

A man wearing a blue shirt, a white baseball cap, and waders is bent over a stream, pouring water from a blue bucket into the water. The stream is surrounded by dense forest and fallen logs. The scene is lit with natural sunlight filtering through the trees.

The Russian River Coho Salmon Captive Broodstock Program: A Recovery Hatchery at Work

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Pacific Ocean

Southern Oregon/Northern CA Coast ESU

(Threatened)

Central California Coast ESU

(Endangered)


Russian River Basin

Warm Springs Hatchery

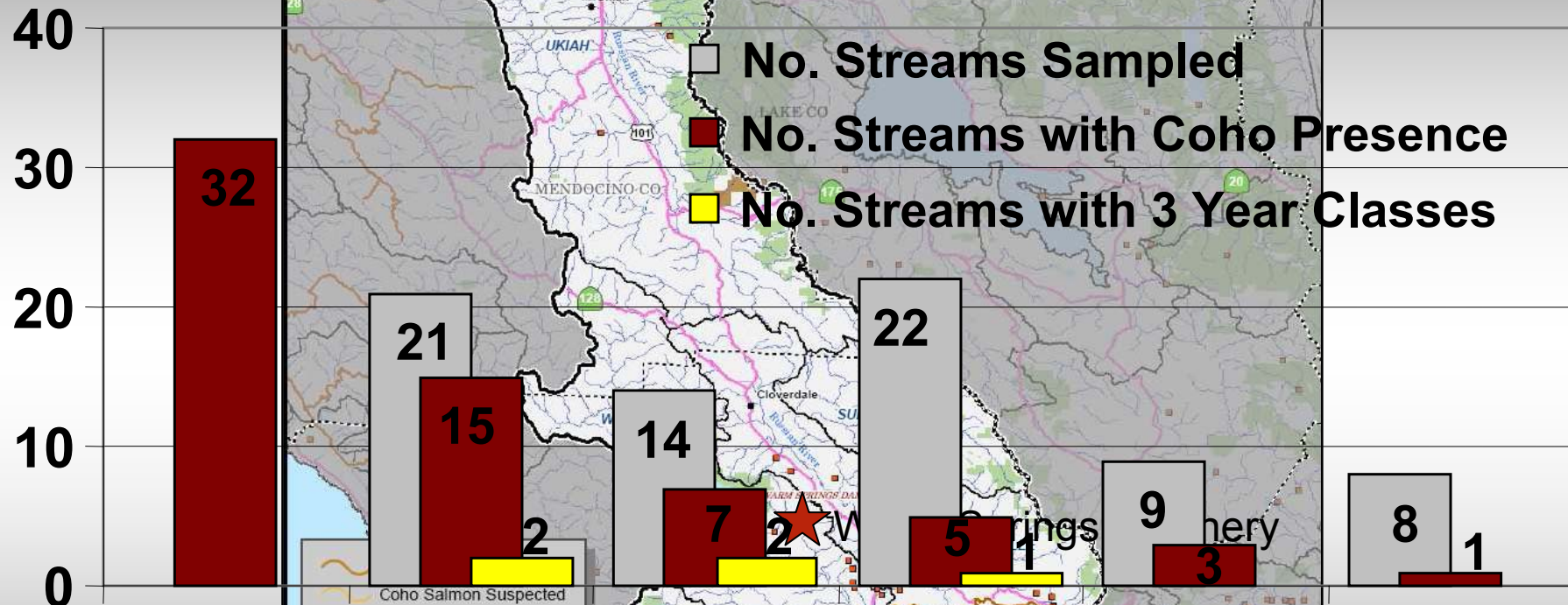
San Francisco

ESU Name

-  Southern Oregon / Northern California Coasts
-  Central California Coast

 Counties

Decline of Coho in the Russian River Watershed



Historic

1995-1997

1998-2000

2001-2003

2004-2006

2007-2009



•Brown, et al. 1994
•Jong, 2006

Russian River Coho Salmon Captive Broodstock Program

- Extinction of coho salmon in the Russian River basin was imminent without immediate intervention
- In 2001, state and federal agencies, along with non-profit groups, collaborated to begin a captive broodstock program.



