Salmon Monitoring in the Central Valley: Evolution or Intelligent Design?

John Williams

Outline of talk

1. Conceptual foundations for salmon management and their implications for monitoring.
2. Genetic effects of hatchery culture and the condition of Sacramento River fall Chinook.
3. ISAB recommendations re monitoring integrated hatchery programs.
4. An alternative approach.
5. What should be our normative fish?
6. Back to conceptual foundations and their implications for monitoring.

Salmon at River’s End:

the role of the estuary in the decline and recovery of Columbia River Salmon

Dan Bottom et al. 2001

	Production Thinking	Population Thinking
Goals	**Efficiency, production**	**Resilience, reproduction**
Population Units	**Arbitrarily defined**	**Biologically defined**
Time Frame	**Short**	**Evolutionary**
Objectives	**Control survival and abundance**	**Conserve local populations and life-history diversity**
Estuary Function	**Corridor for a single, homogenous group of salmon**	**Nursery area for many self-sustaining populations**
Estuary Management	**Control predators, promote rapid salmon out-migration**	**Protect habitats of diverse life-history types**

River	Environment	Goal
Upper Sac.	**Natural**	**99,000**
	Hatchery	*9,000*
Feather	**Natural**	**27,000**
	Hatchery	*5,000*
Yuba	**Natural**	**10,000**
American	**Natural**	**24,000**
	Hatchery	*6,000*

“The separation of hatchery and natural fish … is artificial.” PFMF (1984)

Sacramento fall Chinook goal:
122,000 – 180,000.

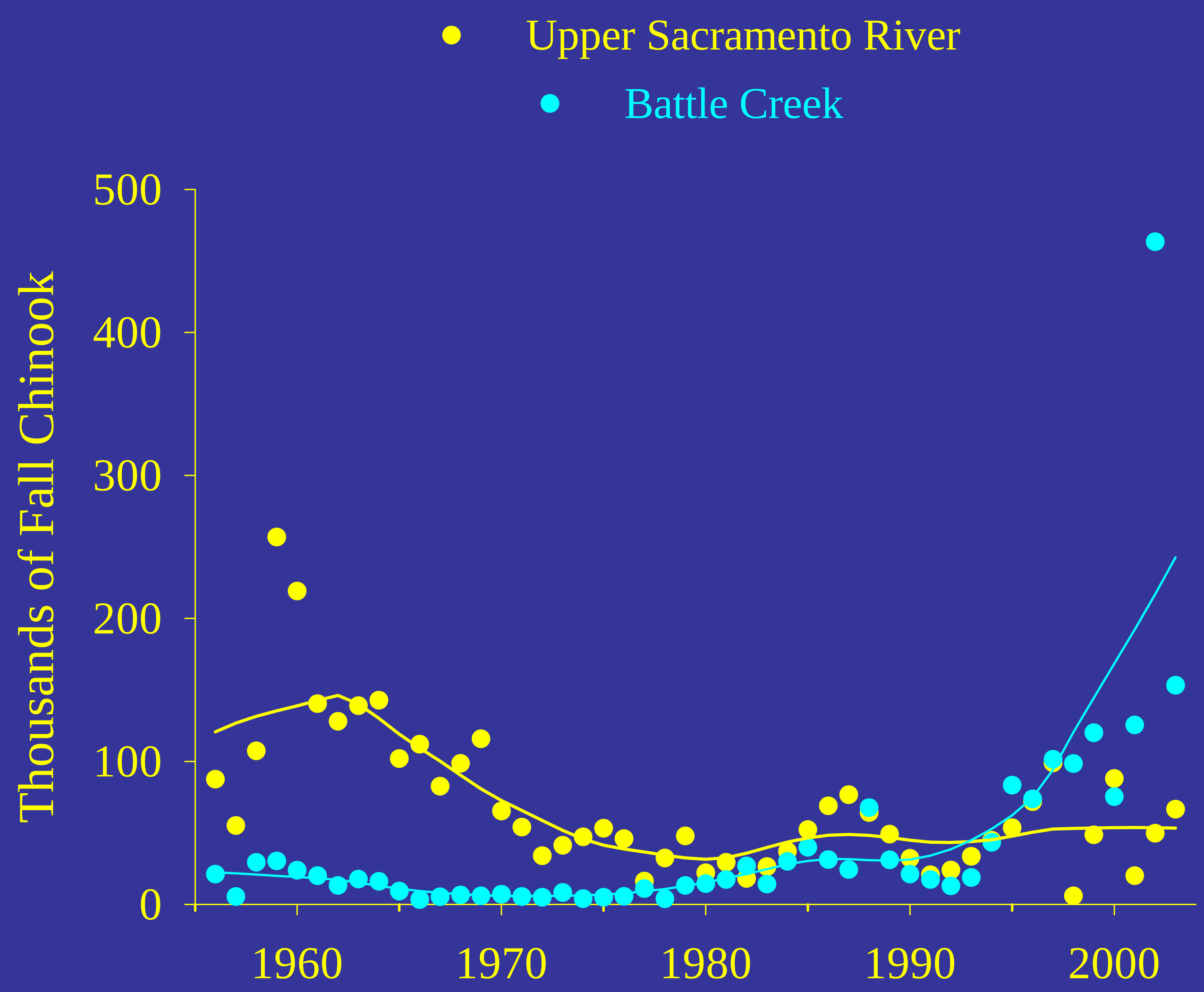
“A major shift in evolutionary biology in the last quarter century is due to the insight that evolution can be very rapid when large populations containing ample genetic variation encounter strong selection (citations omitted).”

