NOAA Teacher at Sea Program
Lesson Plan #4

Unit Plan: Sustainable Harvesting of Chinook Salmon; A Fisheries Management Decision
Activity Title: Pollock Fishing – A structured controversy
Subject (Focus/Topic): Life science: marine ecology /fisheries
Grade Level: 9th – 12th Grade
Average Learning Time: 120 minutes
Lesson Summary (Overview/Purpose): The Chinook salmon population is being impacted as a result of its' ending up as bycatch during the harvesting of walleye pollock. The Chinook salmon fishery impact many stakeholders in the region. One particular stakeholder of concern is the Native Indian population. They rely on the Chinook salmon for subsistence living. The students are presented and must choose from two options for fisheries management that will address the declining populations of Chinook salmon stock. Students will individually learn about one bycatch management protocol and then share the information with the other teammates. Teams will discuss there findings and make preliminary decisions as to which management tool (or combination of tools) should be employed in future pollock fisheries.

Teams are then provided actually letters and documents from stakeholders that were submitted to the North Pacific Fisheries Management Council. Taking these opinions into consideration, teams prepare a report that relays the team's fisheries management decision along with anticipated outcomes resulting from that decision. Each ***Fisheries Management Team*** will present their findings to the class orally. Teams must address specific concerns cited by various stakeholders.

Overall Concept (Big Idea/Essential Question): This activity is designed to allow students the opportunity to place the role of a fisheries manager and make a decision that will impact the various stakeholders associated with the Chinook salmon stock. Students will work as a team to decide which bycatch control method should be employed in the Pollock fisheries established in the Bering Sea and Gulf of Alaska.

Specific Concepts (Key Concepts)
- The Bering Sea is a unique ecological environment that supports a very large food web.
- The Chinook Salmon fisheries have suffered in recent years due to declining stocks and this decline correlates to an increase in number of Chinook salmon bycatch in the Pollock fisheries.
- It is the role of fisheries management agencies to employ methods to not only support the growth of the Chinook salmon population, but also limit its' mortality as a result of bycatch by the Pollock fisheries.
- The following methods of fisheries management have historically been employed to reduce bycatch:
    1) Vessel Bycatch Allowances and the Penalty Box System
    2) Salmon Savings Area
    3) Voluntary Rolling Hotspot System (VRHS)

4) Prohibited Species Cap

• Various stakeholders often favor one bycatch management system over another.

Focus Questions

1) What are methods used by the fisheries management agencies
2) What are the pros and cons associated with each bycatch control method?
3) Does one bycatch control method better suite the needs/requirments of one stakeholder over another?
4) Which bycatch control method do you choose to employ to best address declining populations of Chinook salmon while limiting negatively impact on all stakeholders.

Objectives/Learning Goals

• Students will be able to describe various methods used to limit bycatch in fisheries.
• Students will be able to describe in what ways each bycatch control method is successful as well as its' limitations.
• Students will be able to describe the concerns of the stakeholders involved in the decision making process of choosing which bycatch control method is employed.
• Students will be make an informed decision about which bycatch method or combination of methods should be used in the future to best address declining populations of Chinook salmon.

Background Information

Taken directly from the *Bering Sea Salmon Bycatch Management Environmental Impact Statement Scoping Report*, NOAA & NMFS, Alaska Region. North Pacific Fishery Management Council, March 2008.

Chinook salmon are a high-value species extremely important to Western Alaskan village commercial and subsistence fishermen and also provide remote trophy sport fishing opportunities. Other salmon (primarily made up of chum salmon) harvested as bycatch in the Bering Sea pollock trawl fishery also serve an important role in Alaska subsistence fisheries. However, in response to low salmon runs, the State of Alaska has been forced to close or greatly reduce some commercial, subsistence and sport fisheries in Western Alaska. Reasons for reductions in the number of Chinook salmon returning to spawn in Western Alaska rivers and the Canadian portion of the Yukon River drainage are uncertain, but recent increases in Bering Sea bycatch may be a contributing factor.

