# Surf Clams: Latitude & Growth

## Materials

**For the leader:**

Projector

Whiteboard to project data graph onto

**For the activity:**

Copy of data table

Copy of map

Computer program to graph in or graphing paper

## Overview

Atlantic surf clams (*Spisula solidissima*) can live up to about 35 years and are found in the western North Atlantic from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina. They're most abundant on Georges Bank, the south shore of Long Island, New Jersey, and the Delmarva Peninsula. The surf clam fishery is one of New Jersey's most valuable fisheries. More than 80% of the total Mid-Atlantic and New England area catch of surf clams are landed in New Jersey. However, over the last decade, the stocks of New Jersey surf clams, along with those of within the mid-Atlantic region, including in southern Virginia and the Delmarva Peninsula have dramatically declined.

One theory for the decline of the surf clam population is that the water is getting warmer in the mid-Atlantic. This increase in temperature may be causing mortality in larger surf clams and recruitment failure (a decrease in larval survival causing decreases in the population). In addition, growth rates depend on water temperature - southern surf clam populations in warmer water grow more slowly than the more northern populations. Another impact of the warmer waters is a gradual shift in the distribution of surf clams to the north. Recent federal surf clam stock assessments indicate that nearly 50% of the stock was located off Georges Bank in 2008 whereas only 5% of the stock was located there in 1986.

Scientists use data about the location, size, and condition of surf clams as well as bottom temperature and depth throughout the range of surf clams to study the health of the population and make predictions about the population in the future. In this activity students will investigate the differences in size of surf clams from two locations using model data from the NOAA Fisheries federal stock assessment surveys that Dr. Daphne Munroe uses in her research. The activity places a strong emphasis on teaching students how to look for patterns in data. The students will plot, fit, and compare data to draw conclusions about the influence of geography on biological patterns. Through gaining these data interpretations skills, students will also gain a better understanding of how scientists look at evidence when asking questions.

Students will first plot the age vs. length (mm) data for the surf clams from off of New Jersey and fit the data to a model. Students will then plot the age vs. length (mm) data for the surf clams from off of the southern Delmarva Peninsula and fit that data to a model. Finally, students will compare growth model outputs for surf clams from these two locations along the mid-Atlantic to observe differences in growth with latitude.

**Motivating Questions: How do scientists observe changes in the population with respect to geography? How does latitude affect a how individuals grow?**

## Take Home Message

Scientists collect data from a sample of surf clams from the wild population and then use that information to model the growth curves (changes in individual size over time) of the population. By collecting this information from multiple places, scientists can compare differences in populations based upon geography.

| | |
|---|---|
| **Engage**: Lead the students in a discussion about what they know about surf clams and how animals change with latitude. | 10 minutes |

| | |
|---|---|
| **Explore**: Students plot the growth data (age vs. length) and model outputs from growth curves. | 50 minutes |
| **Make Sense**: Students use model outputs from different regions of the mid-Atlantic to observe differences in growth with respect to latitude. | 20 minutes |
| **Total:** | **80 minutes** |

## Audience

Late elementary and middle school students ($5^{th}$-$8^{th}$ grade).

## New Jersey Core Curriculum Content Standards - Science

| Grade | Content Statement | CPI# |
|---|---|---|
| 6 | The number of organisms and populations an ecosystem can support depends on the biotic resources available and on abiotic factors. | 5.3.6.C.2 |
| 8 | Evidence is generated and evaluated as part of building and refining models and explanations. | 5.1.8.B.1 |
| 8 | Mathematics and technology are used to gather, analyze, and communicate results. | 5.1.8.B.2 |
| 8 | Carefully collected evidence is used to construct and defend arguments. | 5.1.8.B.3 |
| 8 | Scientific reasoning is used to support scientific conclusions. | 5.1.8.B.4 |
| 8 | Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work. | 5.1.8.D.1 |