Stearns and Hendry (2004:15) “Evolution illuminated: salmon and their relatives”

“Inevitably, hatchery brood stock show domestication effects, genetic adaptations To hatchery environments that are generally Maladaptive in the wild.”

Myers et al. (2004)

Do hatchery fish supplement or replace natural fish?



Upper Sacramento River
Battle Creek
Thousands of Fall Chinook
500
400
300
200
100
0
1960
1970
1980
1990
2000

Ad-clipped fish of fish inspected

	Battle Creek	Mill Creek	Deer Creek
2003	**11.6%**	**5.3%**	**9.5%**
n	945	1,295	21
2004	**7.5%**	**5.7%**	**3.1%**
n	2,151	405	130

“**Evolutionary bi**ologists have long recognized that an organism’s performance (or fitness) in one specific environment is accompanied by the organism’s decreased performance (or fitness) in other environments.”

S. Elena and R. Sanjuán (2003), Climb every Mountain? “Perspectives” essay in Science (302:2074) discussing experimental work on bacteria reported in that issue.

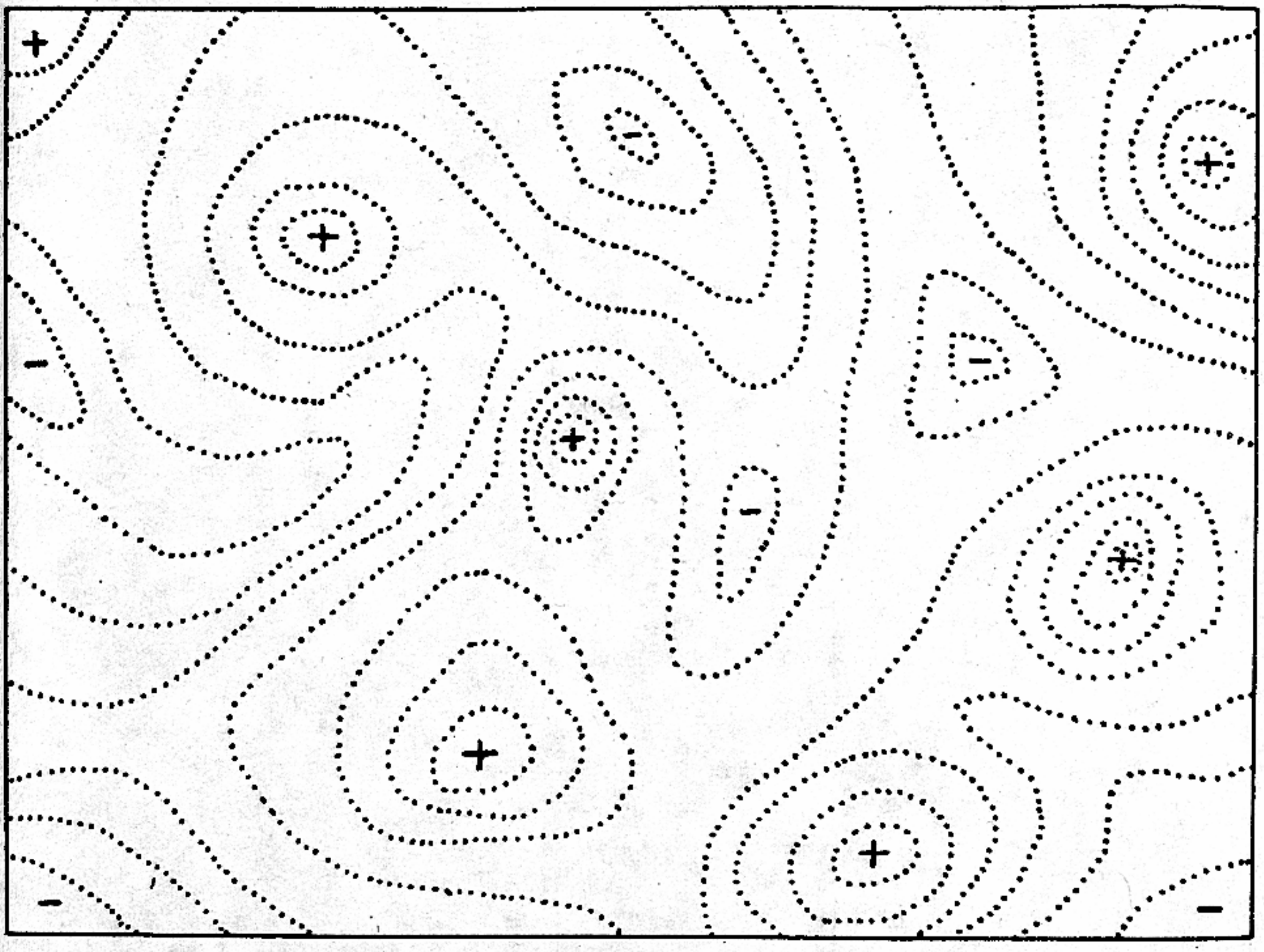
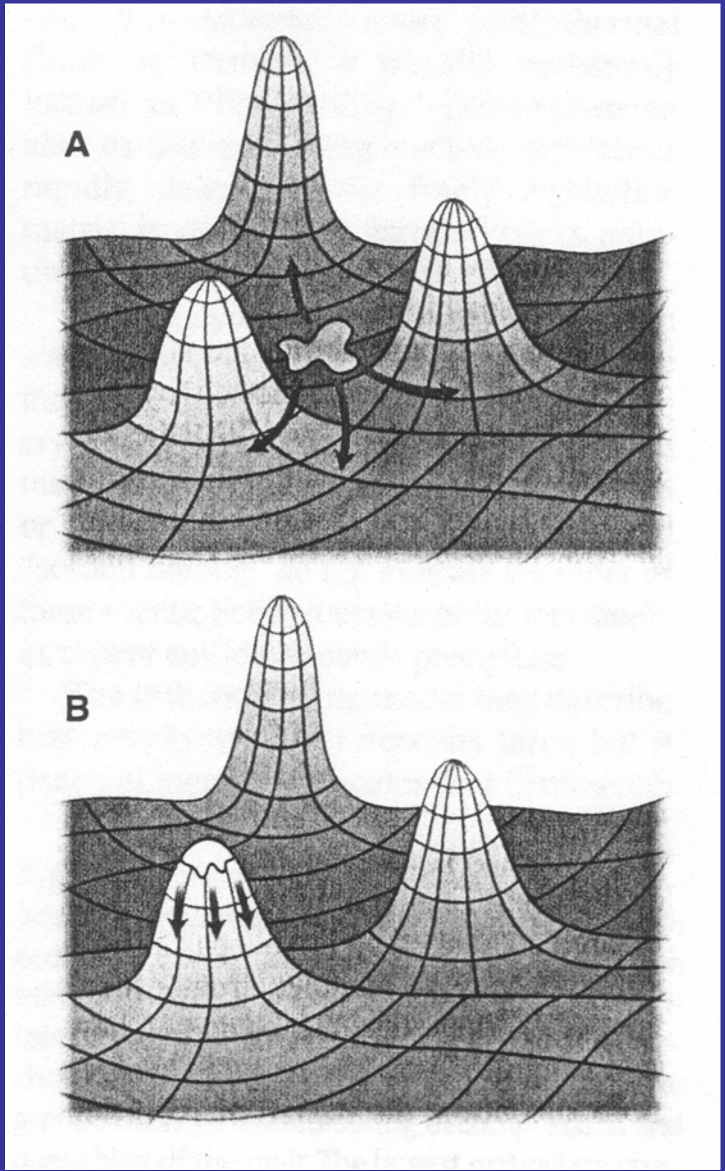


FIGURE 2.—Diagrammatic representation of the field of gene combinations in two dimensions instead of many thousands. Dotted lines represent contours with respect to adaptiveness.