Cooperating Landowners

Partnership



Principle Goal: Re-establish self-sustaining runs of native coho salmon into streams within the Russian River watershed that historically supported coho salmon

Program Components:

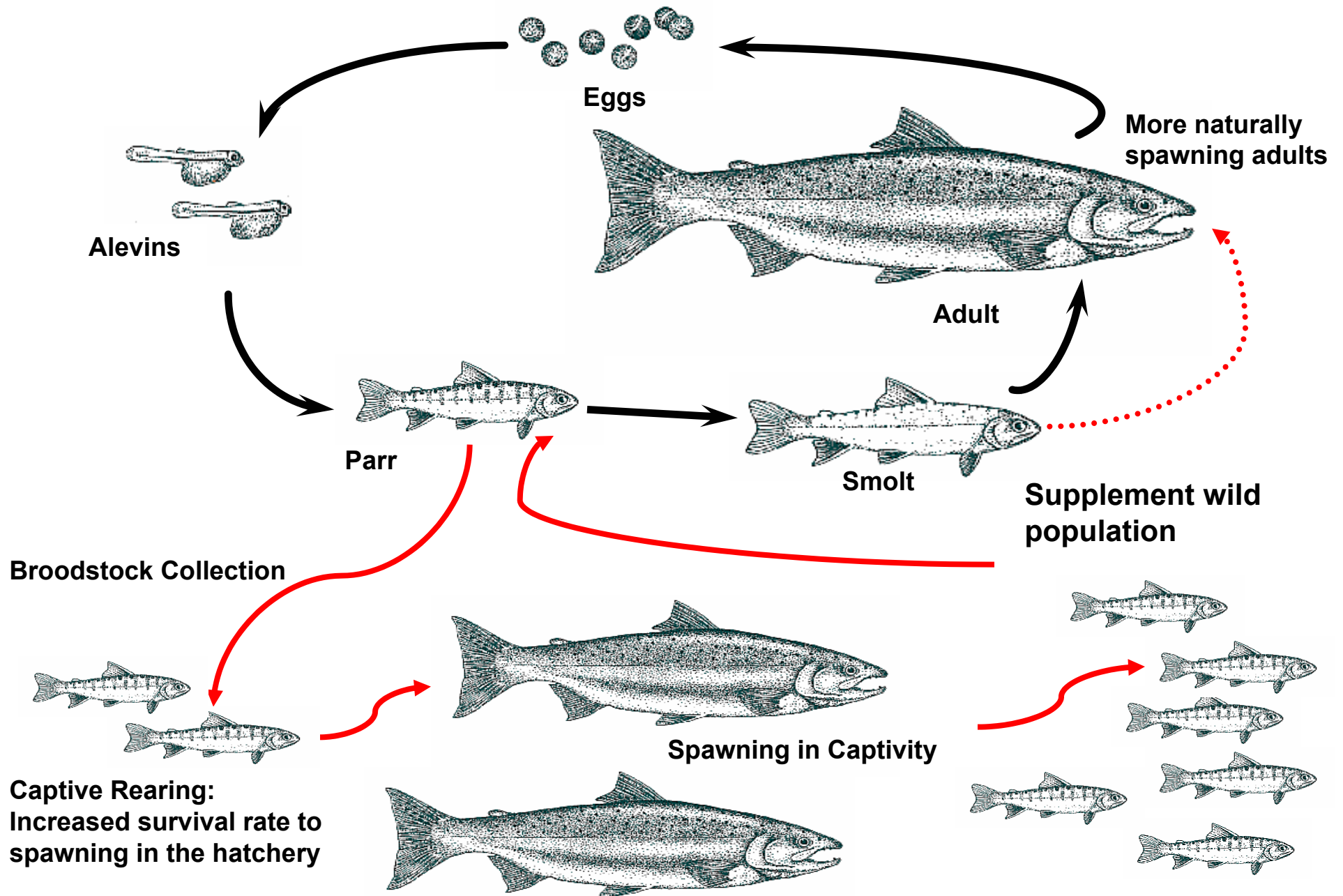
Hatchery



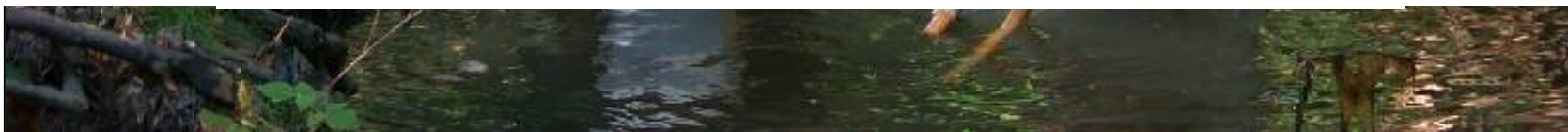
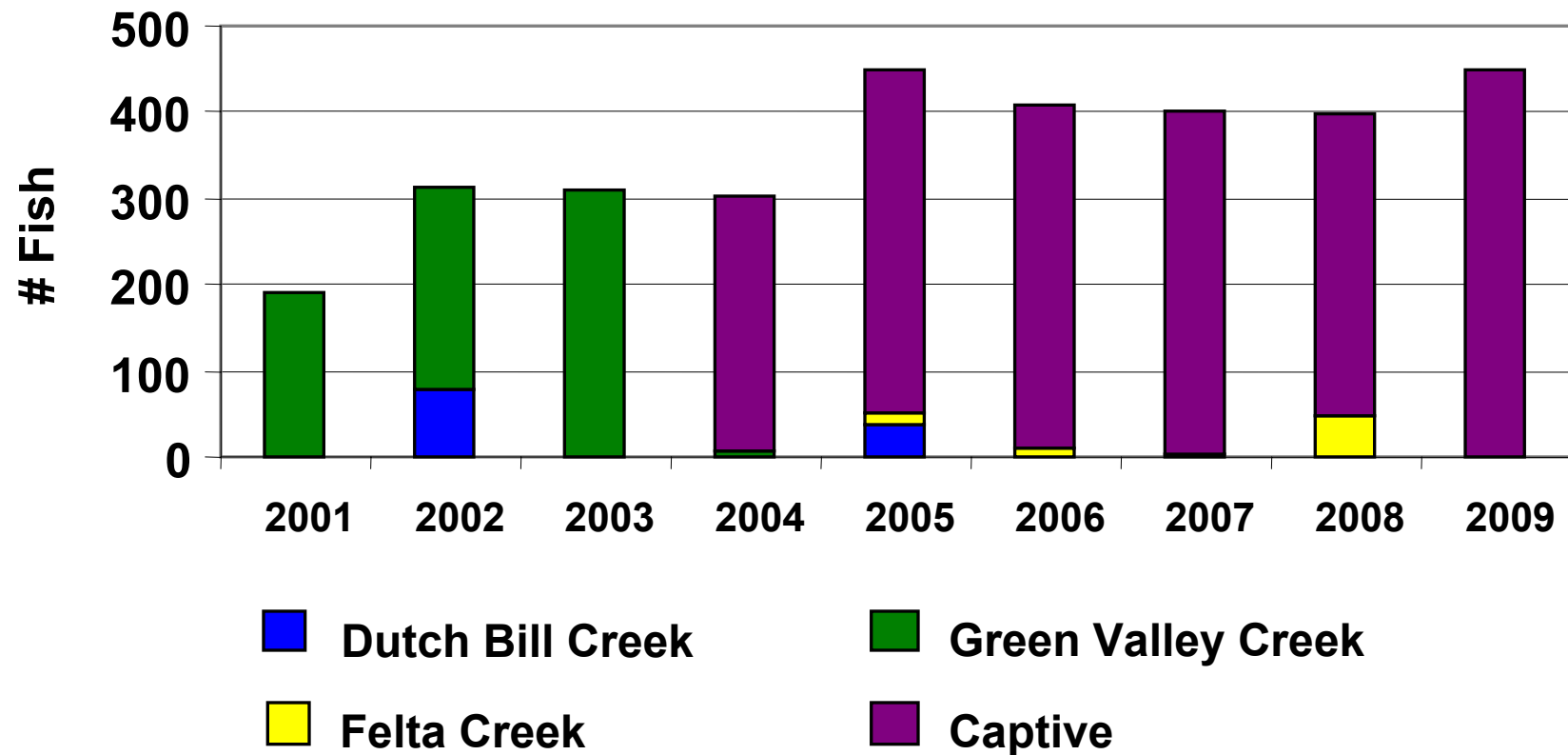
Monitoring



