NOAA Teacher at Sea Program
Lesson Plan #6

Unit Plan: Sustainable Harvesting of Chinook Salmon; A Fisheries Management Decision
Activity Title: Hydrography and Acoustics during Fisheries Research (NOAA Teacher at Sea Lesson)
Subject (Focus/Topic): Life science: marine ecology /fisheries
Grade Level: 9th – 12th Grade
Average Learning Time: 90 minutes
Lesson Summary (Overview/Purpose): When completing fisheries studies, scientists often recover and analyze physical and chemical data as well as biological.

Overall Concept (Big Idea/Essential Question): This activity is designed to acquaint students with some of the less familiar aquatic animals in the Bering Sea and Alaskan ecosystems. More importantly, this activity will help students describe the complicated ecological connections between the Chinook salmon and other marine and terrestrial life.

Specific Concepts (Key Concepts)
• The Bering Sea is a unique ecological environment that supports a very large food web.
• Fishery scientists monitor the health of various fishery populations such as Walleye Pollock and salmon.
• A crucial aspect to understanding the ecosystem that the marine specie live in requires an investigation of the physical and chemical properties of the water column in which the species are found.
• Scientist recover physical and chemical data from the ocean water that is sampled to better understand and predict the biological makeup of the marine ecosystem.

Focus Questions

1) Since the entire waster column cannot be hand sampled, how do oceanographers choose where to sample?
2) How do physical features in the water column, such as the pycnocline, impact the biology of the ocean?
3) What does the fluorescence of the water tell you? Would you ever expect fluorescence at bottom samples?
4) How may the chemical and biological makeup of the same water column change from day to night?
5) How can sonar be used to help scientist time their sampling events?

Objectives/Learning Goals
• Students will be able to use a physical data set from an ocean water column to predict the extent and location of the biological life living in it.
• Students will learn about the decision-making process of an oceanographer in terms of where actual water samples are recovered from a large water column. These recovered samples will be taken back to the lab for further analysis.

• Students will learn about the limitations of sonar and how different frequency waves are used to identify different types of pelagic creatures.

Web Resources
Bering Sea CTD Explained
http://www.youtube.com/watch?v=WOguuxSY3oI&feature=player_embedded#!

Hydrography Questions
A Lesson at Sea
http://oscardyson2010.blogspot.com/p/lesson-at-sea.html
NOAA Log #1
http://oscardyson2010.blogspot.com/2010/08/noaa-log-1.html
Hydrographic studies
http://bsierp.nprb.org/fieldwork/2008/ctd.html
Understanding CTD Data
http://teacheratsea.wordpress.com/tag/thermocline/
Ocean Mixed Layer and Thermocline
http://oceanworld.tamu.edu/resources/ocng_textbook/chapter06/chapter06_04.htm

Acoustic Analysis Questions
Annual Acoustic Surveys
http://bsierp.nprb.org/fieldwork/2010/pollock-acoustic.html
NOAA Log #4: The Sounds of Science
http://oscardyson2010.blogspot.com/2010/08/noaa-log-4.html
Acoustics Explained from a Teacher at Sea, Story Miller
http://storymillernoaa2010tas.blogspot.com/2010/07/blog-5-72710.html

Common Misconceptions/Preconceptions
• Fisheries research is simply about catching and analyzing fish data.
• Salinity of the ocean is simply indicative of the quantity of NaCl in the water.
• Sonar can only be used to distinguish fish of different sizes

Materials
Handout with Five Expert Topics titled in boxes for Pre-Assessment
Poster paper if student groups will be coordinating information on a poster.
Team Building Exercise requires scraps of recycled paper and an empty envelope for each team.

Technical Requirements
• Access to the Internet for student research.

Teacher Preparation
Make available to students the handouts entitled, “Hydrography Aboard the Dyson” and “Acoustic Analysis Aboard the Dyson”. Students will use the

Keywords: oceanography, hydrography, acoustician, primary producers, swim bladder, CTD, pycnocline, fluorescence, thermocline, halocline, consumers, zooplankton, frequency, wavelength

Pre-assessment Strategy/Anticipatory Set (Optional)
Students listen to the CTD cast from the Oscar Dyson, Bering Sea CTD Explained. They should note what depth the oceanography collected water samples for lab analysis.

Lesson Procedure
Student will use the website created by Teachers at Sea and other research scientists to explore some basics about Hydrography and Acoustic Analysis aboard a fisheries vessel.

When students have completed the individual question sets, have them make up groups of 3-4 students to answer the focus questions.

