Evolutionary Implications of Animal Harvesting: A Case Study on Pacific Salmon

History of Evolutionary Implications of Animal Harvest
After years of developing the strongest adaptations, early hominid began to hunt out certain species with certain attributes resulting in "unnatural selection." Human predation causing evolutionary implications has been going on at different rates and stages for many years. Thus, human exploitation has led to changes in specific traits as the desired trait is targeted for commercial harvesting and the traits that remain are the dominant traits, which are successfully selected and passed on. (Allendorf et al., 2008) As a result of the increased mortality, modified natural selection, modified sexual selection, and selective change for sexual maturity has occurred in populations. (Allendorf & Hard, 2009, Figure 1.)

Problems
Selective Harvest and Modified Natural Selection
- Fishing mortality occurs with great intensity due to commercial fisheries (Kuparinen & Merila, 2007) and results in there being no random selection of heritable, fitness-related traits (Hutchings & Fraser, 2007).
  - Individuals with desired characteristics, such as large body size, are targeted for human consumption (Allendorf & Hard, 2009).
- The harvest impacts natural selection as the frequency of desirable phenotypes will be reduced in the wild population
- Individuals that grow faster and recruit to the fishery at a younger age are preferentially removed leaving behind those with a genetic propensity to grow more slowly (Fenberg & Roy, 2008).
- Selective fishing can lead to changes in characteristics such as sexual maturation at a younger age and smaller size (Hutchings & Fraser, 2007) leading to reduced fecundity and fisheries yield (Kuparinen & Merila, 2007).
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Case Study
- The commercial salmon fisheries boomed on BC’s coasts in the 1920s.
- In 1945, payment for salmon shifted from price by piece to price by pound (Ricker, 1981)
  - Increase use of gillnets to efficiently fish large salmon
  - Beginning of selective harvest in BC’s commercial fishing
- Based on catch data from 1951 - 1975, all five Pacific salmon species experienced a decline in average body size (Ricker, 1981)
- Reduced size does not just mean less biomass for human consumption and ecosystem needs but also can lead to lower fecundity in reproductive females
  - Small females carry smaller eggs and/or fewer eggs, which can lead to lower survival rates
  - It can be assumed that we are harvesting the older fish, which leaves the smaller, younger fish to spawn and will alter the age of maturity in the next generation
A study done between 1975 - 1993 displays a downward trend of 40% in body size for Pink Salmon (Bigler 1996). Due to the predictable runs of Pink salmon, the data surrounding body size is consistent and can easily illustrate the difference in body size between generations.

**Solutions**

Solutions to the evolutionary impacts of selective harvest focus on the long-term over short-term sustainable harvest. The goal is to incorporate genetic principles into the management of wild populations (Allendorf and Hard 2009). Strategies for recovery and sustainable harvest include:

**Coordinated management and regulations** of multiple fisheries would lessen the impact on current selectivity of fish of a particular size and gender and the maximum sustainable yield (MSY) of the overall catch (Rice et al. 2012).

**Marine Protected Areas (MPAs) and no-take reserves** are effective methods for recovery if they are established strategically with an understanding of population dispersal and interactions between MPA stock and unprotected stock (Allendorf & Hard 2009).

**Precautionary approaches** to stock management can reduce uncertainty. The implementation, monitoring, and assessment of MPAs and no-take reserves fill knowledge gaps through the long-term rehabilitation and study of these stocks. MPAs are buffers that combat uncertainty without leading to significant loss in total catch (Lauck et al. 2008).

**Harvesting to mimic natural size and age mortality** is preferable because it harvests juveniles and protects large, old individuals because of their cultural/genetic importance (Hutchings 2008; Birkeland & Dayton 2005).

**Maximum size restrictions** benefit the entire population because they protect all individuals over a given size, preserve the fastest-growing genotypes, and broaden age structure to increase spawning stock biomass (Conover & Munch 2002).

**References**