A
B

Review of Salmon and Steelhead Supplementation

Independent Scientific Advisory Board

2003

Robert Bilby
Susan Hanna
Peter Bisson
Eric Loudenslager
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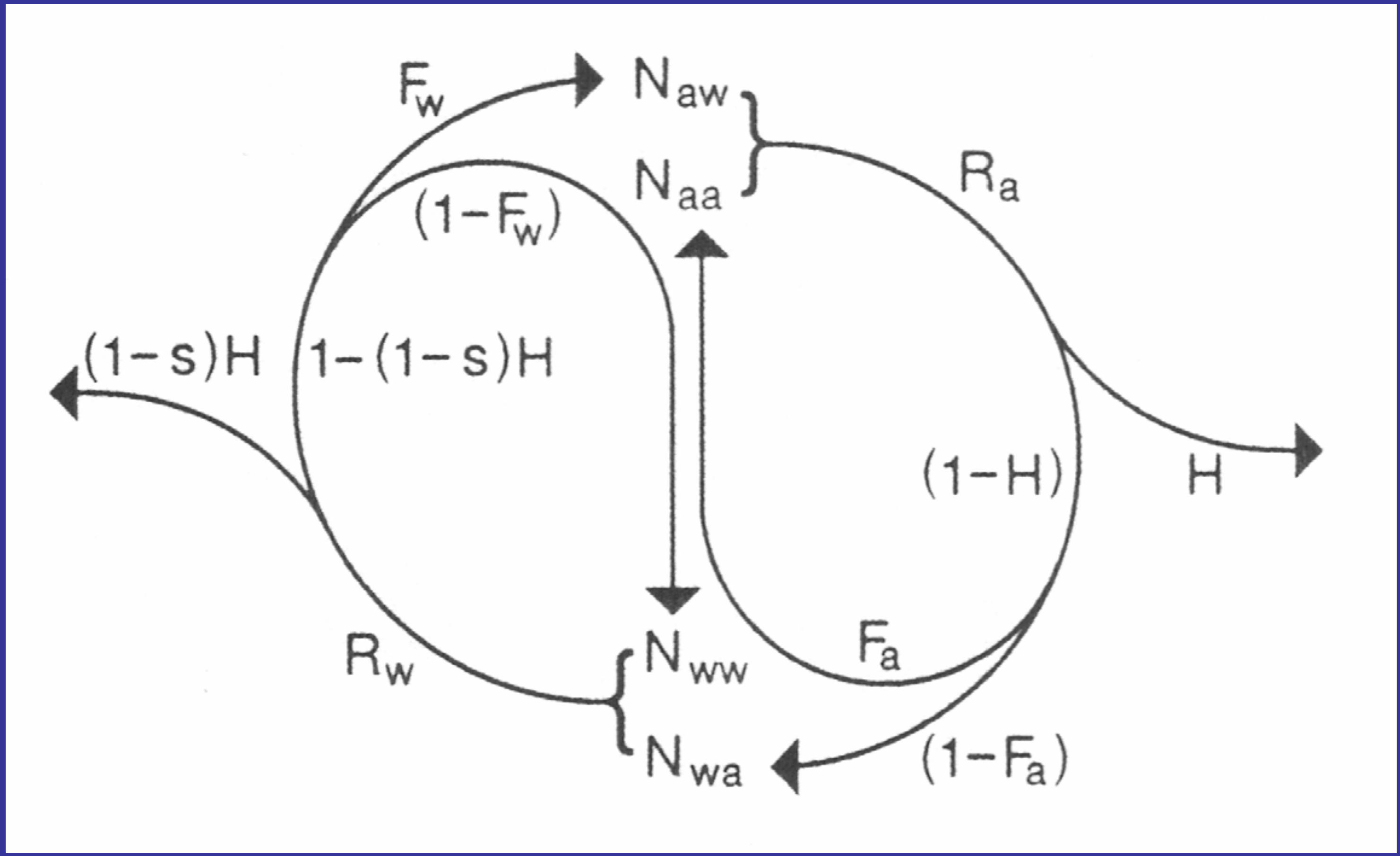
Lyman McDonald
Dan Goodman
David Philipp
Robert Gramling
Brian Riddell