## Preparation (15 minutes)

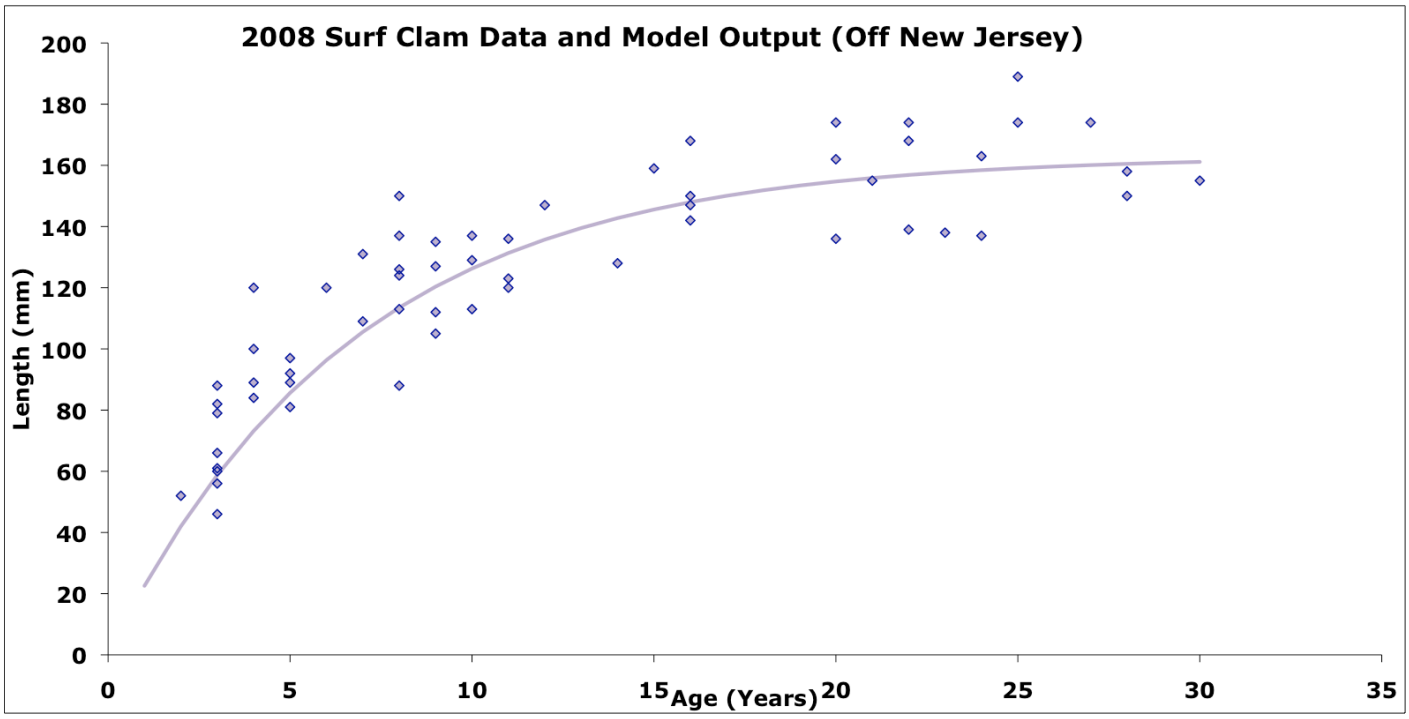
1. Write the motivating questions on the board:

