Introduction

- Shellfish are a major commercial resource in Alaskan waters.
- Abundances of some shellfish stocks have declined, possibly from overharvesting or climate change.
- Alaska Fish & Game is charged with protecting wild populations under the sustained yield principle.
- Standing genetic diversities within and between populations are important buffers against environmental change.
- Can stock restoration or enhancement of depleted stocks be achieved without altering the genetics of wild populations?

Hatchery culture can change genetic makeup

- Inbreeding in a small broodstock can lead to the loss of genetic diversity.
- Increasing larval survival may lead to unintentional selection in ‘safe’ environment.

Broodstock management

- Origin of broodstock must be near point of release to ensure genetic similarity between releases and wild populations.
- Genetic effective population size of hatchery broodstock must be large enough to prevent loss of genetic diversity
  \[ N_e = H_0 \left(1 - \frac{1}{2}N_H^e\right) \]
- Numerous examples of loss of genetic diversity in hatchery broodstock.

Ryman-Laikre effect

The release of hatchery offspring can genetically swamp wild populations

\[ \frac{1}{2}N_H^W = x^2 - \frac{1}{2}N_H^W (1 - \frac{1}{2}N_H^W) \]

\[ N_H^W = \text{combined hatchery-wild population} \]
\[ N_H^e = \text{effective broodstock size} \]
\[ N_W^e = \text{effective wild population size} \]
\[ x = \text{Census wild population size} \]

- Effective population size: the size of a hypothetical population experiencing the same amount of random drift as an actual population.

Estimating broodstock size

\[ N_H^e = \frac{x^2 N_W^e N_H^W}{N_W^e (1 - \frac{1}{2} N_H^W)} \]

- Broodstock sizes can be calculated with estimates of wild population census and effective sizes.
- When \( N_W^e = N_H^W \), releases do not depress the genetic effective size of a population.
- Estimates of appropriate broodstock size and release numbers, depend on the abundance of the wild population.
- Sex ratio and variation in family size greatly influence broodstock effective size.

N\(_W^e\) can be 3-4 orders of magnitude smaller than census sizes, in nature.
(numerous genetic studies)

Small broodstock sizes can reduce \( N_H^W \), even with a relatively small numbers of hatchery releases.

Geoducks

- Farmed in SE Alaska
- Hatchery-produced spat are released for grow-out
- If hatchery offspring spawn, there may be genetic effects on wild stocks