Ad Hoc Member Richard Williams

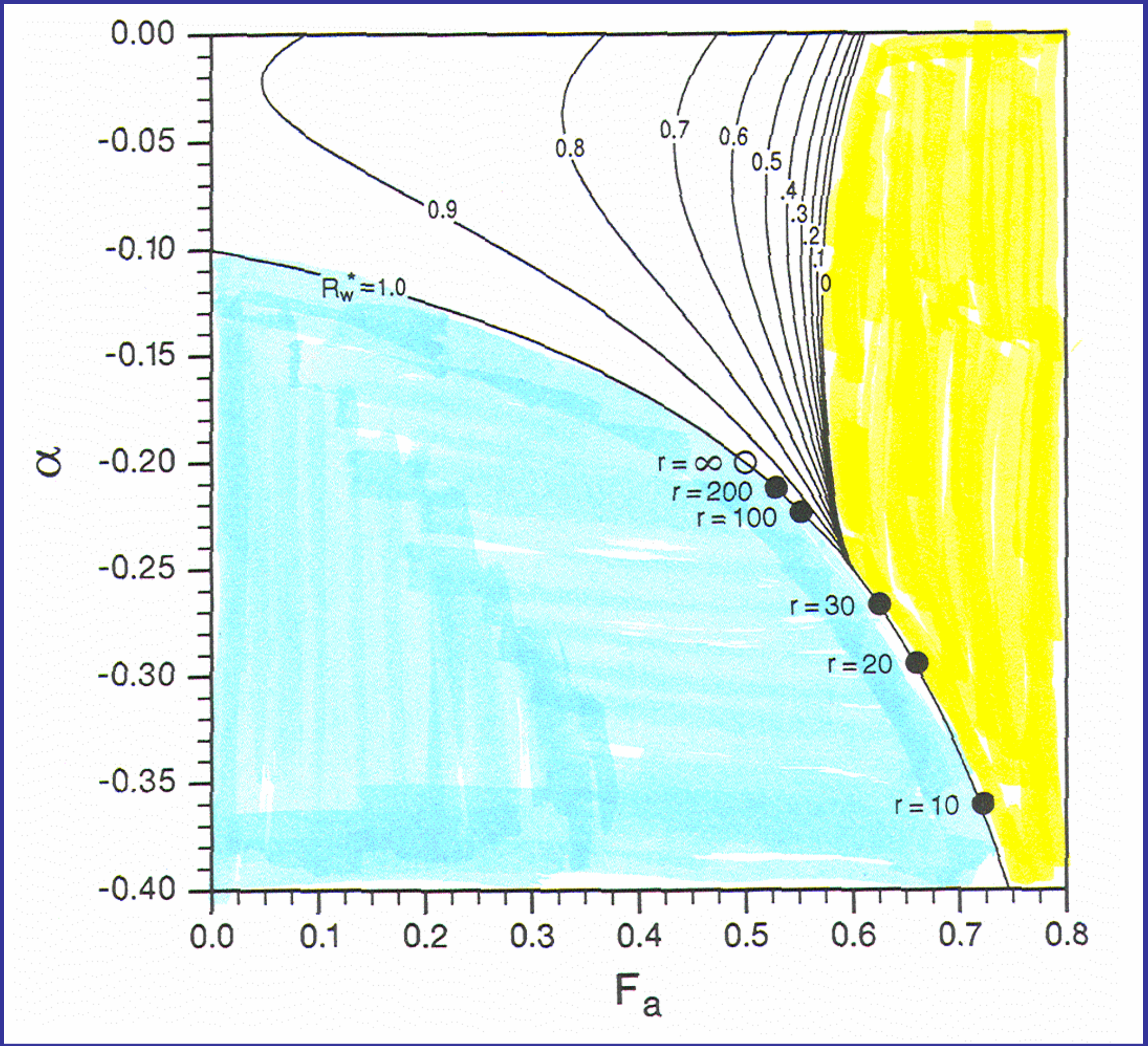
Dan Goodman

2004. Salmon supplementation: demography, evolution and risk assessment. Pages 217-232 *in* Nickum et al. (eds) Propagated Fish in Resource Management. AFS Symposium 44.

2005. Selection equilibrium for hatchery and wild spawning fitness in integrated breeding programs. CJFAS 62:374-389



F_w
N_{aw}
N_{aa}
$(1-F_w)$
R_a
$(1-s)H$
$1-(1-s)H$
$(1-H)$
H
R_w
N_{ww}
F_a
N_{wa}
$(1-F_a)$