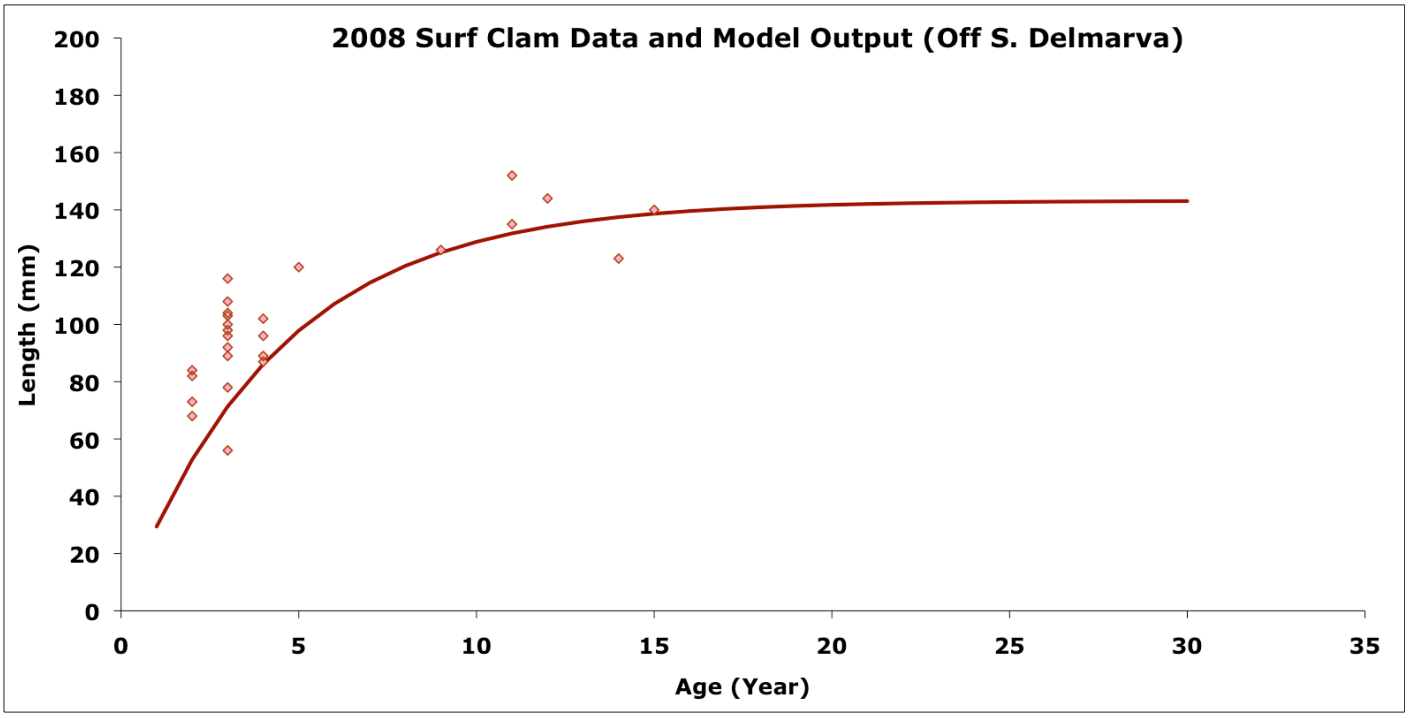
   **How do scientists observe changes in the population with respect to geography?**
   **How does latitude affect a how individuals grow?**

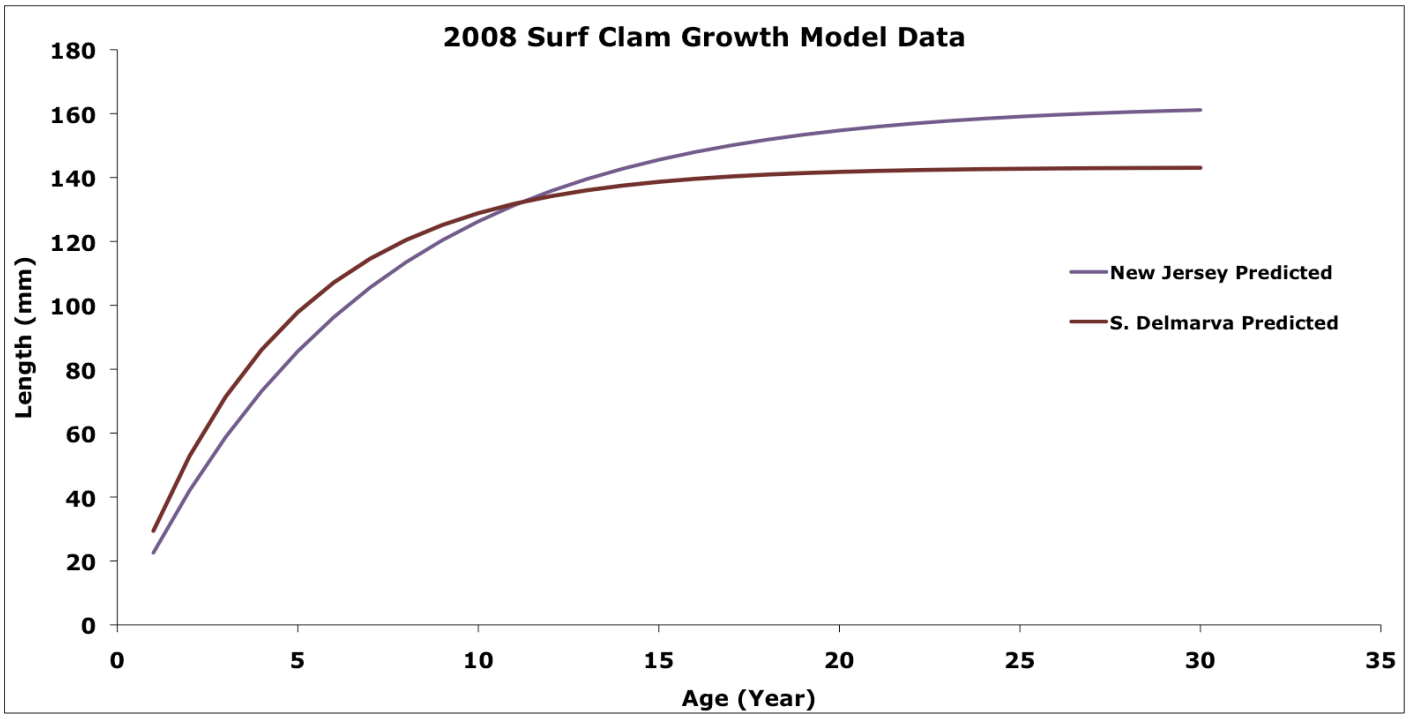
2. Make class copies of student worksheets for each student (at the end of this write-up).
3. Make copies of the different surf clam sampling areas map (at the end of this write-up).
4. Make or project the Class Surf Clam Data Table on the board:

| | Off New Jersey | Southern Delmarva Peninsula |
|---|---|---|
| Maximum Length (how big) | | |
| Maximum Age (how old) | | |

5. Make or project the graphs on the board, but make sure it is hidden from the students.


2008 Surf Clam Data and Model Output (Off New Jersey)
Length (mm)
Age (Years)
0
20
40
60
80
100
120
140
160
180
200
0
5
10
15
20
25
30
35


2008 Surf Clam Data and Model Output (Off S. Delmarva)
Length (mm)
Age (Year)
0
20
40
60
80
100
120
140
160
180
200
0
5
10
15
20
25
30
35




## Engage (10 minutes)

1. Lead the students in a discussion about changes in animals with latitude.

**Q. Do the same animals live at the equator as in the North Pole? What about in Florida and Maine? What about Virginia and New Jersey?**

**Q. What about marine animals that live from North Carolina to Nova Scotia, are they all the same?**

2. Be accepting of all responses from the students.
3. Lead the students in a discussion about shellfish and surf clams.

**Q. Do you know about shellfish? What do you know about surf clams? What do they need to survive? Where do they live?**

4. After a minute or two, and depending on what the students already know, share some information with them that you feel they need to know to understand the activity of the day. (Note – it might be helpful to show the students images of Atlantic surf clams.)

## Explore (50 minutes)

1. Explain to the students that scientists use age and size information to learn about how an animal grows over time. Ask them about why scientists are interested in understanding the relationship between the age and size of an animal? Be accepting of all answers, as this is a brainstorming session.
2. Explain to the students that they are going to be shellfish scientists and will get to see how scientists use age and size information of surf clams to learn about their population. First, we will all look at the age and size of surf clams together as a class.
3. As a class make a graph of the age and size data for the surf clams from off of New Jersey on the board. Have them plot the length vs. age for each surf clam on their graphs with Age (Years) as the x-axis and Length (mm) as the y-axis.
4. Have the students talk with a partner to answer:

**Q. What patterns do you observe in the data?**

**Q. Is there a relationship between age and size of Atlantic surf clams off of New Jersey? How old do they get? How big do they get?**

5. After a few minutes, have the students come back together and share their observations as a class. Make sure to have the students support their statements of the patterns and trends by stating what evidence they are using.
6. As the conversation is winding down explain to them that scientists use this data to create a model of how surf clams grow. Show them the graph entitled "2008 Surf Clam Data and Model Output (Off New Jersey)" with the predicted growth curve line.
7. Explain to the students that in order for scientists to understand differences within a species across an area they must take samples of the animals in different locations. The fisheries scientists that collected these data off of New Jersey also collected samples off of the southern Delmarva Peninsula.
8. Have the students work with a partner to plot the southern Delmarva Peninsula data from the data table. Remind them that their graphs should look similar to the New Jersey graph you discussed as a class. They should plot each individual clam by putting Age (Years) on the x-axis and Length (mm) on the y-axis.
9. When the partner groups are done plotting the data, have them find another partner group and share their graphs. While they are comparing their graphs, have them talk about:

**Q. What patterns a can you observe in the data?**

**Q. Is there a relationship between age and size of Atlantic surf clams off of the southern Delmarva Peninsula? How old to they get? How big do they get?**

10. After a few minutes bring the students back together as a class to have them share with one another what they found in their graphs of the southern Delmarva Peninsula. Make sure to have the students support their statements of the patterns and trends by stating what evidence they are using. (Note – It would be helpful to project the S. Delmarva graph above at this point for the students to all look at together.)

