Dungeness Crab Growth

Introduction

The Dungeness crab (Cancer magister) is a large marine crustacean found off the Pacifica coast of North America from the Aleutian Islands to Baja, California. It is one of the largest and most abundant crabs on the Pacific coast.

Dungeness crabs are fished between December and June along the Pacific coast of North America. In U.S. waters, nearly the entire adult male Dungeness crab population is fished each year. Female crabs are not fished in order to maintain the viability of the crab population. However, the question of fishing female crabs has been raised as a possible means of controlling the large fluctuations in yearly catches of crabs. To support the change in fishing law, it has been noted that the fishing industry in Canada allows female crabs to be fished and does not suffer from such large fluctuations in catches. It has also been argued that the great imbalance in the sex ration may have contributed to the decline in the crab population along the central California coast.

Size restrictions on male crabs are set to ensure that they have at least one opportunity to mate before being fished. To help determine similar size restrictions for female crabs, more needs to be known about the female crab's growth.

The lack of growth marks on crab shells makes it difficult to determine the age of a crab. This is because crabs molt regularly, casting off their old shell and growing a new one. Adult female Dungeness crabs molt in April and May, although they do not necessarily molt yearly. Biologists require size---specific information on molting to understand the female crab's growth pattern. Of particular interest is the size of the increase in the width of the shell having observed only the size of the shell after the crab molted; for example, for a female crab with a postmolt shell that measures 150mm across, the scientists want to provide a prediction for how much the shell changed in size. For this study, we wish to investigate the growth patterns of female Dungeness crabs in order to assist biologists in developing recommendations for size restrictions on fishing female crabs.

Data

The data for this study were collected as part of a study carried out by Hankin, Diamond, Mohr, and Ianelli with assistance from the California Department of Fish and Game and commercial crab fishers from northern California and southern Oregon.

Two sets of data are to be provided. The first consists of premolt and postmolt widths of the carapaces (shells) on 472 female Dungeness crabs. The data are a mixture of some laboratory data and some capture---recapture data. Scientists and commercial fisheries obtained them over three fishing seasons. The first two seasons were in 1981 and 1982. The third season was in 1992. For each crabs the following variables were available:

- *Premolt* - Size of the external carapace along the widest part of the shell excluding spines, before molting (in mm).
- *Postmolt* - Size of the external carapace along the widest part of the shell excluding spines, after molting (in mm)
- *Increment* - postmolt minus premolt
- *Year* - Collection year (not provided for recaptured crabs)
- *Source* -1=molted in laboratory, 0 =capture-recapture

The capture-recapture data were obtained by tagging 12,000 crabs. These crabs were caught, measured, tagged with a unique identification number, and returned to the water. The crabs were tagged and released in January through March of each year, before the annual spring molting season. Commercial fisheries brought tagged crabs they caught in their traps to the laboratory for second measurements. Commercial traps have netting designed to catch the larger male crabs; female crabs caught with these traps were typically larger than 155mm. For an incentive to return the tagged crabs, a lottery of the returned crab tags, with a $500 prize was held at the end of each fishing season.

The laboratory data were collected during the molting season for female crabs. Crabs that were in premating embrace were caught and brought to the laboratory. The premolt carapace width was measured when the crab was first collected, and the postmolt measurements were made three to four days after the crab left its old shell to ensure that the new shell had time to harden. The postmolt measurements for all crabs were made in the laboratory, after which they were released.

Studies suggest that crabs in captivity have smaller molt increments than those in the wild.

Prepare a statistical analysis plan that assesses the relationship between premolt and postmolt carapace size (and other factors).