What Happened to the Snow Crab?

For use with Fish Watch at www.fishwatch.gov

Grade Level
9-12

Materials
- Handout 1
- Handout 2
- Computers for pairs of students with internet access for graphing (or graph paper if no internet is available)
- Graph paper (optional)
- Teacher Handout 1-Snow Crab Graph
- Teacher Handout 2

Audio/Visual Materials
- Projector to show images
- Computers with Internet access

Teaching Time
Two to Three 45-minute class periods

Seating Arrangement
Students sitting in pairs

Key Words
- Annual landings
- Overfishing
- Overfished

Focus
- Sustainable seafood
- Overfishing

Focus Questions
- What happened to the snow crab?
- Is it okay to eat overfish/shellfish?

Learning Objectives
- Analyze and draw conclusions from annual landings data
- Explain the difference between overfishing and overfished

Background Information

Overfishing versus Overfished

Overfishing occurs when the rate of removal from a fish stock is too high. It would be natural to assume that overfishing and overfished have the same causes, but they may not. A stock is deemed “overfished” when its population is too low, or below a prescribed threshold. A population can be overfished but be managed under a rebuilding plan that over time returns the population to optimal levels. Reasons that a fish stock becomes overfished can include

National Science Education Standards

Grades 9-12

Content Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Content Standard C: Life Science

- Interdependence of organisms

Content Standard F: Science in Personal and Social Perspectives

- Natural resources
- Science and Technology in Local, National and Global Challenges

Ocean Literacy Essential Principles

Essential Principle 1

The earth has one big ocean with many features.

Fundamental Concept h

Although the ocean is large, it is finite and resources are limited.

Essential Principle 6

The ocean and humans are inextricably connected.

Fundamental Concept b

From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.

Fundamental Concept e

Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and environmental changes, natural mortality, disease and natural population cycles Environmental changes play a large role in what happens to a fish stock in our waters. A fish's environment (habitat) includes physical factors, such as temperature and bottom type, as well as chemical factors, such as oxygen levels and dissolved minerals. The habitat needs for each stage of a fish's life cycle—egg, larvae, juvenile, and adult—vary within the same water body. So changes in these environmental factors can greatly affect the population of a stock.

Environmental changes play a large role in what happens to a fish stock in our waters. A fish's environment (habitat) includes physical factors, such as temperature and bottom type, as well as chemical factors, such as oxygen levels and dissolved minerals. The habitat needs for each stage of a fish's life cycle—egg, larvae, juvenile, and adult—vary within the same water body. So changes in these environmental factors can greatly affect the population of a stock.

History of the Snow Crab

Snow crab – named for their sweet, delicate, snow-white meat – is one of Alaska's signature crab fisheries. Although the Alaska snow crab fishery has had its ups and downs over the years, management has effectively responded to these fluctuations. Every year, scientists determine the abundance of the snow crab resource. Using these abundance estimates, managers set a harvest limit for the following fishing season.

The Japanese harvested snow crabs from the 1950 until 1980. The American pot fishery began in the 1970s. The fishery peaked in the 1990s, and in 1999, scientists found that the snow crab stock had fallen below the minimum stock size threshold (e.g. had become overfished). Managers cut harvests for the following fishing seasons to a level that would allow the stock to recover. Since 2005, the fishery has been under a Crab Rationalization program under which qualified participants are issued individual fishing quotas.

In 2005, the derby-style fishery – where anyone could enter the fishery and the fishery was closed when the catch limit was reached – was replaced with an individual fishing quota (IFQ). Under the IFQ management system, individual fishermen are given a share of the harvest and can catch their share at any time during the fishing season. This has resulted in a safer and more efficient fishery, as fishermen can take weather and economic factors into account when deciding when to fish.

Under managed harvest levels, Alaska snow crab has rebounded and is now above its target population level. This is good news for the resource and for fishermen, too. An abundant resource can sustainable support higher harvests, and managers boosted the harvest limit for 2011-2012 by 64 percent to nearly 90 million pounds.

Several modifications to pot gear have been introduced to reduce bycatch mortality. Starting in the 1978-79 season, pots used in the snow crab fishery began to have escape panels to prevent abandoned gear from continuing to catch crabs, also known as "ghost fishing." Over time, the escape panel has been modified to allow more crabs to escape.

activity leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

Fundamental Concept g

Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean.

Essential Principle 7

The ocean is largely unexplored.

