Day 11. Captive breeding in salmon: Does it help or hinder fish recovery?

For many threatened and endangered species, conservation strategies include captive breeding programs. These programs are intended to bolster declining populations by rearing individuals (often juveniles) to a size or age that has a higher probability of survival in the wild. For example, one component of salmon conservation includes rearing offspring from returning adults in hatcheries and releasing these hatchery-bred fry back into their rivers of origin.

Captive breeding programs have come under attack for a variety of reasons, including the possibility of hatchery-induced evolutionary changes. In this case, we'll examine results from a study (Heath et al. 2003) that examines this possibility for chinook salmon in British Columbia. (All figures and figure captions from this paper.)

<u>Background information on egg size in chinook salmon—Figure 1:</u>

1. Review the x- and y-axes in parts A and B of this figure with a neighbor. What are the units and scale on each axis? Then describe the axes in terms of the life-history trade-offs we discussed.

2. Describe and interpret the pattern in part A of the figure. Is there evidence for a trade-off? If so, what kind of trade-off? Is it in the expected direction?

3. Describe and interpret the pattern in part B of the figure. Is there evidence for a trade-off? If so, what kind of trade-off? Is it in the expected direction?

4. These data were collected from hatchery-reared fish. Would you expect any differences in the results if the data were from wild-reared fish? If not, why not? If so, what differences would you expect to see?

Effects of captive breeding—Figure 3

1. **Predict:** How would you expect selection due to captive breeding to act on egg size for hatchery-bred fish? Carefully explain your reasoning.

2. Review the x- and y-axes on Figure 3a with a neighbor. (YIAL stands for Yellow River Aquaculture Limited, the commercial salmon farm where they collected their data.)

3. Describe and interpret the pattern in Figure 3a. What do these data suggest about the effects of captive breeding?

4. Review Figure 3b with a neighbor. What are the x- and y-axes? What are the units and scale on each axis? What are the 4 lines on this figure? Be sure you thoroughly understand the symbols, etc.

5. Describe the pattern in Figure 3b.

6. What conclusions would you draw from this figure about the effects of captive breeding on salmon populations? Explain.

7. Are you ready to make a conservation recommendation based on these results? If not, what additional information do you want?

Figures

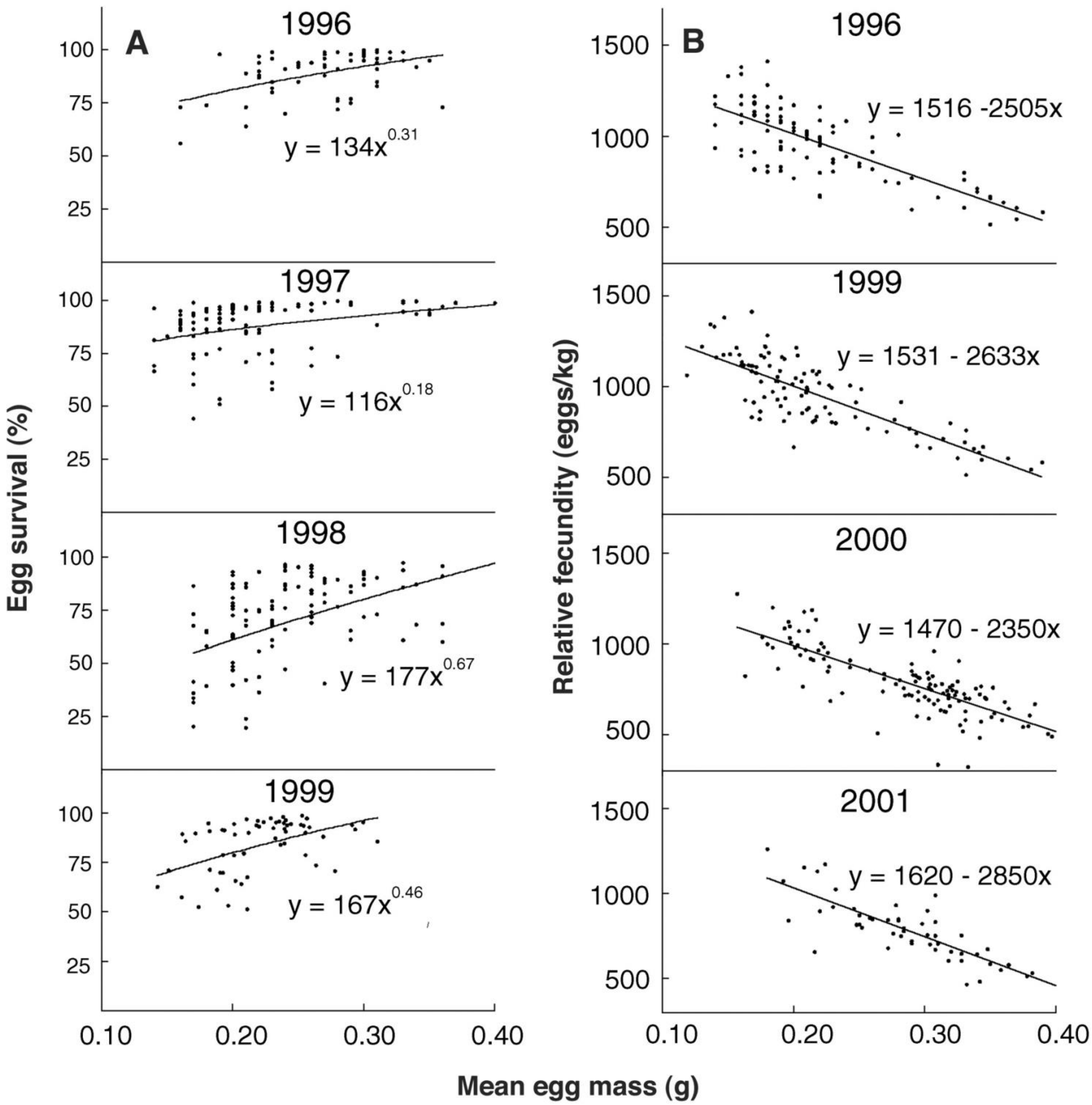

Figure 1. Relationships between egg mass and (A) early juvenile survival and (B) relative fecundity in chinook salmon; each point represents a full-sib family from a single female. (A) Egg mass was measured as the mean mass of 20 to 50 unfertilized eggs. Early survival was measured by counting eggs at fertilization and documenting mortality until juveniles began to feed on their own. (B) Relative fecundity was calculated as the total number of eggs produced divided by the total body mass of the female.

