HOW DO PEOPLE USE NATURAL RESOURCES?

Overview

In this lesson, students will determine how the sea surface temperature has changed near Port Clarence and how this change affects salmon migration on the Pilgrim River.

Objectives

On successful completion of this lesson, students will be able to:

- describe the relationship of sea surface temperature and how it affects the timing of the salmon run;
- graph the change in sea surface temperature near Port Clarence,
- graph the arrival of salmon at a weir on the Pilgrim River; and
- interpret the graphs of the effect of sea surface temperature on salmon runs on the Pilgrim River.

Alaska Standards

Alaska Science Standards / Grade Level Expectations

[6] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[6] SA3.1 The student demonstrates an understanding that interactions with the environment provide an opportunity for understanding scientific concepts by gathering data to build a knowledge base that contributes to the development of questions about the local environment (e.g., moose browsing, trail usage, river erosion).

[6] SC2.2 The student demonstrates an understanding of the structure, function, behavior, development, life cycles, and diversity of living organisms by identifying basic behaviors (e.g., migration, communication, hibernation) used by organisms to meet the requirements of life.

Alaska Math Standards

6.EE.9. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.

6.SP.5. Summarize numerical data sets in relation to their context, such as by:

a. Reporting the number of observations (occurrences).

b. Describing the nature of the attribute under investigation, including how it was

measured and its units of measurement.

c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range), as well as describing any overall pattern and any outliers with reference to the context in which the data were gathered.

d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

Alaska Cultural Standards

[E] Culturally knowledgeable students demonstrate an awareness and appreciation of the relationships and processes of interaction of all elements in the world around them. Students who meet this cultural standard are able to:

[E2] understand the ecology and geography of the bioregion they inhabit

Bering Strait School District Scope & Sequence

M.S. sequence 6.9: Ecosystems

M.S. sequence 7.9 Water Cycle and Oceans

M.S. sequence 7.10 Natural Resources

Materials

- STUDENT WORKSHEET: Sea Surface Temperature and the Affect on the Salmon Run

Additional Resources

Glencoe Life Science Ch 21-23
Glencoe Earth Science Ch 15-18

Whole Picture

Natural resources are all those things that come directly from the earth and are used to make the things that people need for food, shelter, and energy. Natural resources include things like plants, soil, sunshine, water, fossil fuels, wildlife, metals, and minerals. Alaska has an abundance of natural resources: forests in the south, fossil fuels and minerals in the north, and wildlife and fish in both the interior and in the seas.

Every day, people depend on natural resources. Where natural resources are exported, they are an important part of the cash economy. When turned into fuel — whether from fossil, wind, or solar sources — they power homes and vehicles. When processed, they provide the materials to build our homes, clothe our bodies, and allow us to communicate with each other at long distances. Natural resources also provide us with the food and minerals to nourish our bodies.

In northern Alaska, some important natural resources are exported as part of the cash economy. Oil and natural gas are extracted from the ground and exported to locations where they are

refined into fuel that is then shipped back to the villages. This fuel powers snow machines, four-wheelers, and boats, and also heats our homes. It is also shipped outside the state, where people use it to power their vehicles. Likewise, fish and seafoods are important natural resources for the cash economy. The Bering Sea is home to abundant fisheries (fisheries are systems organized to harvest fish for sale, such as commercial fisheries. Elements of the system include number of fishermen, gear, species harvested, and timing of harvest, etc.), including king crab, salmon, and pollock. The products from these lucrative fisheries are exported around the world.

Perhaps the most important use of Alaska's natural resources is as subsistence food. Most people who live in rural villages depend largely on the plants and animals harvested from the land. (Though some "western" food is available at village stores, much of it is expensive.) In addition, the rituals and ceremonies people practice during and surrounding subsistence activities are culturally important. In this way, natural resources are fundamental not only for nutrition, but also for spiritual value (Barnhardt and Kawagley, 2005).

