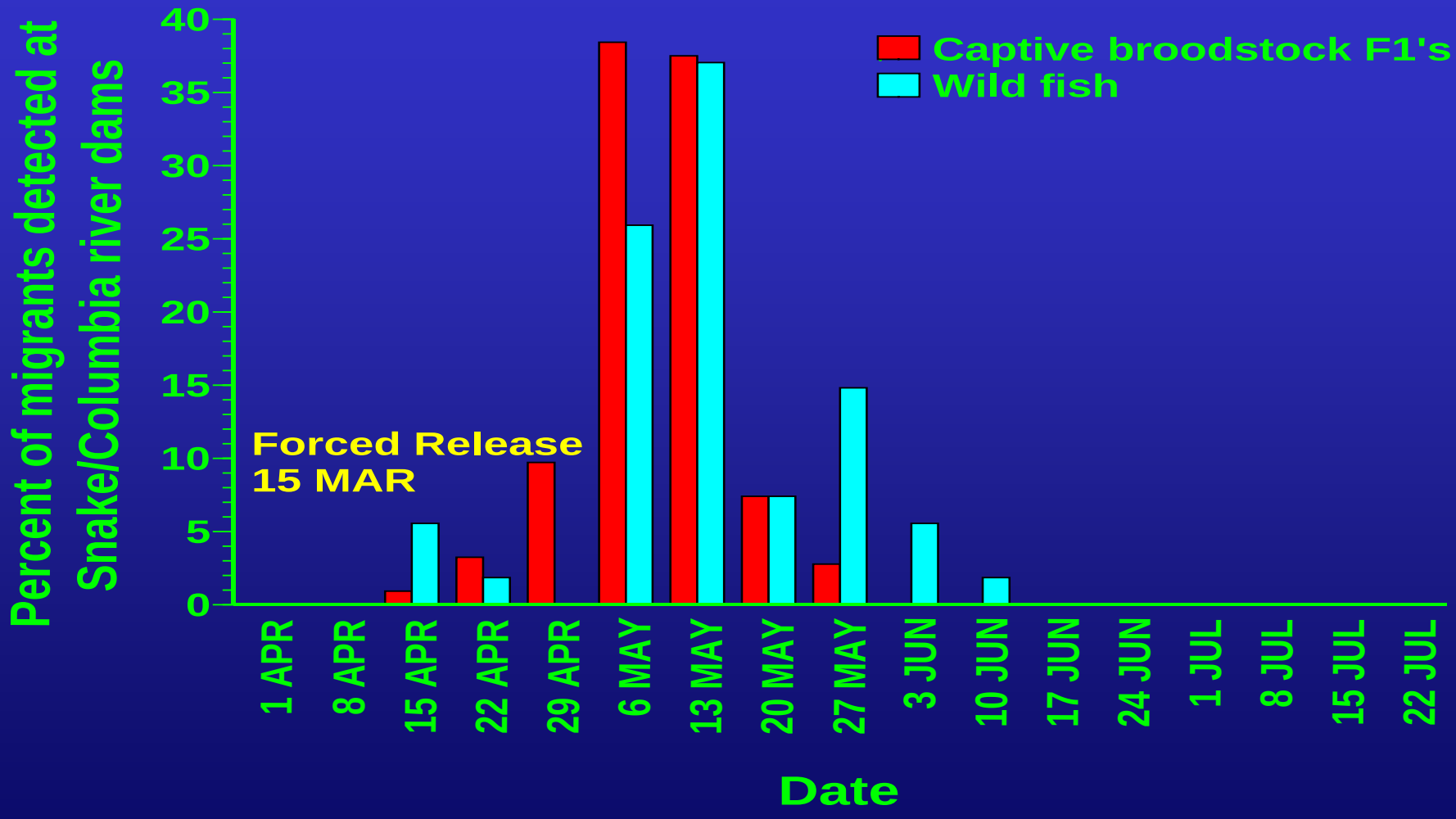


F_2 Generation?