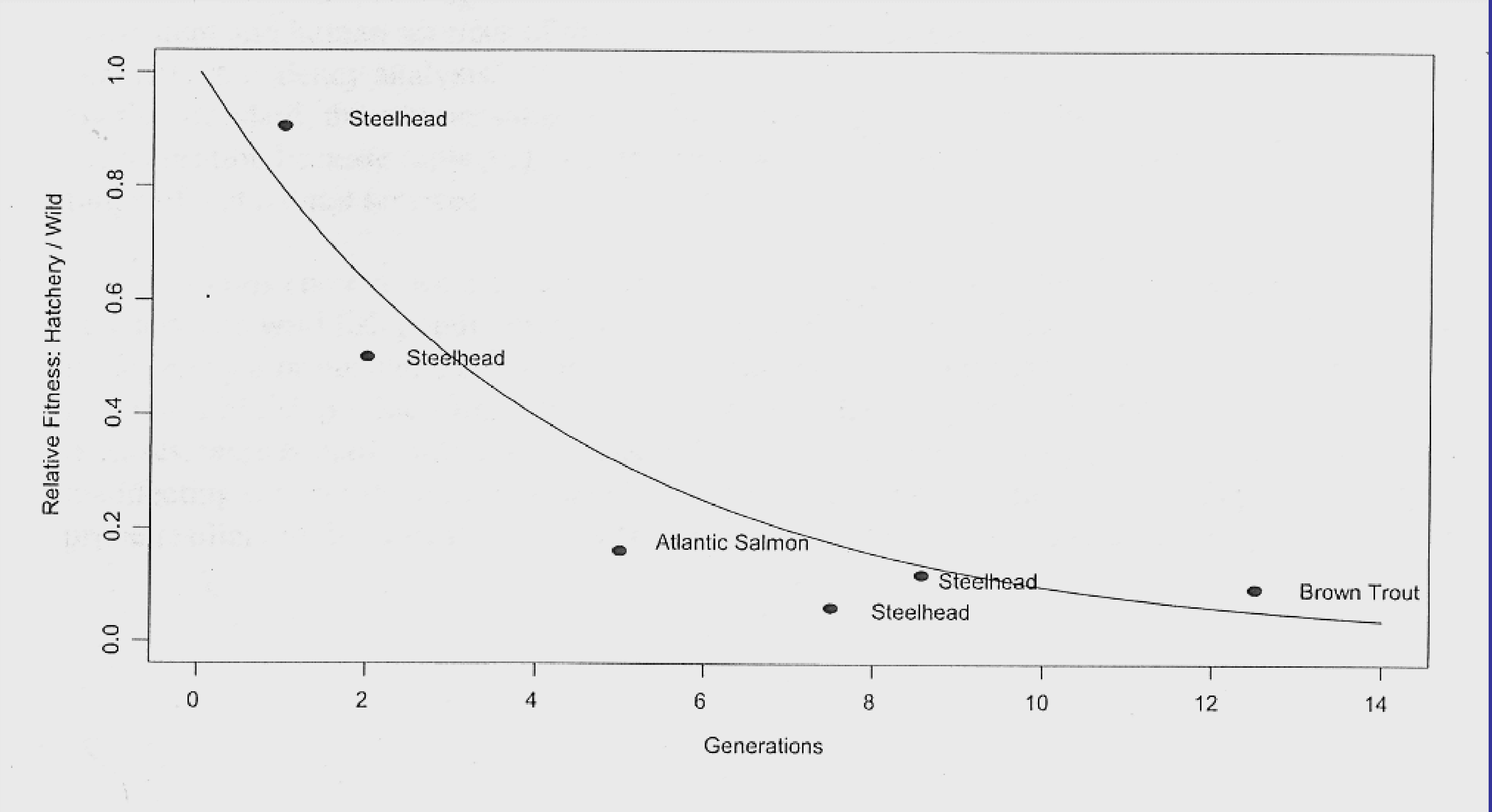
Initial parameter values:

$R_w = 1$

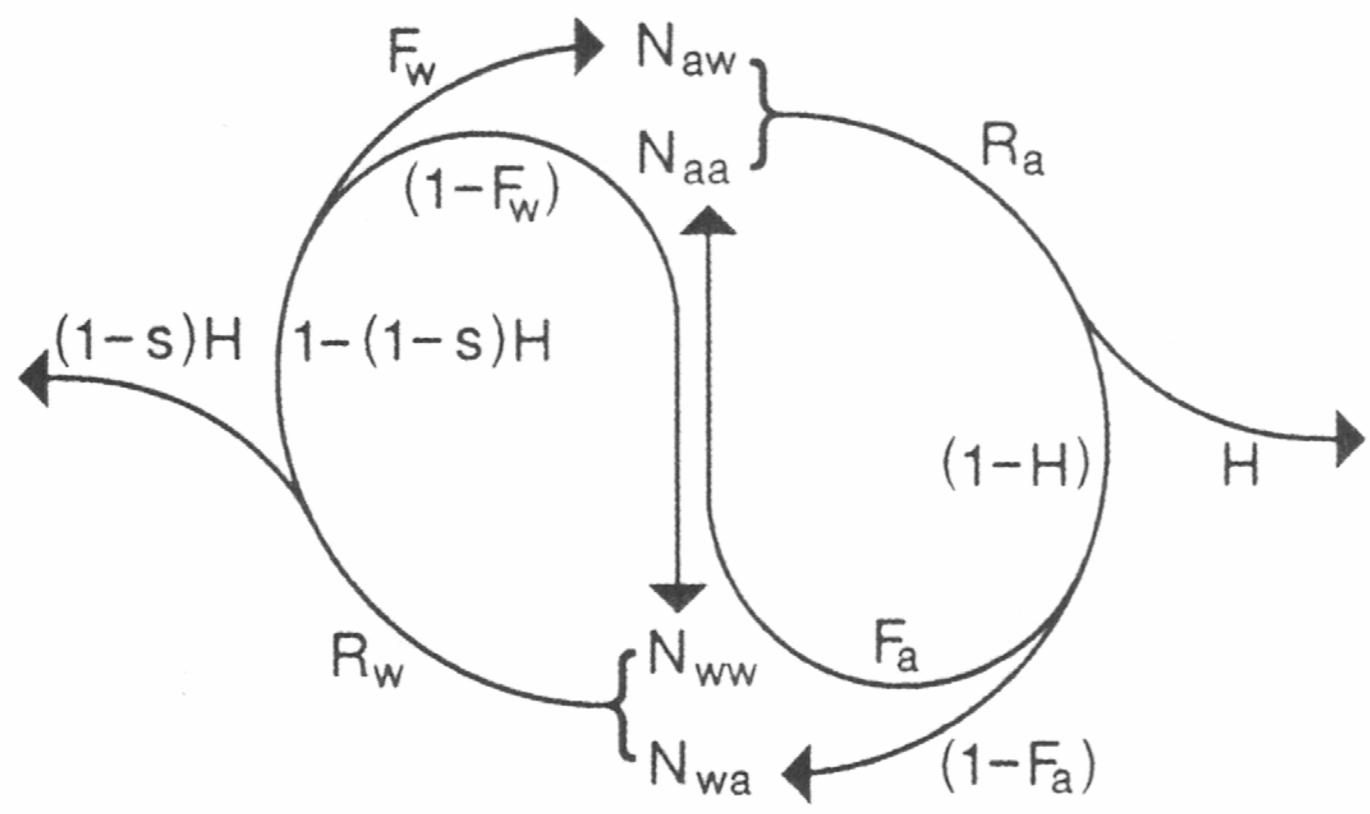
$R_a = 5$

$S = 1$

$F_w = 0.5$



From RSRP, Report for Meeting Aug 30, Sept. 2., 2004



