CC-05-07
YRP Communications Committee
Activity Guide Project, 2007

Fisheries Activities for Classrooms

Introduction

The Yukon River Panel Communications Committee is pleased to present you with these classroom activities regarding a number of fisheries-related topics. The annual salmon runs are a critical resource for the villages in the Yukon River watershed, and providing youth with the knowledge, skills, and values to respect and preserve these salmon is essential. We hope these activities will prove to be a valuable resource to that end.

These activities were developed by professional fisheries educators within the Yukon River Drainage Fisheries Association (YRDFA) and the U.S. Fish and Wildlife Service to highlight key cultural, environmental, and management-related aspects related to salmon. They have been field tested with youth on the Yukon River at the Andreafsky Science Camp outside of St. Mary's, AK, and the science class in Grayling, AK.

For additional information on these and other fisheries-related topics, please visit the Yukon River Panel's website at www.yukonriverpanel.com or YRDFA's website at www.yukonsalmon.org, or contact YRDFA at (907) 272-3141.

Activities

Fish Now or Later

Description: Students play a game to learn about salmon allocation and the effects of over-harvest on a population.
Subjects: Geography, Math
Grade Level: 2-6

Fisheries in the News

Description: Students locate, review, analyze, and write reports on articles about current fisheries topics.
Subjects: Social Studies, Science
Grade Level: 6-12

Fisheries Research Plan

Description: Students learn first hand about the work and common challenges faced by fisheries biologists and managers by developing their own fisheries research plan.
Subjects: Social Studies, Math
Grade Level: 6 - 12

Yukon River Panel Activity

Description: Students learn by reviewing materials developed by the Yukon River Panel and then expand on this knowledge through research into other Yukon River communities and subsequent discussion.
Subjects: Social Studies
Grade Level: 6-12

Fish Now or Later

Objectives:
Students will learn the effects of over-harvest on a salmon population
Students will learn the importance of salmon to many communities in Alaska

Subjects: Geography, Math
Grade Level: 2-6
Group Size: This activity is designed for a group of ten students, but larger or smaller groups can play by adjusting the math.
Duration: One to two class periods

Materials:
Map of Alaska and the Yukon Territory showing the Yukon River
240 pennies, beans, poker chips, or other small items to represent fish
Paper and pencil for each student
Calculator

Method:
Students play a game to learn about salmon allocation and the effects of over-harvest on a population. Participants make decisions about how many beans (representing a fish population) they will take from a common source. Students will experiment with adjusting their take each turn in order to harvest the maximum number of fish while maintaining a stable or increasing salmon population.

Background:
Salmon are important to river communities in many ways. They serve as a subsistence food source and are a significant part of local economies where there are commercial fisheries. Managing this fishery for maximum harvest while allowing enough salmon to escape and spawn is a complex task.

This activity focuses on the salmon populations of the Yukon River, but it can easily be adapted to represent fish populations important to different communities.

Pre-Activity:
The salmon life cycle exercise is a good introduction to this activity.

Procedure:
Use an overhead projector to trace the Alaska map onto butcher paper, or make photocopies for the class to use. Have the students study the map and familiarize themselves with the location of the Yukon River and the communities found along it. Have each student choose to represent a community. Make sure to include villages found all along the river from the Alaska coast into Canada. If time permits, have the students research their chosen community and share information about its size, economy, and reliance on fish for food (see *Yukon River Panel Activity*).

Discuss the salmon life cycle. Also, the students should understand that at least 50% of the salmon caught in the Yukon River are on their way to spawning grounds in Canada.

Round One: Arrange students in a circle on the floor sitting in sequence according to where their village is found on the river. A bowl of 20 beans will represent the population of salmon swimming up the river every summer. Start with the student representing a coastal community. Tell them to harvest the number of fish from the bowl that their village needs, then pass the fish on to the next community up the river. Inevitably, the bowl of beans runs out long before the fish make it all the way up the river.

Discussion:
This situation naturally leads to a discussion about the subsistence and economic needs of communities all along the Yukon and the cultural importance of the salmon. Ask the students: "How many fish are left to spawn and bring salmon back in coming years?" If the answer after your first round is "zero", this can lead to a discussion on the need for escapement so that a population can replenish itself.

Round Two: Have the students create regulations which permit an adequate catch for each village while allowing some fish to escape and spawn. Give them a bowl containing 240 beans and tell them that for every two fish (a male and female) that are allowed to spawn, three new fish will be added to the population (the original pair dies).