Source

Heath, D. D., J. W. Heath, C. A. Bryden, R. M. Johnson, and C. W. Fox. 2003. Rapid evolution of egg size in captive salmon. Science **299**:1738-1740.

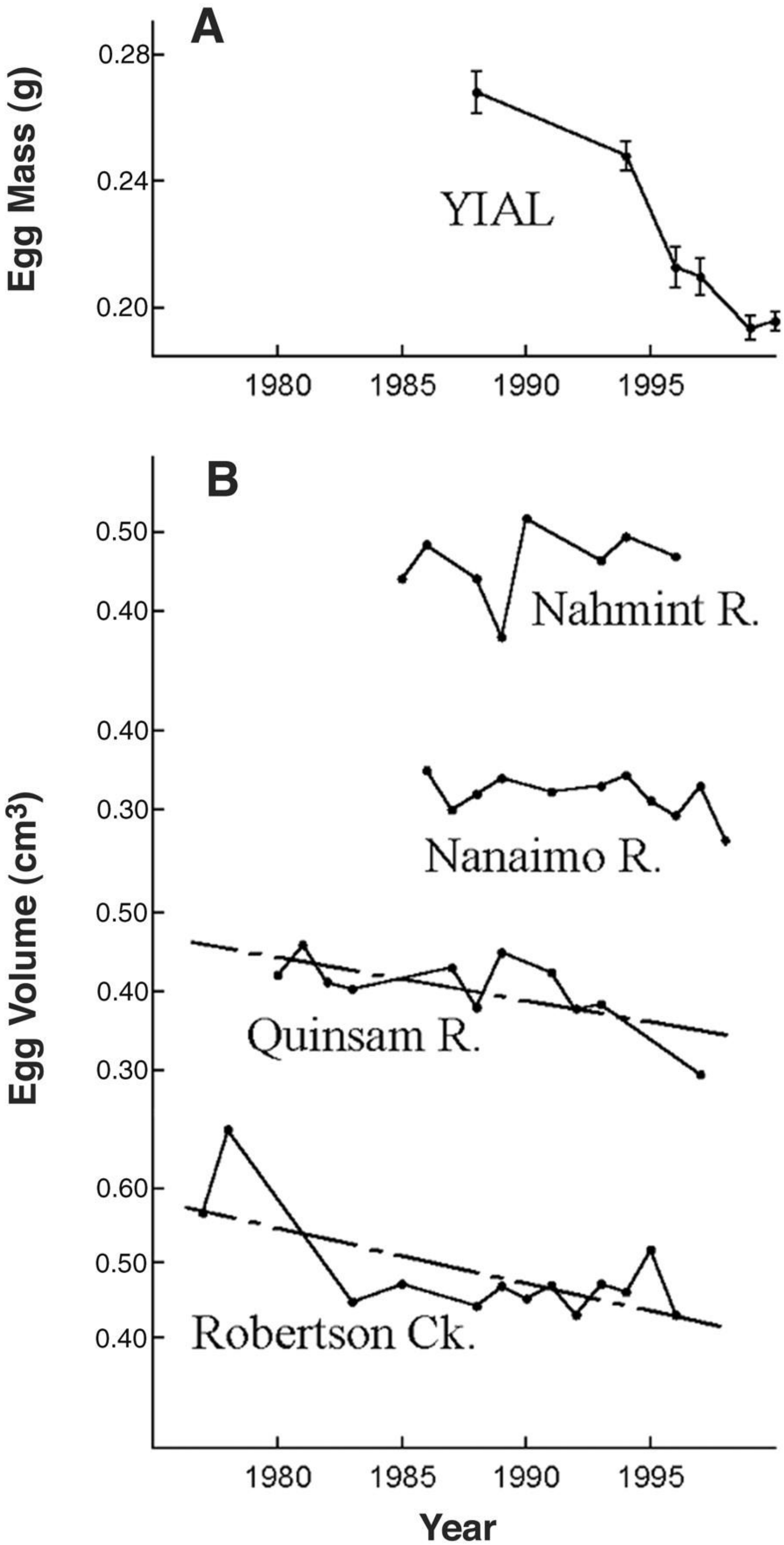

Figure 3. Change in egg size over time for (A) the captive population (YIAL) and (B) four river populations of chinook salmon on Vancouver Island, B.C. (A) Mean egg mass in the captive YIAL chinook salmon. (B) Mean egg volume for four populations of chinook salmon on Vancouver Island. Supplementation effort was quantified as the number of females spawned in the hatchery divided by the total number of females returning to the system,, averaged over the years for which we have egg size data. Mean supplementation efforts were as follows: Robertson Creek, 28%; Quinsam River, 43%; Nanaimo River, 16%; and Nahmint River, 4%. The fitted regression lines are for the populations that show significant decreases in egg size ($P < 0.01$).

SourceHeath, D. D., J. W. Heath, C. A. Bryden, R. M. Johnson, and C. W. Fox. 2003. Rapid evolution of egg size in captive salmon. Science **299**:1738-1740.