The Iñupiat, Yup'ik, and Siberian Yupik people of northwestern Alaska have practiced subsistence activities for millennia. As semi-nomadic people, they historically built their seasonal homes as a part of the landscape, using only the materials immediately available to them (Kawagley, 2006). Dependence on natural resources for survival can also be seen in archaeological material culture like toggle-head harpoons, bolas, and collecting baskets (UAMN, 2015). In addition, a spiritual connection can be seen in traditional masks, which depict the reproductive cycling of plant and animal spirits — both important natural resources for survival. Even today, guidance from the elders teaches us that the natural resources we depend on must be treated carefully and with respect, so as to ensure their availability in the future (ANKN, 2006).

As the climate begins to change, wisdom from the elders will be ever more important as people adapt their uses of natural resources to changing landscapes and scarcity of raw materials. Learn from elders and culture bearers in your community how people can continue to use and protect local natural resources.

Vocabulary

weir – a barrier or enclosure across a river or stream set to capture fish.

Activity Procedure

1. Ask the class how many of them eat salmon? How many have been salmon fishing? Ask how they know when to go fishing for salmon? Do they go at exactly the same time each year? Are some runs of salmon early or later? Why?
2. Introduce the activity. Discuss with students the importance of salmon in Alaska, and in their lives. Ask why scientists want to monitor changes to the salmon life cycle.
3. If necessary, review making graphs with students. Also explain what a "line of best fit", or "trend line" shows about the data. Hand out the worksheet and allow students time to complete the worksheet.

4. What are some factors that could affect salmon run times? Introduce sea surface temperatures and let students know they will be looking at the relationship between sea surface temperatures and when the salmon run. Ask students how the change in the timing of salmon could affect their lives? How should salmon runs be monitored and managed?

Extension Activities

- Discuss regional and local variations in sea surface temperatures, such as El Niño.
- The arrival of fish, and/or sea surface temperature could also be correlated to the average amount of sea ice. The data is included below.

Year	Average amount of sea ice coverage in May (325 km^2 area)
2003	7.581
2004	18.484
2005	25.484
2006	41.484
2007	18.71
2008	30.548
2009	22.258
2010	31.516
2011	36.484
2012	30.194
2013	34.903
2014	29.161

References

Alaska Department of Fish and Game, Accessed from: http://www.adfg.alaska.gov/sf/FishCounts/index.cfm?adfg=main.home

National Sea Ice Data Center, Accessed from: http://nsidc.org/data/nsidc-0051

Remote Sensing Systems, Accessed from: http://www.remss.com/measurements/sea-surface-temperature

Michael P. Carey, Ph.D., Research Fish Biologist, USGS Alaska Science Center, Fish and Aquatic Ecology Program

Alaska Native Knowledge Network (ANKN). (2006). Alaska Native Values for Curriculum. Accessed from: http://ankn.uaf.edu/ancr/Values/index.html

Barnhardt, Ray, and Kawagley, Angayuqaq Oscar. (2005). "Indigenous Knowledge Systems

and Alaska Native Ways of Knowing." Anthropology & Education Quarterly, 36(1): 8-23.

Kawagley, Angayuqaq Oscar (2006). *"A Yupiaq Worldview: A Pathway to Ecology and Spirit".* Long Grove: Waveland Press.

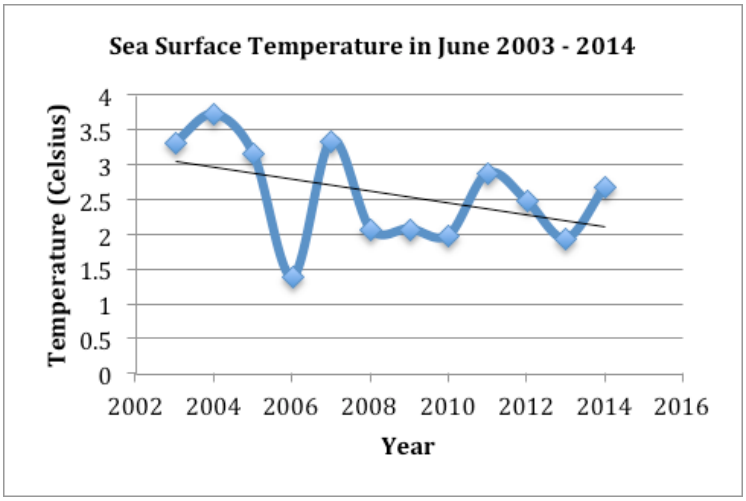
University of Alaska Museum of the North (UAMN). (2015). "Archaeology." Accessed from: https://www.uaf.edu/museum/collections/archaeo/