Recovery Hatchery Model



Broodstock Collection History



Raising Broodstock to Maturity



PIT-tagging and genetic sampling

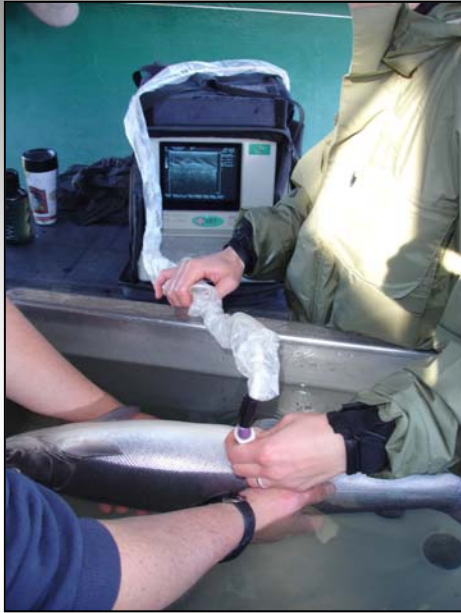


Low rearing densities
and natural food
supplementation



Routine
broodstock
inventories

Ripeness Sorts



Ultrasasound to determine sex and
monitor gonadal development

Ovaplant
(GnRH)
used as a
spawning
aide



Disc-tags used for easy
identification during
spawning

Broodstock Spawning

Spawning Matrix

- Males are ranked for each female
- No pairs with $R_{xy} \geq 0.25$ (half-sibling) are spawned
- 1 female: up to 4 males
- Each male spawned up to 5 times



