Developing Genetic Guidelines for the Culture, Enhancement and Restoration of Shellfish Populations in Alaska

W. Stewart Grant, Genetics Laboratory, Alaska Department of Fish & Game, Anchorage, AK
william.grant@alaska.gov

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

$$H_t = H_o(1-1/2N)^t$$

- Numerous examples of loss of genetic diversity in hatchery broodstock.

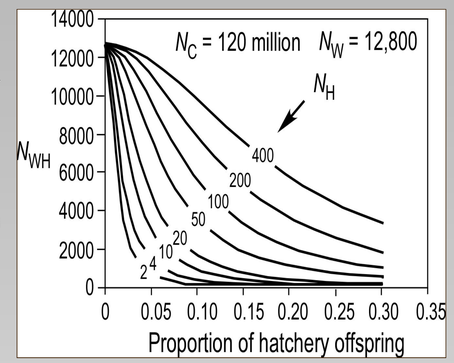
Ryman-Laikre effect

The release of hatchery offspring can genetically swamp wild populations

$$1/N_{HW} = x^2/N_H + (1-x)^2/N_W$$

N_{HW} = combined hatchery-wild population
N_H = effective broodstock size
N_W = effective wild population size
x = Census wild population size

- *Effective population size*: the size of a hypothetical population experiencing the same amount of random drift as an actual population.
- N_W can be 3-4 orders of magnitude smaller than census sizes, in nature. (numerous genetic studies)
- Small broodstock sizes can reduce N_{HW}, even with a relatively small numbers of hatchery releases.



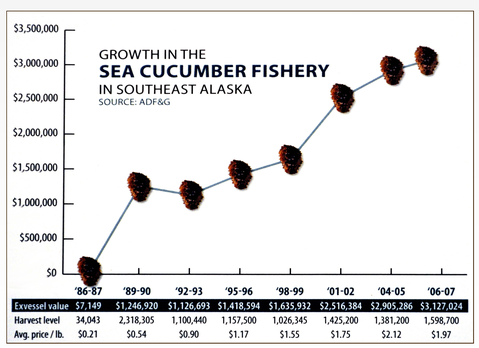
Estimating broodstock size

$$N_H = \frac{x^2 N_W N_{HW}}{N_W - (1-x)^2 N_{WH}}$$

- Broodstock sizes can be calculated with estimates of wild population census and effective sizes.
- When $N_W = N_{WH}$, 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.

Giant Sea Cucumber

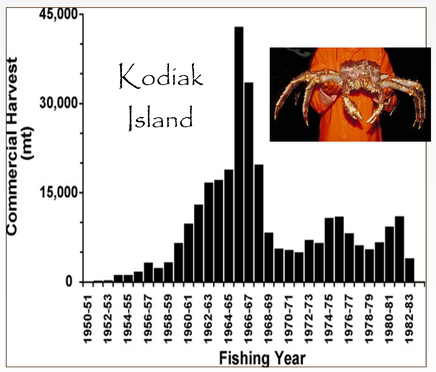
- Rapidly growing fishery in SE Alaska.
- Is stock enhancement possible?
- Genetic effects on wild populations?



Pacific Fishing (2009)

Red King Crab

- Declining stocks in many areas.
- Commercial fishery around Kodiak Island is closed
- Culture studies underway to produce crabs for restoration.
- What effect will releases have on wild stocks?



Bechtol & Kruse (2009)

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

Audubon web (2009)

Wikipedia