Answers

Part 1

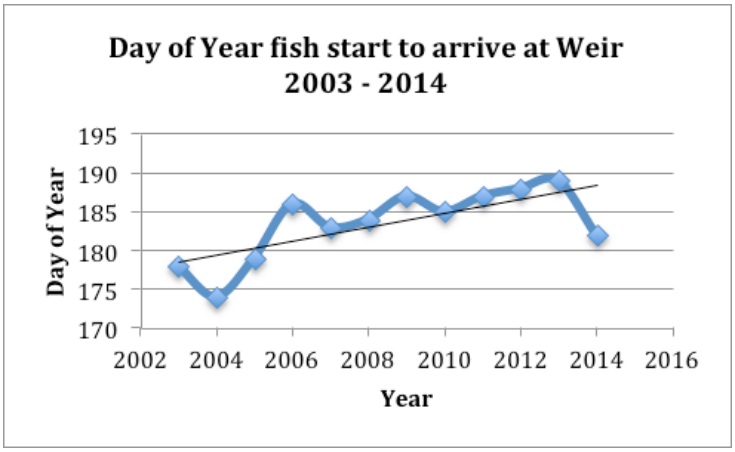
1. Earlier

Part 2



2. It is getting colder.
3. The line would go down.

Part 3



4. The salmon are arriving later.
5. The line would go up.

Conclusion

6. You would expect them to arrive earlier.
7. Yes, they arrived 7 days earlier.
8. Year – 2004

   Temperature – 3.73 C
9. Year – 2004

   Arrival day – 174
10. Year 2006

    Temperature – 1.94 C
11. Year – 2013

    Arrival day –189
12. Answers will vary. It could be due to differences in conditions between the Bering Sea and the weir. The differences between 2006 (lowest temperature) and 2013 (latest arrival) are close, with only 3 days difference between them.
13. Answers will vary. There are other examples of local and regional differences of sea surface temperatures due to wind, atmospheric temperatures, fresh water runoff, etc. El Nino is a well-known example of a prolonged warming in the Pacific Ocean.
14. Answers will vary. If the timing of the spawning run is too early or late the river may be too warm or cold to reach the spawning grounds. The fish need to be physically ready for the fresh water in the river. They want to arrive at an optimal time, which is an active area of research, when the flow and temperature will allow them to spawn before the lake is ice covered. Early or late migration has resulted in high mortality for the fish. Food is not an issue, since the salmon stop feeding when they start migrating upstream in fresh water.

Student Worksheet: Sea Surface Temperature and the affect on the Salmon Run

Name_____

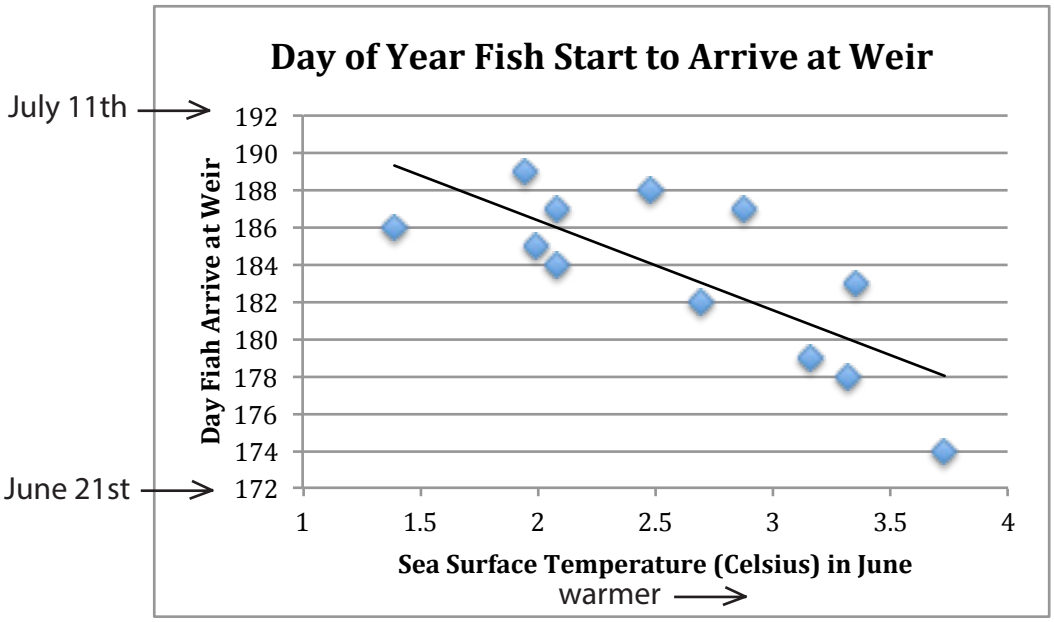
Salmon are an important natural resource for Alaska. In addition to salmon being a major part of the fishing industry, many Alaskans enjoy sport fishing and depend on them for their subsistence lifestyle. In the wake of climate change monitoring of this vital natural resource takes on increased importance. In this activity you will see how changes in sea surface temperature affect the timing of the salmon run on the Pilgrim River, which is located north of Nome, Alaska.