Sperm motility is checked prior to fertilization



Survival rates of each full-sibling group of eggs are monitored separately

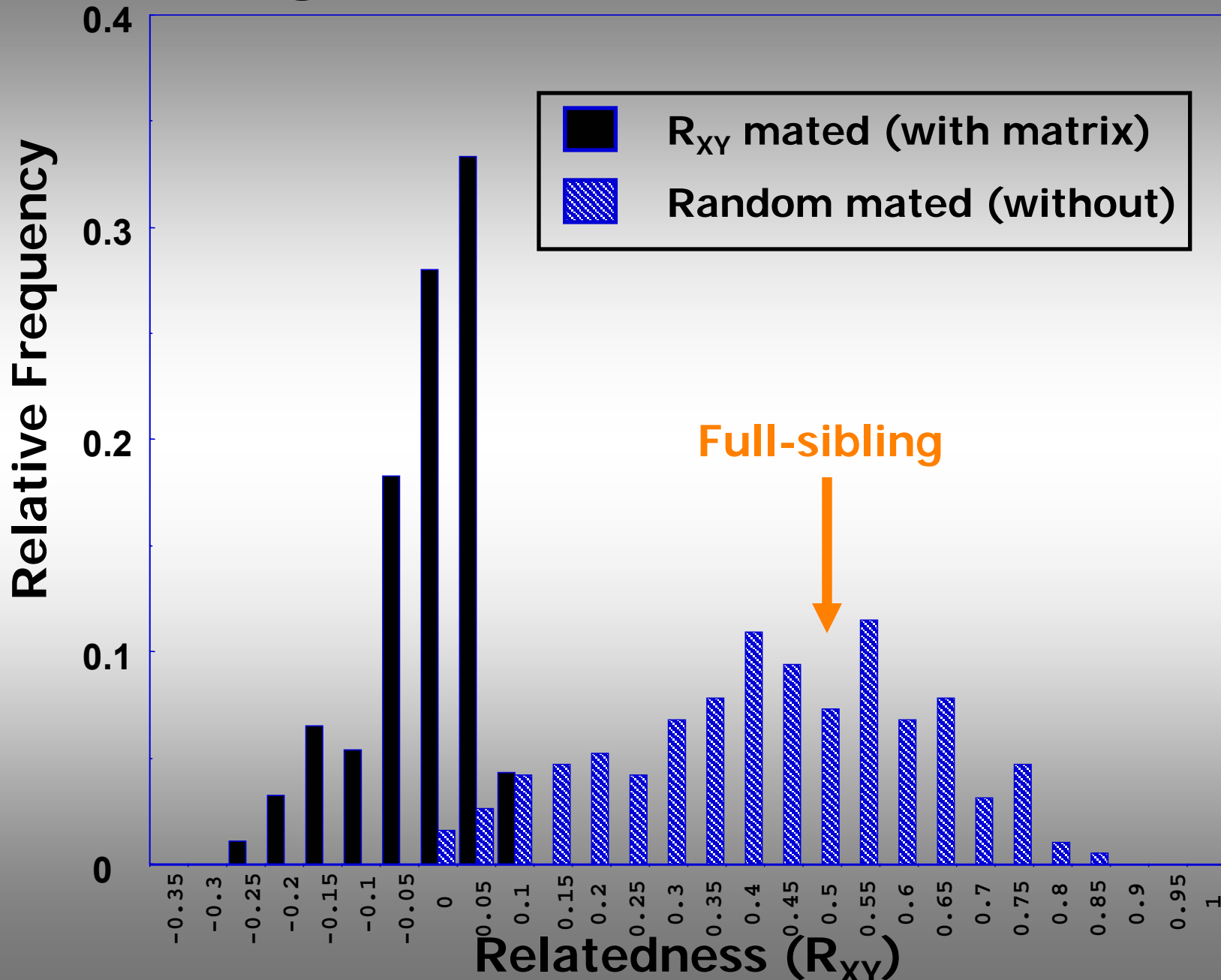
Spawning Matrix

One female per column: males ranked by R_{XY} in order of breeding partner preference

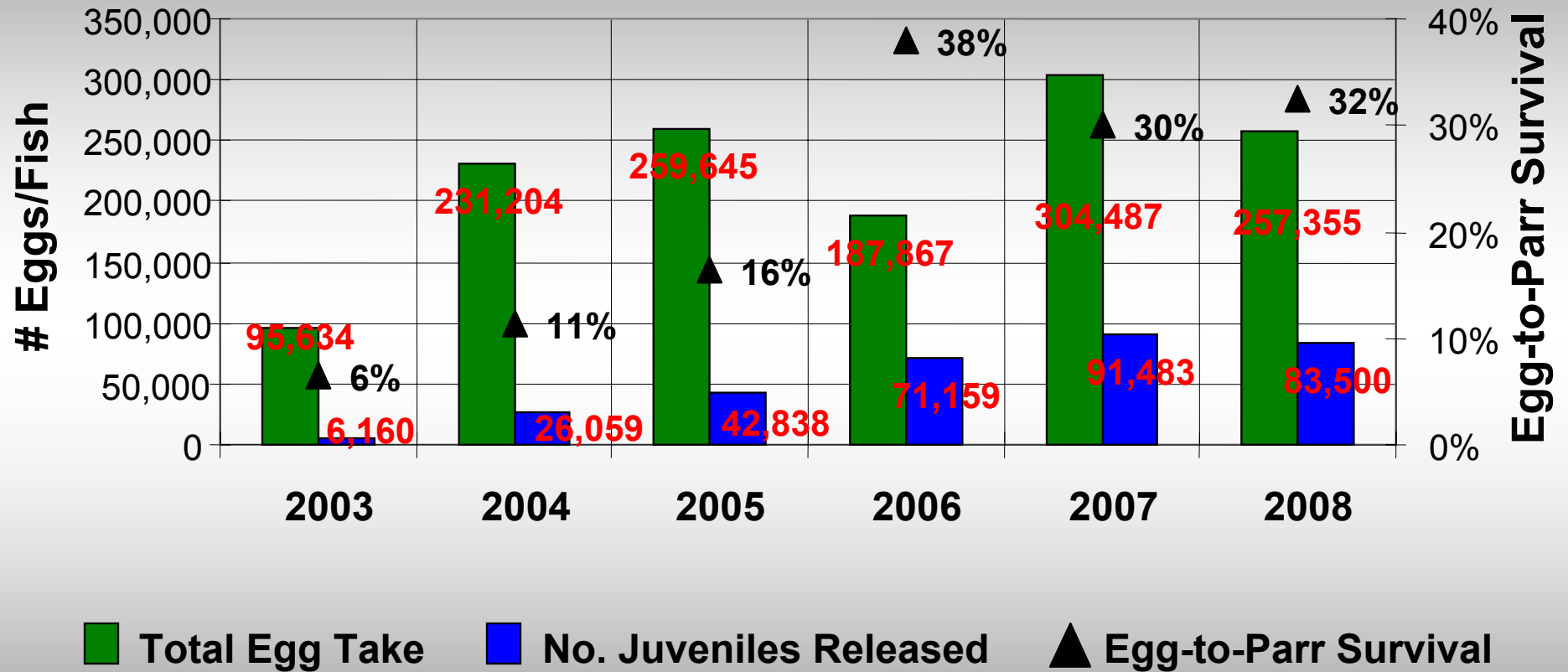
Red: males related to female at \geq half sibling ($R_{xy} = 0.25$)