For example: The students decide to allow each community to harvest 10 fish. 10 fish x 10 communities = 100 total fish harvested along the river. 140 fish (70 pair) remain in the population to spawn. These pairs produce 210 young (70 pair x 3 young each) which are available for future harvest.

Discussion: After a few rounds, have the students count the beans remaining in the bowl in order to assess the long-term health of the salmon population. This may show them that even though there are still beans in the bowl, the total salmon population is slowly declining and will eventually be in trouble if the current harvest levels aren't modified.

Round Three: Tell the students that the Alaska Salmon Council (an imaginary group) made up of fishery biologists and community representatives, has decided that they would like to have the largest possible fish population (biologists have determined that the habitat can support 240 fish) and a sustainable harvest of 8 fish per village per year. Remove all but 75 beans from the bowl (representing a depressed population). Ask the students to come up with methods they can use to bring the population of 75 fish up to a healthy population of 240 fish.

One way would be to suspend harvest for three years.* You would have 75 fish (38 pair) x 3 = 114 fish the first year, so you'd start year two with 57 pairs. 57 x 3 = 170 fish produced the second year, and 85 pair x 3 = 254 fish at the end of the third year. So, you could allow for natural die-off, or permit some harvest to bring the population down to the 240 fish the habitat can support.

* Note that an actual salmon population would take a minimum of 4 to 6 years to start seeing results from a returning population of fish.

Discussion: What might happen to these river communities if they couldn't harvest fish for three years? More complex math is involved, but students could explore ways that the communities could still harvest a small number of fish each year while working toward the long-term goal of a healthy population of 240 fish.

Extensions:
View the film, *Return of the King.* It does an excellent job of demonstrating the importance of the returning Chinook salmon to the villages along the Yukon River. Biologists and managers are also interviewed to illustrate the difficulties of studying and managing these fish to preserve the long-term health of the population while maintaining a sustainable harvest.

Fisheries in the News

Objectives:
Students will learn how to research current news topics.
Students will learn about current fisheries issues and their importance.
Students will develop a better understanding of how to interpret articles in the media.

Subjects: Social Studies, Science
Grade Level: 6-12
Group Size: Any
Duration: One to two class periods

Method:
Students locate, review, analyze, and write reports on articles about current fisheries topics.

Pre-Activity:
A discussion of fisheries issues affecting the local community is a good introduction for this activity. A review of research strategies for current publications is also appropriate.

Procedure:
Read a minimum of three fisheries-related articles from newspapers or magazines. For each article, answer the following questions.

1. What was the title of the article?

2. What was the title and date of the magazine or newspaper?

3. Is the article a news article (providing information) or an editorial (someone's opinion)?

4. Was the author associated with or representing an agency or group? If so, which agency was represented? (Examples: Alaska Dept. of Fish and Game, Department of Fisheries & Oceans, U.S. Fish & Wildlife Service, National Audubon Society, Koniag Native Corporation)

5. What species were involved?

6. What method of fishing was involved?

7. What are the two or more sides involved (examples: sea otters and humans, subsistence and sport fishing, citizens and government)

8. What recent event happened to make this news? What is the article about? (In

most cases, you should have at least a paragraph to answer this question.)

9. Is there a scientific issue involved? If so, what is it? (examples: genetics, habitat, global warming)

10. What is your opinion or reaction to this article?

Extensions:
Contact individuals quoted in the article and learn more about the topic and whether the individuals believed they were accurately represented in the story.

Fisheries Research Plan

Objectives:
Students will learn why monitoring fish populations is important
Students will develop a multi-year fisheries management plan and budget

Subjects: Social Studies, Math
Grade Level: 6 - 12
Group Size: Any
Duration: Two to three class periods

Materials:
Scenario Map
Calculators
Paper and pencil for each student

Method:
Students learn first hand about the work and common challenges faced by fisheries biologists and managers by developing their own fisheries research plan. They must adhere to a budget and use the research methods described in this activity.

Background:
Fisheries managers use many research methods to learn more about salmon run strength and stock health. The information obtained is one of the factors used to set fishing quotas and harvest regulations. The goal of fisheries research is to allow the largest subsistence, commercial, and sport harvest possible while assuring enough fish escape and spawn to maintain the population.

The research methods used by fisheries managers vary tremendously in accuracy, cost, staffing needs, equipment, and training required. Managers usually don't have a budget large enough to cover all the research needs in their areas. This forces them to prioritize the projects that they do, or use a less accurate counting method because it better fits the constraints of their budget.

