

Dungeness Crab Growth

National Marine Fisheries Service

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Outline

Background

Problem Statement

Deliverable

Approach

Conclusion

Introduction to National Marine Fisheries Service

1. Federal agency and a division of the Department of Commerce
2. Manage, conserve and protect living marine resources and their habitats
3. Promote sustainable fisheries and prevent overfishing
4. Balance competing public needs

Problem Raised by the Fishing of Dungeness Crabs

1. A species living along the Pacific coast of North America
2. Male crabs are fished during December and June. Female crabs are not fished. It leads to a large ratio of female to male crabs.
3. Great fluctuations in the catches of crabs
4. Decrease in crab population along the central California coast
5. Female Dungeness crabs are considered to be fished.

My Project

1. Size restrictions on female crabs have to be set so that crabs can mate at least once before they are caught.
2. Growth of crabs needs to be studied so that scientists can set the size of the fishing net to meet the restriction.
3. Crabs mate during the molting season of female crabs. So I need to study the change of sizes by molting.
4. Predict the premolt size from the postmolt size

From Team to Sponsor

The following outputs are expected from this project:

1. A regression formula predicting premolt sizes from postmolt sizes of female Dungeness crabs taken the place of molting into consideration
2. A R programming package which can predict the premolt sizes of shells and produce a graph for the distribution of premolt sizes when people input the data of postmolt sizes of shells and the place of molting in the program

From Sponsor to Team

In order for my project to be of successful one, I will need:

1. Data of shell sizes before molting and corresponding postmolt sizes specifying the molting environment and measurement year. The data should be delivered to me by Oct 12, 2012. If my sponsor fails to do so, I will only develop a method for the prediction problem without an explicit regression formula.
2. Computing resources
3. Timely responses to inquiries,
4. Symposium attendance travel expenses.

Collection of Data

The data were collected in the following ways:

1. Place: northern California and southern Oregon
2. Time: Year 1981, 1982 and 1992
3. Type of data: laboratory data and capture-recapture data

Selecting Data

I need to do the following things to the data to make them suitable for my project:

1. Secondary data
2. Delete data without premolt size or postmolt size or data type
3. Delete outliers
4. 472 data left with $\frac{3}{4}$ of them laboratory data

Data

After adjustments, part of the data are shown in the following table:

| Premolt Size | Postmolt Size | Year | Type of Data |
|--------------|---------------|------|--------------|
| 113.6 | 127.7 | NA | 0 |
| 142.3 | 154.8 | 81 | 1 |
| 120.3 | 139.3 | 82 | 1 |
| 111.8 | 129.5 | 92 | 1 |

Part of Data after Adjustments

Methods

1. Software: R
2. Linear regression model with postmolt size and data type as independent variables and premolt size as dependent variable
3. Ordinary least squares method to find the coefficient
4. Analysis of Variance to test the significance level of the coefficient and the performance of the model
5. Refine the model

Form of the Model

My model in the very beginning is in the following form:

$$\text{Premolt Size} = \beta_0 + \beta_1(\text{Postmolt Size}) + \beta_2(\text{Type of Data})$$

One way to refine:

$$\begin{aligned}\text{Premolt Size} = & \beta_0 + \beta_1(\text{Postmolt Size}) + \beta_2(\text{Type of Data}) \\ & + \beta_3(\text{Postmolt Size}) * (\text{Type of Data})\end{aligned}$$

Another way to refine:

$$\begin{aligned}\text{Premolt Size} = & \beta_0 + \beta_1(\text{Postmolt Size}) + \beta_1(\text{Postmolt Size})^2 \\ & + \beta_3(\text{Type of Data}).\end{aligned}$$

Work Remaining to Be Done

1. Find the coefficients for the simplest linear model
2. Test the model
3. Refine the model

Recommendations for Future Research

1. Take the time into consideration
2. Take the types of crab shells into consideration

References



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Stat Labs: Mathematical Statistics Through Applications.
Springer, 2000.



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About National Marine Fisheries Service.

<http://www.nmfs.noaa.gov/aboutus/aboutus.html>.

Accessed: September 30, 2012.