Part 1

How does sea surface temperature affect the timing of salmon run?

The following graph shows the relationship between sea surface temperature and the day of arrival of fish at a weir on the Pilgrim River taken from 2003 - 2014. The sea surface temperature was taken by satellites on the Bering Sea, just outside of Port Clarence.

The y axis is the day of the year, not the number of fish that arrive at the weir. For example, Jan 1st is day #1, Feb. 1st is day #32, March 1st is day #60, etc. Day #172 is June 21st and day 192 is July 11th. A line of best fit is also included to show the trend of the data.



Look carefully at the graph then state the relationship between the sea surface temperature and the day of arrival of fish at the weir.

1. The warmer the sea surface temperature the earlier/later fish will arrive at the weir. Circle the correct answer.

Part 2

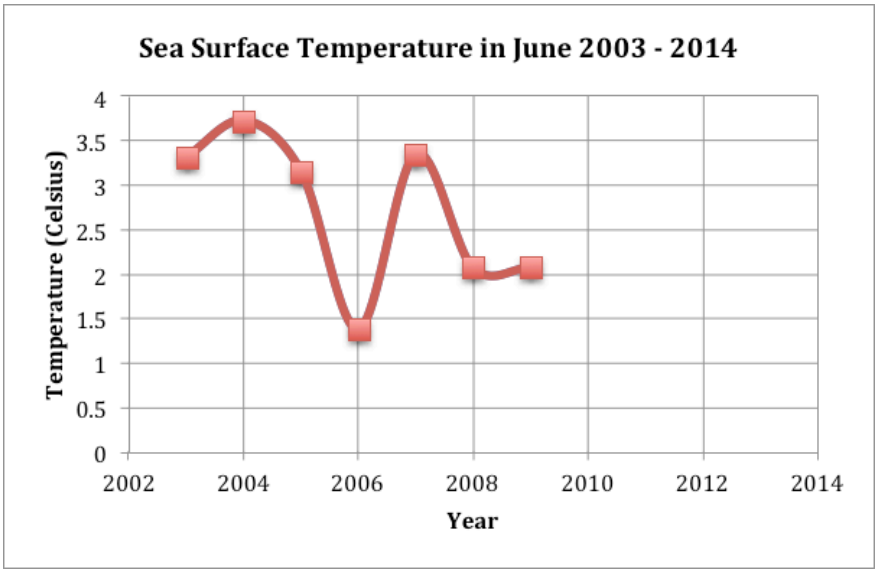
How has the sea surface temperature changed near Port Clarence?

The data below shows the sea surface temperature from 2003 – 2014. The temperature was taken by satellites of the Bering Sea, near Port Clarence.

Year	Sea Surface Temp in June (Celsius)
2003	3.32
2004	3.73
2005	3.16
2006	1.39
2007	3.35
2008	2.08
2009	2.08
2010	1.99
2011	2.88
2012	2.48
2013	1.94
2014	2.69

Complete the graph

The data from 2003 – 2009 has been already been done. Complete the graph by adding the data for 2010 – 2014.