## Make Sense (20 minutes)

1. After a few minutes of discussion about the graphs from the southern Delmarva Peninsula, tell the students that we are going to interpret and analyze the data from both locations together as a class.
2. Project the "2008 Surf Clam Growth Model Data" graph on the board. Explain which lines are from which locations. (Note – It might also help to show the students the map of the study locations as well.)
3. Have the students discuss with a partner what patterns they observe in the data using the following discussion prompts:

**Q. Compare the two locations, what patterns a can you observe in the data? Are they similar? Are they different?**

**Q. Is there a relationship between age and size of Atlantic surf clams throughout the mid-Atlantic? Is it the exact same relationship at different locations or are there differences?**

4. After a few minutes, bring everyone back together as a class to discuss that patterns they observed. Make sure to have the students support their statements of the patterns and trends by stating what evidence they are using.
5. As the conversation slows, ask the students to determine the maximum age (how old) and maximum size (how big) the surf clams get to be for both off of New Jersey and the southern Delmarva Peninsula. As

the students are talking record their answers to how big and how old the surf clams got on the Class Surf Clam Data Table.

6. Have the students answer the writing prompt.

**Q. Is there a difference in maximum age and/or size of surf clams between the two locations? If so, in which area do surf clams grow bigger?**

7. After a few minutes let them discuss in their small groups what differences in age and/or size they observed between the southern Delmarva Peninsula and New Jersey. Make sure to have the students support their statements of the patterns and trends by stating what evidence they are using.
8. After a few minutes of small group discussion, have the students report out what patterns they observed to the class. Help the students see that surf clams in the south are smaller than in the north of the mid-Atlantic.
9. As the conversation slows, ask the students to form a hypothesis on why there is a difference in size of the surf clams between the north and south. Be accepting of all responses. Then, ask them how they could test this hypothesis. The idea is to have the students understand that in science answering one question can often lead to more questions.
10. Once the discussion slows down, point to the motivating questions and ask:

**Q. How do scientists observe changes in the population with respect to geography? How does latitude affect a how individuals grow?**

11. Ask students to share their ideas about the questions with a partner. After a minute, ask volunteers to share the ideas they discussed with the entire class. Be accepting of all responses from the students. This is your opportunity to make sure the students understand the "take home message".
12. Ask if the students have any final questions about the activity, graphing, or relationship between surf clam growth and geography.

# Surf Clam Sampling Areas & Data Tables

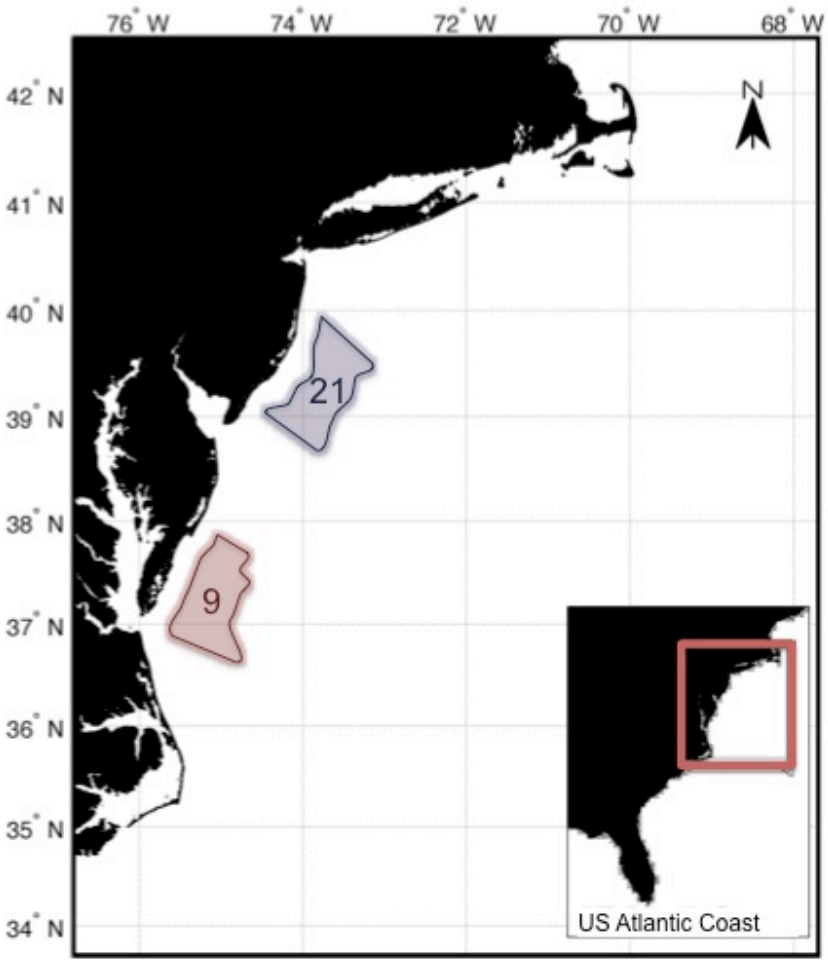



Figure 1. Sampling areas (strata) of surf clams off of New Jersey (21) and the southern Delmarva Peninsula (9) from NOAA Fisheries Federal Stock Assessment Surveys.