Conservation concerns acknowledged by the Council during the development of the Salmon Savings Areas have not been resolved. Continually increasing Chinook salmon bycatch indicates the VRHS under the salmon bycatch intercooperative agreement approach is not yet sufficient on its own to stabilize, much less, reduce the total bycatch. Hard caps, area closures, and/or other measures may be needed to reduce salmon bycatch to the extent practicable under National Standard 9 of the MSA. We recognize the MSA requires use of the best scientific information available. The Council intends to develop an adaptive management approach which incorporates new and better information as it becomes available. Salmon bycatch must be reduced to address the Council's concerns for those living in rural areas who depend on local fisheries for their sustenance and livelihood and to contribute towards efforts to reduce bycatch of Yukon River salmon under the U.S./Canada Yukon River Agreement obligations.

The proposed action is to manage salmon bycatch in the Bering Sea pollock fisheries to improve compliance with the Magnuson-Stevens Act. National Standard 9 of the Magnuson-Stevens Act requires that conservation and management measures shall, to the extent practicable, minimize bycatch. The Council is considering alternative ways to manage salmon bycatch, including replacing the current Chinook and Chum Salmon Savings Areas in the BSAI with new regulatory closures, salmon bycatch limits, or a combination of both based on current salmon bycatch information. These management measures could incorporate current or new bycatch reduction methods.

Web Resources

Fisheries Bycatch: Consequences and Management
http://nsgl.gso.uri.edu/aku/akuw96001.pdf

Salmon Bycatch Management in the Bering Sea Walleye Pollock Fishery: Threats and Opportunities for Western Alaska
www.yukon**salmon**.org/news/**Bycatch**%20Article%2012-09.pdf

Bering Sea Salmon Bycatch Management Environmental Impact Statement: Scoping Report
http://alaskafisheries.noaa.gov/sustainablefisheries/bycatch/salmon/chinook/deis/scopingreport.pdf

Interview with Susan Salveson; Division chief of sustainable fisheries for the National Marine Fisheries Service Alaska Region
http://www.habitatmedia.org/EOEN_interviews/tran-salveson.html

Common Misconceptions/Preconceptions

- One single fisheries management tool
- Species are only interconnected by simple predator and prey relationships.
- Human impact on terrestrial land will not influence ocean ecosystems

Materials

Print out copies of the four Bycatch Management Protocols that the individual students will investigate and share with his/her group.

1) Vessel Bycatch Allowances and the Penalty Box System
2) Salmon Savings Area
3) Voluntary Rolling Hotspot System (VRHS)
4) Prohibited Species Cap

Access the *Bering Sea Salmon Bycatch Management Environmental Impact Statement: Scoping Report* and print out examples of letters from stakeholders to share with the teams. Most of the letters support Native American interests so be sure to include letters from commercial entities. These letters can be found after page 70.

Technical Requirements

- Access to the Internet for student research and collaboration.

• Access to the Internet to listen to an interview with Sue Salveson (Assistant Regional Administrator Sustainable Fisheries Division, Alaska Region, NMFS)

Teacher Preparation
This lesson has students working in their ***Fisheries Management Teams*** to make engage in a modified structured controversy. The following format lays out the steps the group will take.

1) Individuals Learn about specific Bycatch Control Method
2) Teams gather to share information about Bycatch Control Method by sharing and respectfully challenging each other's information/opinion. (Students are expected to take on an adversarial position at this time)
3) Teams drop their adversarial positions, clarify their understanding of each other's information and rationale, and work on a outline of the team's report to find a higher level of synthesis.
4) Reporter – documents team's outline of rationale for the decision they have made.

After the initial outline is submitted to the teacher, teams are issued the primary source documents from the stakeholders. ***Fisheries Management Teams*** discuss how these documents can/will influence their decision as to which bycatch control method(s) their teams have selected to employ.

Teams prepare a formal presentation to the be presented to the entire class summarizing the group's findings, their reasoning behind their choice for bycatch control method and the positive and negative consequences that their decision has on stakeholders.

Keywords: bycatch, groundfish, landings, stock, hot-spots, caps

Pre-assessment Strategy/Anticipatory Set (Optional)
As a class you may wish to read the letter from Benedict Jones to Sue Salveson (pg 59 *Bering Sea Salmon Bycatch Management Environmental Impact Statement: Scoping Report)* to introduce the lesson and the need for fisheries management in the case of Chinook salmon in the Bering Sea.

Lesson Procedure

1) Each student (or pairs if needed) in a group reads silently the Bycatch control method that provided for them. Each student will briefly explain the method and make a case to their ***Fisheries Management Teams*** as to why this method should in the Pollock fisheries.