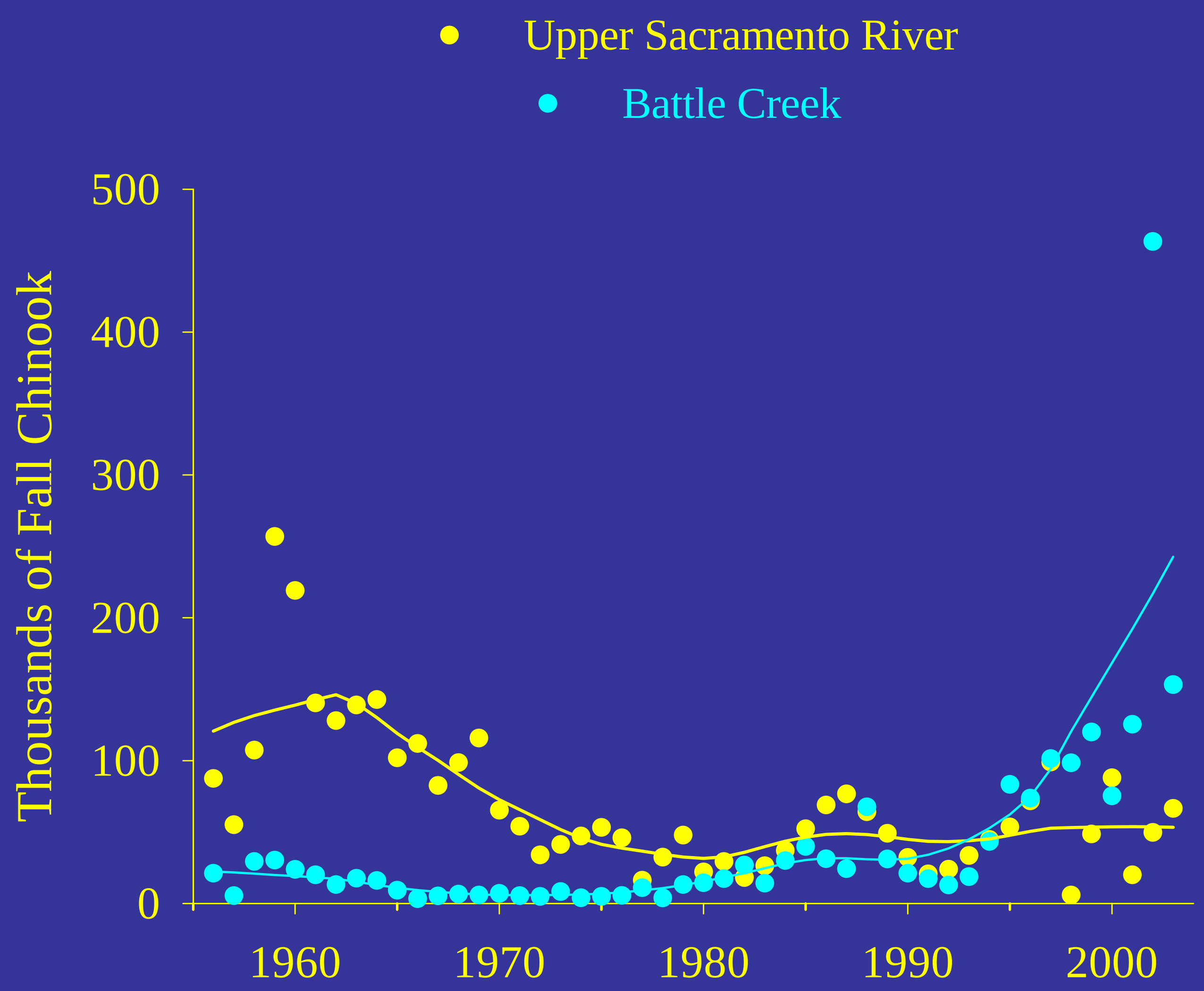
F_w
N_{aw}
N_{aa}
R_a
$(1-F_w)$
$(1-s)H$
$1-(1-s)H$
$(1-H)$
H
R_w
N_{ww}
N_{wa}
F_a
$(1-F_a)$

