Anadromous Salmon in Southeastern Alaska: Harvest, Evolution and Biodiversity

Mary Willson

Any harvest practice has the potential to make evolutionary changes in the harvested population, simply because harvest reduces the density of fish. For salmonids, which have highly competitive courting and mating systems, a lowered density clearly reduces the intensity of competition. Competition among males for females, and among females for nest sites, would be reduced roughly in proportion to the number of each sex removed from the population. When up to 50-90% of adults are harvested before spawning, competition can be reduced markedly.

Such changes in population processes can produce changes in the fish themselves. For example, the oil content of salmon fuels both the migration to the spawning grounds and the breeding competitions in the spawning areas. When the intensity of competition is reduced, there is diminished selection for oil content (which contributes to the economic value of the fish) and eventually oil content may decrease.

There is also a variety of possible differential effects on harvested populations when harvest disproportionately removes certain segments of a population. Differential removal of large individuals, as can often occur with the use of gillnets, creates selection against large size, with the result that smaller individuals may come to dominate the population. The degree to which this result occurs depends on the degree to which body size is controlled genetically (which may vary among populations), as well as the level of size-selectivity of the harvest. Differential removal of a temporal segment of a population of returning spawners (salmon) can change run timing. Especially for iteroparous breeders (spawning more than once in a lifetime), heavy harvest of adults imposes selection for breeding at younger ages (and smaller size).

A third effect of harvest on salmon populations is exerted most notably in 'mixed-stock' fisheries such as those that occur in the Taku Inlet area. Many salmon populations exhibit particular adaptations to their specific spawning stream. In a large system like the Taku River, there are numerous tributaries, many of which may have spawning populations that exhibit local adaptations, and these local populations vary in size. When the fish entering a river system (or staging just before entry) are harvested, local populations are often still mixed together. Harvesting a large proportion of the mixed stock will eventually but ineluctably take ALL of the spawners from the smaller populations. Clearly, the result diminishes genetic diversity of the species, and by eliminating the spawning run of some of the tributaries, also reduces availability of fish to wildlife.

The addition of millions of salmon from hatcheries, while augmenting the harvestable populations, also has potential to change the genetic composition of local populations. Hatchery adults that stray from returning to their natal (hatchery) streams invade other stream systems, disrupting whatever local adaptations may have existed. Thus, an unintended consequence of hatchery production is the weakening of local adaptations and reduction of biodiversity.

PERTINENT REFERENCES

Ashley, M. V., M. F. Willson, O. Pergams, S. M. Gende, D. J. O'Dowd, and J. S. Brown. 2003. Evolutionarily enlightened management. Biological Conservation 111: 115-123.

Hendry, A.P., and S.C. Stearns (eds). 2004. Evolution Illuminated: Salmon and Their Relatives. Oxford University Press.

Halupka, K. C., M. D. Bryant, M. F. Willson, and F. H. Everest. 2000. Biological characteristics and population status of anadromous salmon in Southeast Alaska. PNW-GTR 468.

Halupka, K. C., M. F. Willson, M. D. Bryant, F. H. Everest, and A. Gharrett. 2004. Conservation of population diversity of Pacific salmon in Southeast Alaska. North American Journal of Fish Management 23: 1057-1086.

Willson, M. F. 2002. The fallacy of the superfluous males. Conservation Biology 16: 557-559.