2) The ***Fisheries Management Teams*** gather after silently preparing each of their cases and in the order below, make their case to their team. In the order indicated below, the individual team member present their case. In an adversarial fasion, when the second team member presents his/her findings, he/she must address the points made by the previous team member. This continues throughout the team presentations and therefore, the last team member to present must address all three previously described control methods.

3) Teams drop their adversarial positions, clarify their understanding of each other's information and rationale, and work on creating an outline of the team's report indicating the following:

- Which control method(s) the team has selected?
- Why this control method(s) is the best choice in the case of the Chinook salmon?
- How will this control method benefit various stakeholders?
- How will this control method challenge or upset various stakeholders?

4) After teams have submitted their original outline, they are provided primary source document that are citizen and group opinions that were submitted in the matter. Teams should discuss whether or not these informed opinions will change their outline and submit a brief paragraph stating the group's decision.

5) Teams prepare a formal presentation to the be presented to the entire class summarizing the group's findings, their reasoning behind their choice for bycatch control method and the positive and negative consequences that their decision has on stakeholders.

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 a team. The structured controversy is a complex multi-step activity that challenges students to use their relationships and thinking skills. Assessment should be not be focused on the actual decision that the team has brought forth, instead it should include parameters that reward the following:

1) Involvement in overall teamwork
2) Ability to use interpersonal skills, especially sharing information, respectful listening, asking probing non-judgmental questions, consensus seeking and validating.
3) Ability to use intrapersonal skills, especially giving and receiving feedback and achieving consensus on individual role and responsibilities.
4) Recognizing the similarities and differences between the bycatch control methods.
5) Combining information efficiently into a cohesive statement that is supported by good reasoning.

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-categories 1 and 2
- NSES D: Life Science
Sub-categories 4 and 6
- NSES F: Science and Technology
Sub-categories 1 and 2

- NSES G: Personal and Social Perspectives
Sub-categories 2, 3, 4, 5 and 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: g and h
- Principle 3: The ocean is a major influence on weather and climate.
Fundamental Concept: e
- Principle 5: The ocean supports a great diversity of life and ecosystems.
Fundamental Concepts: a, b, c, d, e, and f
- Principle 6: The ocean and humans are inextricably interconnected
Fundamental Concepts: e and g
- Principle 7: The ocean is largely unexplored.
Fundamental Concept: b, c, d, e, and f

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Vessel Bycatch Allowances and the Penalty-Box System:

Excerpt taken from: Mitigation of Fishery Bycatch: An Overview by Clarence G. Pautzke in Fisheries Bycatch Consequences and Management. North Pacific Fishery Management Council, 605 West 4th Avenue, Anchorage, AK 99501

Several new measures that could prove to be more cost effective are just on the horizon. For example, the North Pacific council is exploring the use of vessel bycatch allowances (VBAs). These represent another step toward placing accountability for bycatch at the individual fisherman level. The original overall bycatch limits on halibut, for instance, did not compel all fishermen to fish responsibly. More often than not, the limit simply caused a race for fish. Groundfish fishermen, knowing that a prohibited species catch (PSC) limit was about to close the fishery, hastened their harvest of groundfish as much as possible before the closure, rather than throttling back and being more cautious about bycatch. With an overall PSC limit, fishermen with egregiously high bycatch rates can devastate the rest of the fleet. In response, the overall PSC is subdivided by area, season, fishery, and gear type, to buffer fishermen and fleets from each other.

To further isolate irresponsible fishermen, the council developed what is termed a vessel incentive program (VIP), wherein any fisherman with a bycatch rate in excess of a standard rate is penalized. A “penalty box” system was the original intent of the council, wherein a fisherman would have to leave the fishery for a time-out immediately after violating the standard. This approach was abandoned because of the need to prove a violation with great statistical accuracy and precision, and because of the two- to three-year appeals process fishermen can exhaust before being barred from the fishery. The penalty box program thus devolved into the VIP program, which has been very ineffective in controlling bycatch even though the bycatch rates are published by individual vessel name to encourage peer pressure. Few fishermen have been penalized under the VIP program.