2. What is the general trend for the temperature of the sea surface from 2003 - 2014? Is it getting warmer, colder or staying the same?

3. If you were to add a line of best fit, like was done in Part 1, would the line go up, down, or be horizontal?

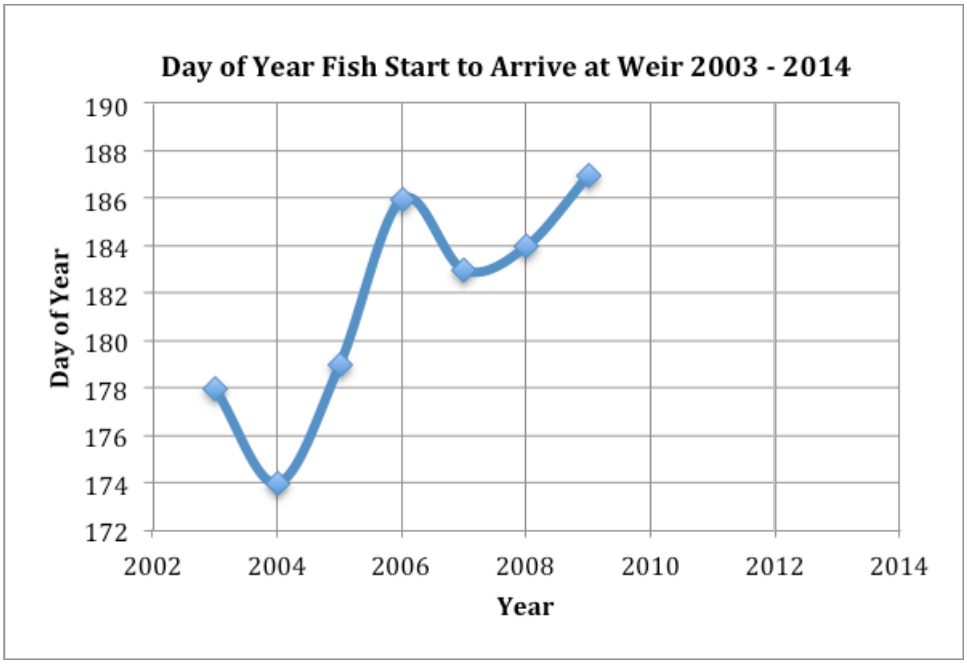
Part 3

How has the arrival of the salmon run changed from 2003 - 2014?

The data table shows the day the salmon arrived at the weir on the Pilgrim River from 2003 – 2014. Remember, day 178 is June 21st and day 192 is July 11th. It is not telling how many fish arrived, just what day they arrived.

Year	Day of Year fish start to arrive at Weir
2003	178
2004	174
2005	179
2006	186
2007	183
2008	184
2009	187
2010	185
2011	187
2012	188
2013	189
2014	182

Complete the graph by adding the data for 2010 – 2014. The data for 2003 – 2009 has already been done.



4. What is the general trend of the data showing? Are the salmon arriving earlier, later or at about the same time from 2003 – 2104?

5. If you added a line of best fit, like was done in part 1, would it go up, down, or be horizontal?

Conclusion

6. In 2014 the sea surface temperature was warmer than it was in 2013. Since it was warmer in 2014 would you expect the fish to arrive sooner or later than they did in 2013?

7. Look at the data in Part 2 and Part 3. Did the fish arrive earlier in 2014 then they did in 2013? How many days difference was there between the arrival in 2013 and 2014?

8. What year had the highest sea surface temperature and what was the temperature?

   Year:

   Temperature:

9. What year had the earliest arrival day of salmon at the weir and what day was it?

   Year:

   Arrival day:

10. What year had the lowest sea surface temperature and what was the temperature?

    Year:

    Temperature:

11. What year had the latest arrival day and what day was it?

    Year:

    Arrival:

12. Why do you think the year with the lowest sea surface temperature did not have the latest arrival day?

13. Global warming and increasing temperatures in the ocean are often in the news. Why do you think the sea surface temperature near Port Clarence went down from 2003 – 2014?

14. An increase, or decrease of sea surface temperature affects the return of salmon to spawning grounds. What would be the consequence of the fish returning too soon, or too late?