1) Since the entire waster column cannot be hand sampled, how do oceanographers choose where to sample?
2) How do physical features in the water column, such as the pycnocline, impact the biology of the ocean?
3) What does the fluorescence of the water tell you? Would you ever expect fluorescence at bottom samples?
4) How may the chemical and biological makeup of the same water column change from day to night?
5) How can sonar be used to help scientist time their sampling events?

Assessment and Evaluation
For the purpose of this lesson, evaluate students based on both their individual work as well as their ability to work as part of an team. As a class review the answers to the Hydrographic question set and the Acoustic Analysis question set, before allowing student to proceed with the focus questions.

Standards

National Science Education Standard(s) Addressed:
- NSES A: Unifying Concepts and Processes
Sub-categories 1, 2, 3 and 4
- NSES B: Science as Inquiry
Sub-category 2
- NSES F: Science and Technology
Sub-categories 1 and 2
- NSES G: Personal and Social Perspectives
Sub-category 6
- NSES H: History and Nature of Science
Sub-categories 1 and 2

Ocean Literacy Principles Addressed:

- Principle 1: The Earth has one big ocean with many features.
Fundamental Concepts: e and g
- Principle 3: The ocean is a major influence on weather and climate.
Fundamental Concept: b and e
- Principle 5: The ocean supports a great diversity of life and ecosystems.
Fundamental Concepts: a, d, e, and f
- Principle 7: The ocean is largely unexplored.
Fundamental Concept: b, d, e, and f