F_163_(160D6C7)	F_165_(160C3C5)	F_166_(160E163)	F_167_(16068F1)	F_171_(1604E38)
M_223_(160BFf3)	M_209_(1495320)	M_153_(1610A78)	I(M)_205_(160CC2C)	M_209_(1495320)
M_221_(13C9707)	M_223_(160BFf3)	M_209_(1495320)	M_242_(1610B3C)	M_242_(1610B3C)
I(M)_205_(160CC2C)	M_172_(160EC27)	M_223_(160BFf3)	M_223_(160BFf3)	M_221_(13C9707)
M_242_(1610B3C)	M_152_(160FAFC)	I(M)_205_(160CC2C)	M_209_(1495320)	I(M)_205_(160CC2C)
M_172_(160EC27)	I(M)_205_(160CC2C)	M_190_(1610D74)	M_221_(13C9707)	M_223_(160BFf3)
U(M)_276_(1607DDC)	M_190_(1610D74)	M_242_(1610B3C)	M_153_(1610A78)	M_190_(1610D74)
M_209_(1495320)	M_10_(1606DDA)	M_221_(13C9707)	M_172_(160EC27)	M_198_(1607E4B)
M_153_(1610A78)	M_221_(13C9707)	M_198_(1607E4B)	M_37_(160B0BC)	M_304_(160E9D1)
M_10_(1606DDA)	U(M)_276_(1607DDC)	M_172_(160EC27)	M_190_(1610D74)	M_246_(16104F3)
I(M)_247_(160AB18)	M_180_(160CE0F)	U(M)_276_(1607DDC)	M_198_(1607E4B)	M_262_(1609ECD)
M_190_(1610D74)	M_242_(1610B3C)	M_244_(160E775)	M_244_(160E775)	U(M)_280_(161118D)
M_198_(1607E4B)	M_198_(1607E4B)	M_262_(1609ECD)	M_8_(160C330)	M_180_(160CE0F)
M_286_(1607BC1)	I(M)_195_(160E060)	M_155_(13C4AE8)	I(M)_237_(1605CE8)	U(M)_276_(1607DDC)
M_180_(160CE0F)	M_153_(1610A78)	U(M)_280_(161118D)	M_178_(160E77A)	M_244_(160E775)
M_248_(160C9F7)	M_246_(16104F3)	M_152_(160FAFC)	U(M)_276_(1607DDC)	M_172_(160EC27)
M_187_(160BA99)	M_262_(1609ECD)	M_248_(160C9F7)	M_248_(160C9F7)	M_273_(1606887)
M_244_(160E775)	M_304_(160E9D1)	M_180_(160CE0F)	M_274_(160E61A)	I(M)_195_(160E060)
M_155_(13C4AE8)	U(M)_280_(161118D)	M_286_(1607BC1)	M_231_(160F368)	M_152_(160FAFC)
U(M)_280_(161118D)	M_155_(13C4AE8)	M_196_(160B22A)	M_155_(13C4AE8)	M_153_(1610A78)
I(M)_195_(160E060)	M_248_(160C9F7)	M_15_(160D355)	M_301_(160C952)	M_155_(13C4AE8)
M_22_(160BF8A)	M_37_(160B0BC)	M_36_(1610BAC)	M_297_(1609CC9)	M_249_(160CE1A)
M_246_(16104F3)	M_233_(160DFBB)	M_10_(1606DDA)	M_294_(160B597)	I(M)_213_(1608CE8)
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M_231_(160F368)	I(M)_213_(1608CE8)	M_181_(160BC8D)	M_164_(160D05F)	M_181_(160BC8D)
M_178_(160E77A)	M_36_(1610BAC)	M_187_(160BA99)	M_227_(1610A0B)	M_6_(160E455)
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M_13_(160FD33)				
M_186_(160AFB5)				