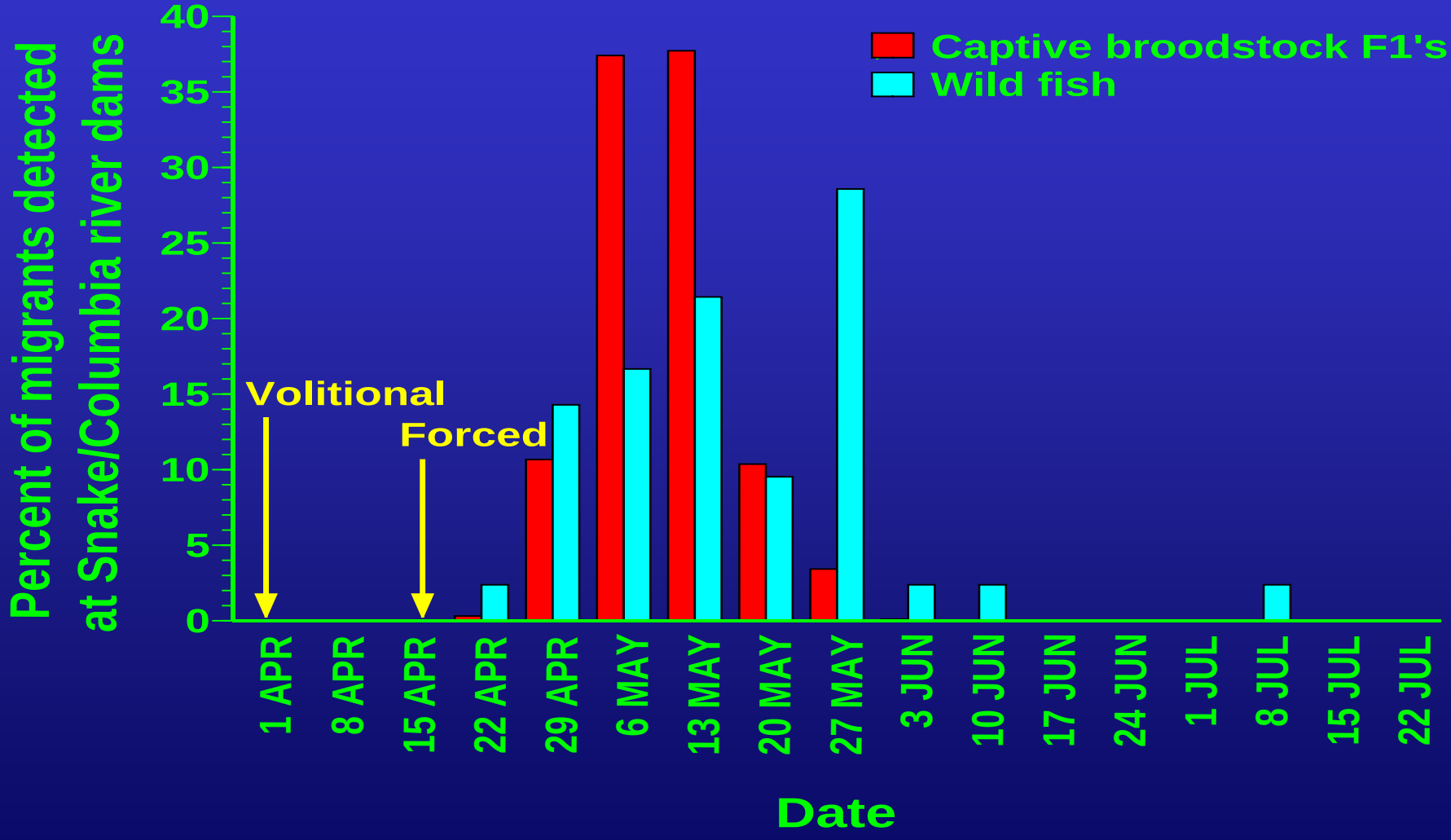


Questions?

F_1 Migration Timing – Grande Ronde River



F_1 Migration Timing – Lostine River



Assumptions/Targets

Collection……..……500 parr/stock/year

Sex ratio……..1:1

Age at maturation:

Age	2	3	4	5
Percent females	0	6	78	16
Percent males	2	35	48	15

Assumptions/Targets continued

Female maturation timing……Aug/Sept

Female gamete production:

Age	3	4	5
Number of eggs	1200	3000	4000

Survival ……..90% parr to smolt

55% smolt to adult

50% overall

Assumptions/Targets continued

Egg viability……75%

F_1 egg-to-smolt survival……80%

Return Rate of F_1's……0.1%

F1 age of maturity:

Age	3	4	5
Percent return	10%	60%	30%

Summary

- **Parr Collections:**
  - Met goal of 500 parr/stock/year (except for Grande Ronde River BY's 1994, 1995 and 1999)
- **Growth:**
  - Growth was slower than expected
- **Survival:**
  - Parr-to-Smolt survival was above 95% expected
  - Smolt-to-Spawn survival met the 55% goal but varied widely
- **Mortality:**
  - BKD was the largest causes of mortality
- **Maturity and Spawning:**
  - Males matured earlier than expected – most Age 3
  - Females matured later than expected – fewer Age 4, more Age 5
  - Fecundity was 60% lower than expected

Endpoints and Off ramps

- Disposition of excess F_1 fish in years of overproduction.
  - We have outlet streams into which we can stock excess production.
- Endpoints for program - goal of consistent return of 150 adults spawning in nature.
  - We have achieved this goal for the Catherine Creek and Lostine River populations. The 2005 brood year was the last collected for these populations.
  - Upper Grande Ronde River population has not achieved this goal and the program is continuing as a Safety Net Program.

Background

Captive Broodstock Rearing

Captive Broodstock Program vs. Conventional Hatchery Program

Grande Ronde River Basin

Grande Ronde River Basin

Grande Ronde River Basin

Grande Ronde River Basin

Grande Ronde River Basin

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Grande Ronde River Basin