ISAB Recommendations:

 # (with C.I.) ♀ natural fish spawning in the river and in the hatchery, by age;

 # (with C.I.) ♀ hatchery fish spawning in the river and in the hatchery, by age;

Fecundity, pre-spawning mortality, spawning effectiveness, adult age structure, adult length and weight, run timing, spawn timing.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500
400
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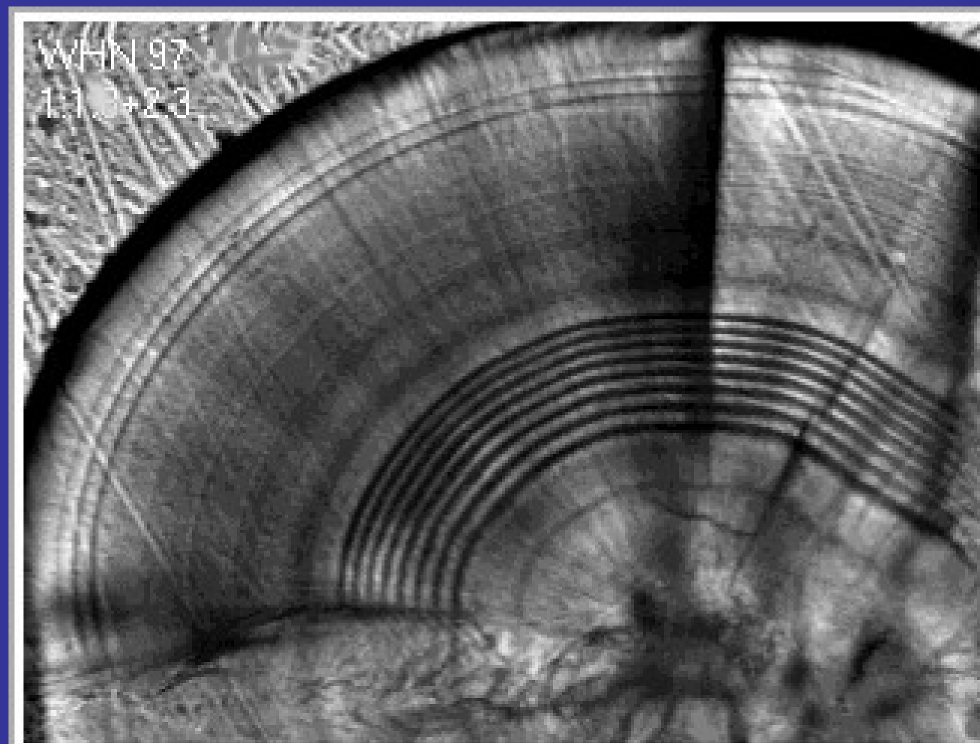
“These adaptations are *consequences* of the inter-gravel requirement and show by their very existence and their being maintained in the face of tremendous scope for selection (some 90% of the brood dies in each cycle before reaching the migrant stage) that development in the gravel is a very important requirement that is maintained by a continuing strong selective pressure.”

R. A. Bams (1969)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