Fundamental Concept c

Over the last 40 years, use of ocean resources has increased significantly; therefore the future sustainability of ocean resources depends on our understanding of those resources and their potential and limitations

Sources:

- www.nmfs.noaa.gov/stories/2011/07/14_overfished_isnt_just_about_fishing.html
- www.fakr.noaa.gov/npfmc/PDFdocuments/resources/SAFE/CrabSAFE/CrabSAFE2011.pdf.
- www.afsc.noaa.gov/Education/factsheets/10_opilio_fs.pdf

Learning Procedure

1. This lesson is an inquiry-based learning lesson. Before beginning this lesson, make copies of NMFS Landings Queries results (Handout 1). Students can also run this query in the database if computer and internet access are available. This information is taken from the Annual Commercial Landings Statistics site at: www.st.nmfs.noaa.gov/st1/commercial/landings/annual_landings.html

2. Distribute Handout 1 or have students print the results from their query. Define annual landings; be sure that students understand that landings are the report of the total number or weight of all marine species captured, brought to shore, and sold (or transferred) to another person or party. Landings are not the same as catch. Catch is a measure of all marine species removed from the marine environment, including bycatch, fish released, at sea discards and species not sold. Landings are anything received from a harvester regardless of whether it is discarded or not sold. Landings do not include all of the organisms that are released and/or discarded at sea.

3. Allow students time to review handout and graph data. Graphing data can be done online at: nces.ed.gov/nceskids/createagraph/default.aspx or students may use graph paper. An example of the graphed data can be found attached (Teacher Handout 1).

4. After graphing is completed, have students analyze the data and graph using Handout 2. Pose the question—What happened to the snow crabs?

5. Discuss the questions on Handout 2. Then lead the class in a discussion of larger questions:

- What are some of the ways that changes in technology might have changed the fishing industry?
- What are some of the ways that these changes might have changed the populations of snow crabs and other fish/shellfish?
- What might happen if annual landings are taken and stocks are not monitored?
- How might this affect our oceans in the future?
- Why is it important to take interest in the health of our fisheries?

Encourage the class to think about the above questions from a number of perspectives (fisheries, snow crab, local restaurant owner, consumers).

6. Wrap up this lesson by discussing the annual landings data. At this point students should have come to the conclusion that there was overfishing in 1999 and that catch limits were set to rebuild the snow crab population. Share Teacher Handout 2 (2011 Crab Stock Assessment and Fishery Evaluation Report. Have students compare their snow crab graph with the stock

assessment graph. Students should notice that their graph mirrors the dotted line from the 2011 Crab Stock Assessment Graph.

- What are the similarities between graphs?
- What are the differences between graphs?

Explain the importance of stock assessments. Assessments provide the technical basis for setting annual fishery quotas and other fishery management measures that will achieve optimum yield from the fishery while avoiding overfishing and ecosystem harm (www.st.nmfs.noaa.gov/StockAssessment/StockAssessment.html).

7. Discuss the following:

- In 1999, snow crabs were overfished. Why were fishermen still allowed to harvest snow crabs?
- What is the difference between overfishing and overfished? Why is it okay to eat overfished stock? (Stock that is responsibly harvested in the U.S. under strict regulations that work to keep the environment healthy, fish populations thriving, and our seafood industry on the job, can be eaten.

The Bridge Connection

www.vims.edu/bridge
Use the search function to search for "fisheries" to access lesson plans and many additional resources.

The "Me" Connection

Ask students if they or anyone in their family participates in recreational or commercial fishing. Discuss how overfishing could impact them personally, whether they are fishermen or they buy and consume fish.

Connections to Other Subjects

Mathematics, Language Arts, Environmental Policy

Evaluation

Assessment could include students' understanding of the concept of overfishing versus overfished, their data analysis, their graphing of the data, and participation in class discussions.

Extension

Students should understand the difference between overfished and overfishing, and why it's okay to eat an overfished fish/shellfish. To demonstrate their understanding, students can design an advertisement or commercial for a sustainably caught fish/shellfish described on www.fishwatch.gov.

Additional Resources

- 2011 Crab Stock Assessment and Fishery Evaluation Report www.fakr.noaa.gov/npfmc/PDFdocuments/resources/SAFE/CrabSAFE/CrabSAFE2011.pdf

- NOAA Fisheries Feature – Magnuson-Stevens Act www.nmfs.noaa.gov/msa2007/

- “Overfished” Isn’t Just About Fishing
  www.nmfs.noaa.gov/stories/2011/07/14_overfished_isnt_just_about_fishing.html

- NOAA Fisheries Service- Alaska Fisheries Science Center (Snow Crab)
  www.afsc.noaa.gov/Education/factsheets/10_opilio_fs.pdf

NMFS Landings Query Results

Handout 1

You Asked For the Following:

- Year : From: 1985 To: 2010
- Species : CRAB, SNOW
- State : Alaska

Year	Species	Metric Tons	Pounds	$
1985	CRAB, SNOW	29,462.1	64,952,252	22,089,480
1986	CRAB, SNOW	43,809.6	96,582,736	52,830,757
1987	CRAB, SNOW	45,779.3	100,924,939	74,886,305
1988	CRAB, SNOW	59,338.5	130,817,707	109,232,789
1989	CRAB, SNOW	66,971.4	147,645,204	117,968,365
1990	CRAB, SNOW	72,586.7	160,024,686	100,015,433
1991	CRAB, SNOW	147,502.1	325,183,233	164,468,126
1992	CRAB, SNOW	141,965.1	312,976,182	160,164,650
1993	CRAB, SNOW	103,970.4	229,213,048	173,055,858
1994	CRAB, SNOW	67,129.2	147,992,955	199,346,511
1995	CRAB, SNOW	33,568.6	74,005,359	174,488,599
1996	CRAB, SNOW	29,194.9	64,363,158	87,949,038
1997	CRAB, SNOW	53,152.4	117,179,683	92,337,590
1998	CRAB, SNOW	109,060.0	240,433,650	135,847,412
1999	CRAB, SNOW	83,006.9	182,997,046	161,037,400
2000	CRAB, SNOW	14,882.8	32,810,551	60,535,468
2001	CRAB, SNOW	11,245.6	24,792,145	38,319,216
2002	CRAB, SNOW	14,486.1	31,936,016	43,976,897
2003	CRAB, SNOW	12,478.7	27,510,643	50,423,551
2004	CRAB, SNOW	10,744.6	23,687,517	48,635,717
2005	CRAB, SNOW	11,278.6	24,864,785	42,760,967
2006	CRAB, SNOW	17,245.5	38,019,384	30,453,809
2007	CRAB, SNOW	15,478.8	34,124,621	50,403,015
2008	CRAB, SNOW	28,323.6	62,442,257	101,157,470
2009	CRAB, SNOW	26,349.1	58,089,302	79,388,555
2010	CRAB, SNOW	21,699.7	47,839,212	54,047,565
GRAND TOTALS:	-	1,270,710.5	2,801,408,271	2,425,820,543

Handout 2

Names _____

Analyzing Snow Crab Data

What do we know by looking at data	Questions that requires research

1. What was the most profitable year for snow crabs? How many pounds were caught? How much money was made?

2. What was the least profitable year for snow crabs? How many pounds were caught? How much money was made?

3. What do you suppose happened between 1999 and 2000?

Teacher Handout 2

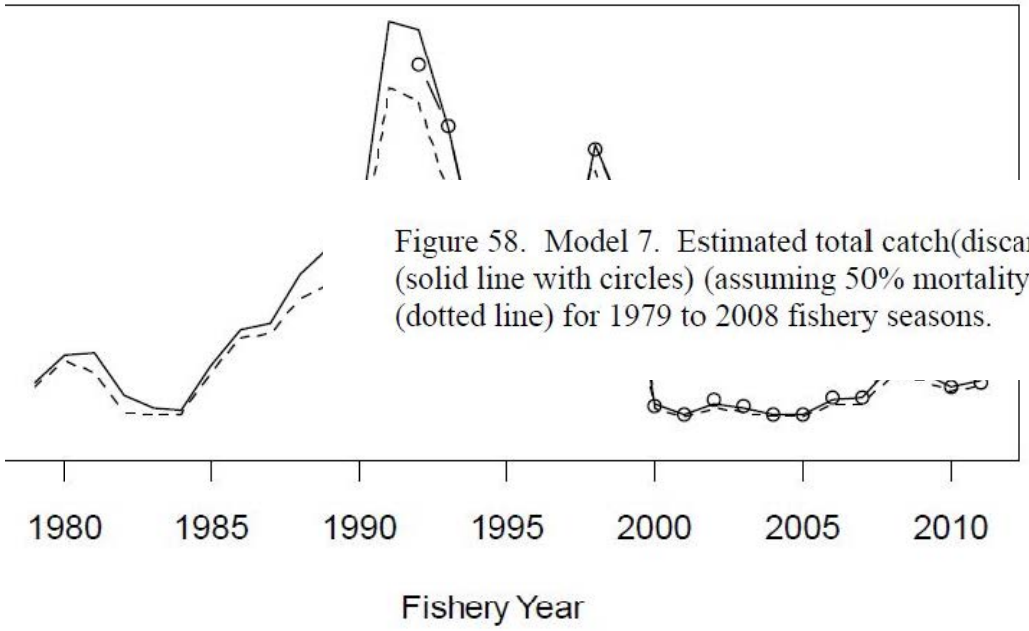

Figure 58. Model 7. Estimated total catch(discard + re
(solid line with circles) (assuming 50% mortality of dis
(dotted line) for 1979 to 2008 fishery seasons.