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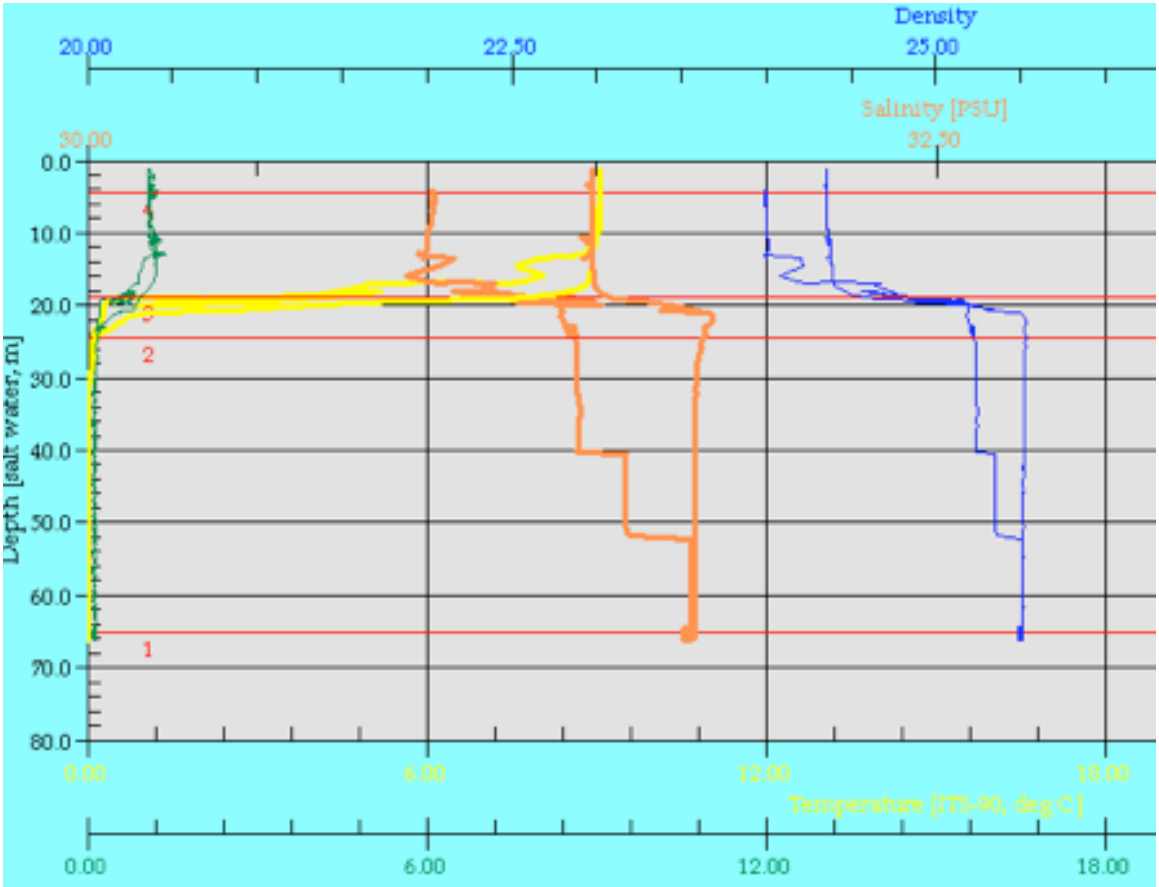
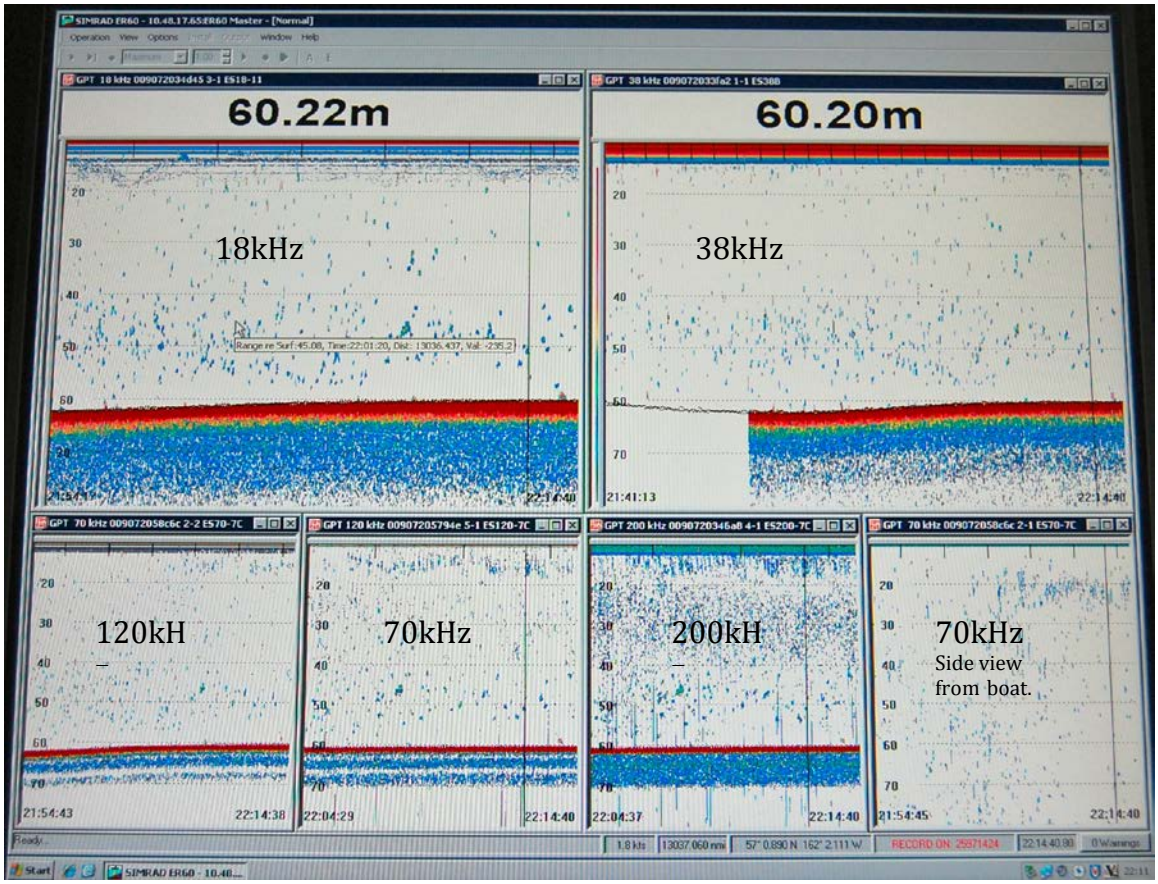
Hydrography Aboard the Oscar Dyson



Questions:

1) There are four parameters being plotted as the CTD is cast. What are they and identify the color line on the plot.
2) How approximately deep is the ocean at this location? (Remember that Oceanographer never allows the CTD to hit the ocean floor since it will cause sediment to be suspended in the water column which will impact CTD results)
3) At what depth did the oceanography find the pycnocline?
4) Would this column of water be considered mixed or layered? How do you know?
5) Where did the oceanographer stop the CTD on the way back up to collect samples?
6) Why do you think those sampling locations were chosen?

Acoustic Analysis Aboard the Oscar Dyson



Questions:

1) Which of the following acoustics uses sound waves with the shortest wavelength?
2) What is the dark read line on the bottom of each acoustic reading?
3) Which of these screens will best help the acoustician find the zooplankton?
4) Which of these screens will best help the acoustician find the pollock?
5) 18kHz acoustic readings and 38kHz are very close. What types of pelagic creatures should be eliminated in the 38kHz reading, but show up in the 18kHz acoustics?