Table 1. Data of surf clams age and size from samples collected off of New Jersey (stratum 21) from NOAA Fisheries Federal Stock Assessment Surveys.

| Age (Year) | Length (mm) |
|---|---|
| 2 | 52 |
| 2 | 52 |
| 3 | 88 |
| 3 | 88 |
| 3 | 56 |
| 3 | 56 |
| 3 | 79 |
| 3 | 66 |
| 3 | 79 |
| 3 | 66 |
| 3 | 82 |
| 3 | 82 |
| 3 | 61 |
| 3 | 61 |
| 3 | 60 |
| 3 | 60 |
| 3 | 46 |
| 3 | 46 |
| 4 | 120 |
| 4 | 120 |
| 4 | 84 |
| 4 | 84 |
| 4 | 100 |
| 4 | 89 |
| 4 | 100 |
| 4 | 89 |
| 5 | 97 |
| 5 | 97 |
| 5 | 89 |
| 5 | 89 |
| 5 | 81 |
| 5 | 92 |
| 5 | 81 |
| 5 | 92 |
| 6 | 120 |
| 6 | 120 |
| 7 | 131 |
| 7 | 131 |
| 7 | 109 |
| 7 | 109 |
| 8 | 150 |
| 8 | 150 |
| 8 | 124 |
| 8 | 137 |
| 8 | 126 |
| 8 | 124 |
| 8 | 137 |
| 8 | 126 |
| 8 | 88 |
| 8 | 88 |
| 8 | 113 |
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| 9 | 112 |
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| 9 | 135 |
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| 9 | 105 |
| 9 | 105 |
| 9 | 127 |
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| 11 | 123 |
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| 12 | 147 |
| 12 | 147 |
| 14 | 128 |
| 14 | 128 |
| 15 | 159 |
| 15 | 159 |
| 16 | 168 |
| 16 | 168 |
| 16 | 147 |
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| 16 | 142 |
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| 24 | 137 |
| 24 | 137 |
| 25 | 189 |
| 25 | 189 |
| 25 | 174 |
| 25 | 174 |
| 27 | 174 |
| 27 | 174 |
| 28 | 150 |
| 28 | 150 |
| 28 | 158 |
| 28 | 158 |
| 30 | 155 |
| 30 | 155 |

Table 2. Data of surf clams age and size from samples collected off of southern Delmarva Peninsula (stratum 9) from NOAA Fisheries Federal Stock Assessment Surveys.

| Age (Year) | Length (mm) |
|---|---|
| 2 | 73 |
| 2 | 73 |
| 2 | 84 |
| 2 | 68 |
| 2 | 84 |
| 2 | 68 |
| 2 | 82 |
| 2 | 82 |
| 3 | 56 |
| 3 | 56 |
| 3 | 89 |
| 3 | 89 |
| 3 | 104 |
| 3 | 104 |
| 3 | 116 |
| 3 | 116 |
| 3 | 96 |
| 3 | 89 |
| 3 | 108 |
| 3 | 96 |
| 3 | 89 |
| 3 | 108 |
| 3 | 100 |
| 3 | 103 |
| 3 | 100 |
| 3 | 103 |
| 3 | 98 |
| 3 | 98 |
| 3 | 78 |
| 3 | 78 |
| 3 | 92 |
| 3 | 92 |
| 4 | 102 |
| 4 | 102 |
| 4 | 96 |
| 4 | 89 |
| 4 | 96 |
| 4 | 89 |
| 4 | 87 |
| 4 | 87 |
| 5 | 120 |
| 5 | 120 |
| 9 | 126 |
| 9 | 126 |
| 11 | 135 |
| 11 | 152 |
| 11 | 135 |
| 11 | 152 |
| 12 | 144 |
| 12 | 144 |
| 14 | 123 |
| 14 | 123 |
| 15 | 140 |
| 15 | 140 |