Matings with vs. without the matrix



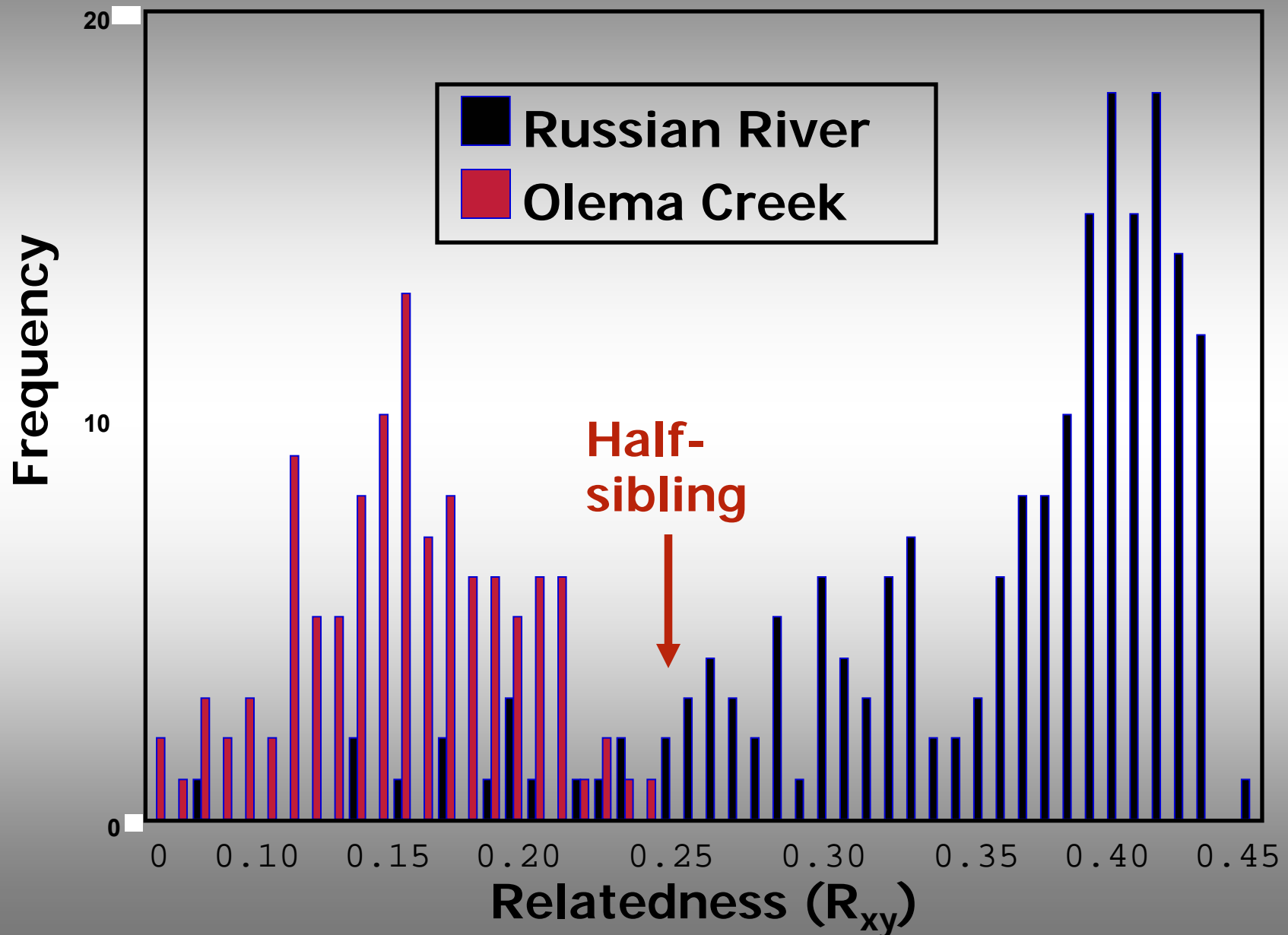
Juvenile Production History



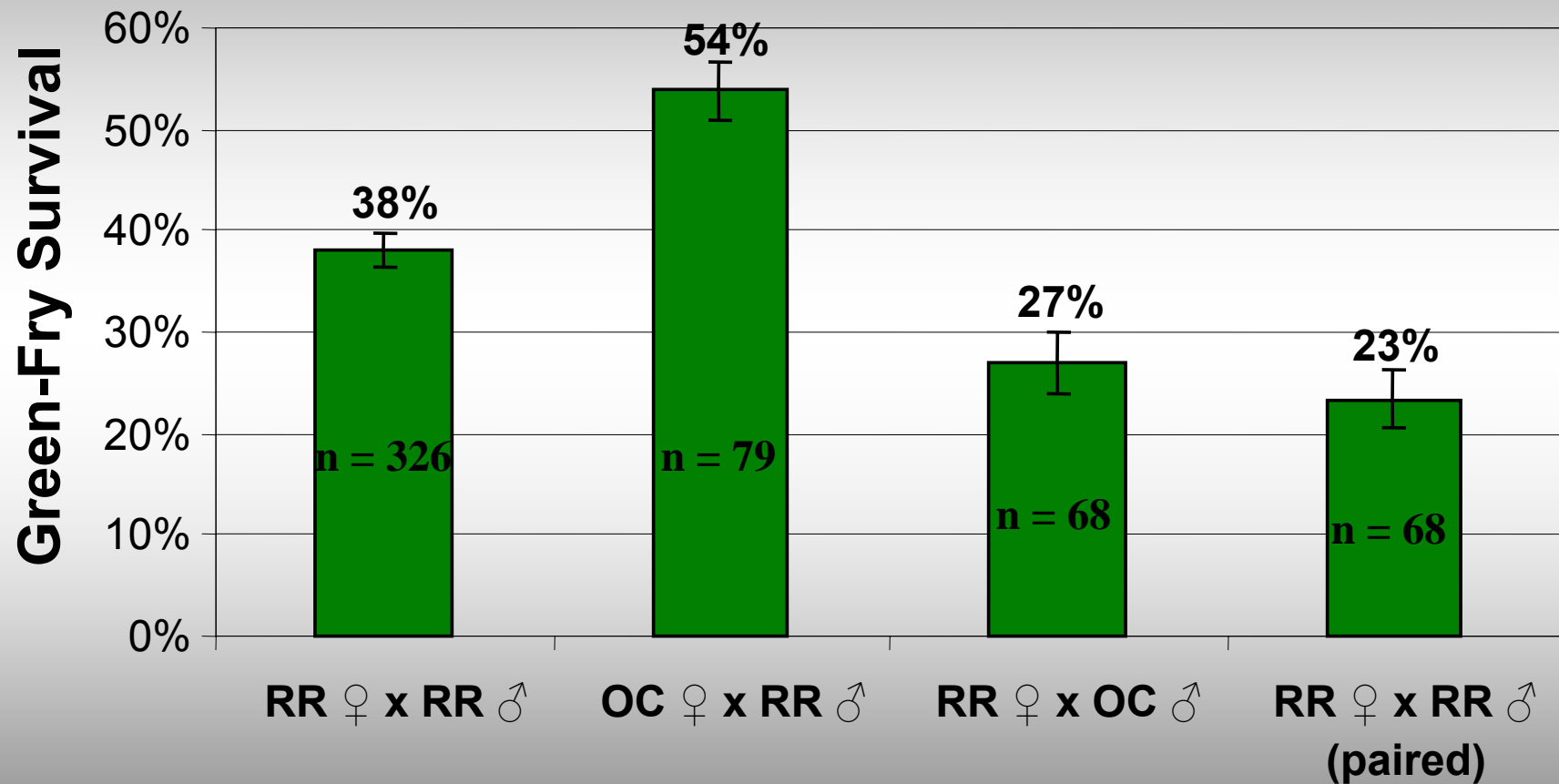
2008-09 Spawning Strategy

- 25% of the spawning effort was dedicated to outbreeding w/ the neighboring Olema Creek (OC) stock.
- No pure OC crosses conducted.
- RR females used for outbreeding were spawned 2 OC males and 2 RR males.
- Off-spring from all cross-types produced were kept separate until PIT-tagging was completed.

Distribution of Relatedness by Central Coast Stock



2008-09 Outbreeding Results



2008-09 Outbreeding Conclusions

- Obvious maternal effect b/w stocks, in which OC females have significantly higher ($p < 0.05$) early life-stage survival rates than RR females.
- Similar early life-stage survival rates ($p > 0.05$) among females spawned w/ both OC males and RR males.

Current Release/Tagging Strategy

- Off-spring are released into 7 tributaries within the RR watershed at 3 different times of the year (spring/fall of 1st year and smolt)
- All receive an adipose fin-clip and code-wire tag; and a portion receive PIT-tags.
- Use code-wire tags in different body locations to distinguish release times and in some cases release streams during outmigrant trapping.
- Fish are PIT-tagged according to their genetic cross-type (RR x RR, OC x RR, RR x OC) to evaluate potential differences in post-release growth and survival.

From the Hatchery to the Streams



What's Next????

- **Continued Outbreeding**
 - evaluating differences in early life-stage and post-release survival among genetic cross-types (RR x RR, OC x RR, RR x OC)
- **WE NEED MORE ADULT RETURNS!!!!!!!!!!!!!!**
 - (Preventing Extinction vs. Recovery)
 - increased emphasis on smolt releases
 - adult releases (e.g. Walker and Salmon Creeks)
 - program expansion.....

Acknowledgements

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