The VBA proposal, strongly endorsed by industry, would truly individualize the fishery. An irresponsible fisherman would close only himself down, not other fishermen who may be fishing cleanly. There are three main hurdles to this program going forward. First, VBAs may be perceived as a form of individual fishing quota. The Senate precluded work on any individual quota systems during FY 1996, and the Magnuson Act reauthorization may preclude development for three to five years. VBAs may be exempted if they are nontransferable. Second, monitoring and enforcement will be very difficult for VBAs. It will require extensive and expensive observer coverage, possibly much more comprehensive than the current program, and much more timely reports of catch. An added complication is that, unlike tracking individual quotas for target catch by checking product on board, VBAs are for species that must be discarded, and thus there will be no opportunity for after-the-fact verification of catch. And if a vessel is too small to carry an observer, it is questionable whether it will be able to participate in the program. Third, the formula for initial allocation of VBAs by fishery and fisherman will need to be very carefully crafted. It must be fair and not viewed as rewarding past poor performance. With these concerns addressed, a program could be in place by 1998, or more likely, 1999.

Savings Area:

Excerpt modified and taken from: Mitigation of Fishery Bycatch: An Overview by Clarence G. Pautzke in Fisheries Bycatch Consequences and Management. North Pacific Fishery Management Council, 605 West 4th Avenue, Anchorage, AK 99501

Geographical Information Systems (GIS) are used to describe bycatch patterns. The ability to overlay crab habitat and crab fishing effort, and the bycatch of trawl fisheries permitted evaluation of the trade-offs among proposed management alternatives. The ability to analyze temporal and spatial patterns using the GIS helped determine the duration and shape of closure areas and optimized groundfish catches in the directed fisheries (Ackley). Data from NMFS annual trawl surveys and observers onboard trawl fishing vessels in the Bering Sea were examined with a GIS to detect spatial or temporal patterns in the bycatch of crab. Results of these analyses have been presented to the NPFMC in the form of Environmental Assessment/Regulatory Impact Reviews (EA/RIRs) to support regulatory amendments to the groundfish FMP that created time and area closures to mitigate bycatch. The time-area closures were crafted to maximize the savings to impacted species while attempting to minimize the effects such closures would have on directed fisheries. The recently implemented closures include an area of Bristol Bay to protect red king crab.

The Pribilof Islands blue king crab population experienced a high abundance level in 1980 of 110 million crab; however, the population fell to 1.2 million in 1985 and has increased slightly to 8.4 million in 1995. Concerns for the blue king crab population resulted in a search for solutions to rebuild the stock. Among several factors influencing the crab population, trawling in the vicinity of the Pribilof Islands was potentially harmful to the habitat required by blue king crab, and trawlers bycaught blue king crab in significant numbers. Pribilof Islanders proposed a 46.3 km buffer around the islands as a no-trawl zone to protect blue king crab habitat. However, it was found by GIS that such a closure was much larger than needed for several reasons:

- There was little bycatch of blue king crab in the deeper waters to the south and west of the Pribilof Islands.
- Critical juvenile habitat exists primarily between the two Pribilof Islands.
- Crabs are primarily concentrated to the north and east of the Islands.

An area providing the maximum savings to crabs and their habitat while allowing trawling in deeper waters of high groundfish production to the southwest was defined by GIS and adopted by the NPFMC as a permanent no-trawl zone in April 1994

Volunteer Rolling Hotspot System:

Excerpt modified and taken from: Gisclaire, Becca Robbins. *Salmon Bycatch Management in the Bering Sea Walleye Pollock Fishery: Threats and Opportunities for Western Alaska*. American Fisheries Society Symposium 70: 799-816, 2009.

A Voluntary Rolling Hot Spot (VRHS) system allows fishery boats and co-ops to voluntarily choose to participate. It was designed to move fishing boats away from areas of bycatch throughout the season. The areas are not fixed in location, but adjust through time to the changing location of high bycatch areas. Critical to implementation of this voluntary system is catch reporting and analysis. Under the system, boats report their bycatch data and location data via the Vessel Monitoring System (VMS) which tracks to a central administrator, Sea State, a private fisheries firm, within 24 h of their catch. VMS is a satellite-based monitoring system which transmits location data of the vessel on which it is installed and enables Sea State to track the locations of fishing vessels. Sea State then analyzes bycatch rates from the entire fleet and issues orders that close areas with high bycatch rates. If warranted, closures can be made twice a week based on the bycatch data (ICA 2006).

Fishing areas are closed when bycatch rates in those areas exceed the base rate—these areas are designated as "hot spots." Prior to 2008, the total of all "hot spot" areas closed to fishing could not exceed 1,000 square miles. In the 2008 agreement, this area was increased to 1,500 square miles (ICA 2008). If the total amount of area which qualifies based on bycatch rate exceeds 1,500 square miles, not all areas will be closed.

Vessels that violate the agreement are fined $10,000 for the first violation, $15,000 for the second violation in the same year, and $30,000 for the third violation in the same year. Under the agreement, several western Alaska groups are named as third party members of the agreement with the right to enforce violations and payments.

While the VRHS system has held great promise in theory as an adaptive approach to bycatch management, in practice the number of bycatch under the system has still been high and in some cases even increased. VRHS's adaptive feature of using bycatch rates to allow flexibility in the closure system is also its shortcoming. Base levels of bycatch establish the trigger points for management action that when exceeded cause closures and tier assignments. The base levels of bycatch are determined using existing bycatch rates, or those from the previous year. As a result, the VRHS system preserves the bycatch status quo—if high numbers of bycatch were caught in the recent past, the fisheries fleet can continue to catch many bycatch. If not many bycatch was caught, fewer bycatch continues to be caught.

Several notable flaws exist in the relationship between catch and abundance. First, bycatch rates indicate numbers of species present in a local area where the fisheries fleet is fishing and thus are not necessarily correlated with overall abundance of stock. Second, while some believe that bycatch serves as an indicator of overall species abundance, recent experience has not shown that to be true.

Another potential contributing factor to the failure of the VRHS system to reduce bycatch is that the closure areas cannot exceed 1,500 square miles. Having a maximum in place means that a limit exists on how much area can be closed. While the intent of this maximum is logical—without a limit the fisheries fleet could face so many closures that few places would be left to fish. In reality, the limit means an allocative choice that harvesting the given fisheries stock takes precedence over protecting the bycatch.

Prohibited Species Cap:

Excerpt modified and taken from: Gisclaire, Becca Robbins. *Salmon Bycatch Management in the Bering Sea Walleye Pollock Fishery: Threats and Opportunities for Western Alaska*. American Fisheries Society Symposium 70: 799-816, 2009.

A bycatch cap puts an actual maximum number of bycatch landings allowed in the fishery. This would trigger a regulatory effect that was undesirable to the fishery. A cap would provide the numerical safeguard to ensure that a limit exists on the total number of species that can be caught as bycatch. A cap would provide additional incentive to reduce bycatch and, if the consequences of exceeding the cap were drastic enough, peer pressure would increase among boat captains to keep their bycatch low.

A cap, a bycatch level that cannot be exceeded, could be designed in a number of ways: floating or fixed; hard or soft. A floating cap indexed to predicted bycatch species abundance would be ideal from a management standpoint in that it could set bycatch levels according to current populations. Unfortunately, preseason or even in-season forecasting of individual species abundance within an acceptable level of accuracy is not possible at this time. A fixed cap set at a negotiated level, however, could provide an interim solution to offer some degree of protection. Another option is hard or soft caps. A hard cap is a set number which when reached would close the fishery. A soft cap, on the other hand, would trigger some lesser degree of time or area closure rather than a full shutdown. While a hard cap which closed the fishery provides the ideal incentive, this option is politically difficult. Pulsing, in which a fishery is closed for a set number of days after exceeding a cap could provide a plausible alternative. A soft cap that closes a set fishing area, could be effective as well, but closure areas would need to be redesigned to ensure they can adapt to changing fish migration patterns.

A derivative of a fishery-wide cap which has been used successfully in other fisheries is the idea of individual bycatch quotas, by vessel or co-op. Under this type of system, vessels or co-ops are given individual bycatch quotas, or caps. Once they have reached their individual number, they are prohibited from fishing. This creates an obvious economic incentive to keep bycatch levels low. Boats with low bycatch numbers are rewarded with more opportunity to fish, and this approach “places a direct positive linkage between bycatch reduction and financial reward” (Norris and Hall 2002). Individual bycatch limits when linked to an overall cap for the fishery could provide additional peer pressure to keep bycatch numbers low. This same idea could be adapted into a cap and trade system. Under this system, bycatch would be allocated by vessel or co-op, but could be traded between entities. When a co-op or boat has caught their quota of the salmon bycatch, they could buy more quota from others, if other co-ops or boats had bycatch quota remaining.