A manager may choose to use a more accurate and expensive counting method on a river with a very large salmon run, or one that is especially important to local residents. An example would be installing a weir or counting tower rather than doing an aerial survey.

Pre-Activity:
Review the survey methods described in this activity with your class so that your students understand the research methods available to them.

Procedure:
Break the class into teams of two to three students each, and distribute the three management scenarios among the teams. Make photocopies of the scenario map for each team to use.

Tell the student teams that they are Tribal Government Resource Management Specialists. They have been given the task of determining how many salmon are spawning in the rivers and streams on tribal lands. Salmon are the most important subsistence food of the people in the villages along these rivers. Commercial fishing for salmon also creates many jobs in your area. So, your government is especially concerned about recent reports that the salmon runs may be smaller than usual.

As a class, review the introduction to the scenarios. Explain to the teams that they each have a yearly research budget of $450,000. A total of $150,000 can be spent each year to purchase needed equipment. The $300,000 left is their annual budget for operating field projects.

Each scenario presents a different problem, and should help the teams decide where to focus their most intense research efforts. Remind the teams, however, that they need to do some sort of survey on every river on their maps. They cannot just spend their entire budget on a few expensive projects.

Discussion:
Have each team present their management plans to the class and discuss why they chose the research methods they did.

Extensions:
- Have a fisheries manager or biologist visit your class and discuss their work.
- Take a field trip to any local fish counting projects, if available.

Scenario One

You are the Tribal Government Resource Management Specialist. Recently, you have been given the job of finding out how many salmon are spawning in the rivers and streams on tribal lands. Salmon are the most important subsistence food of the people in the villages along these rivers. Commercial fishing for salmon also provides the most jobs in your area.

Important events to consider: The early reports from fishermen and fisheries researchers at the mouth of the Brown River show that this year may be the lowest return of Chinook salmon on record. A mining company from Colorado is considering purchasing private land in the headwaters of the Black River for a large goldmine. The village of Snowshoe is requesting that information be collected about the number of salmon spawning in this river so they can fight to halt the development.

There are 7 primary rivers under your management where salmon spawn (see descriptions below). You have a yearly budget of $450,000. A total of $150,000 can be spent each year to purchase needed equipment. The $300,000 left is your annual budget for operating field projects. You need to make a three-year monitoring plan that will help you determine as accurately as possible how many salmon spawn within the whole system.

Purple River: Over 350 feet wide, and very muddy. The Purple River has a run of salmon that is extremely important to the subsistence and commercial economy of area communities.

White River: This is a fairly narrow, shallow, clear-water stream, but it often floods getting deep and muddy when rainstorms occur. This stream is one of the most important spawning areas for Chinook salmon in the region.

Blue River: This is a clear-water river, less than 300 feet wide and 4 feet deep.

Brown River: This river is almost 2 miles wide, very deep and muddy. The Brown River runs over 2,000 miles from the ocean, through your tribal government lands, and into Canada. There are 20 Native villages along this river inside the U.S. that harvest salmon for subsistence and commercial use. These fish are important to villages in Canada, as well. Native tribes in Canada and the Canadian government are concerned that you may be taking too many of the fish that are returning to spawn in Canada.

Green River: This river is over 350 feet wide, 20 feet deep and muddy. The Green River has one of the largest chum salmon runs inside the United States. Many villages in your area harvest fish that originate from this system.

Black River: This river is about 200 feet wide. The Black River is normally clear but heavy rains and floods in summer often make the water too muddy to see through.

Yellow River: This river is over 500 feet wide, deep and muddy. Salmon in the Yellow River are important to commercial and subsistence fishermen on both sides of the border.

Scenario Two

You are the Tribal Government Resource Management Specialist. Recently, you have been given the job of finding out how many salmon are spawning in the rivers and streams on tribal lands. Salmon are the most important subsistence food of the people in the villages along these rivers. Commercial fishing for salmon also provides the most jobs in your area.

Important events to consider: Native tribes in Canada are reporting reduced catches and fewer fish spawning in Canadian streams. The Canadian government is very concerned that you may be taking too many of the fish that are destined to spawn in Canada.

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Scenario Three

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Important events to consider: A huge fire occurred last year near the village of Rocky River. Villagers there cannot count on shooting a moose this year or on generating income from fur trapping. They are extremely concerned about reports of reduced returns of fall chum salmon. The Black River has an important salmon run that may be declining. The village of Fort O'Conor has very high unemployment since a small fish processing plant recently closed.

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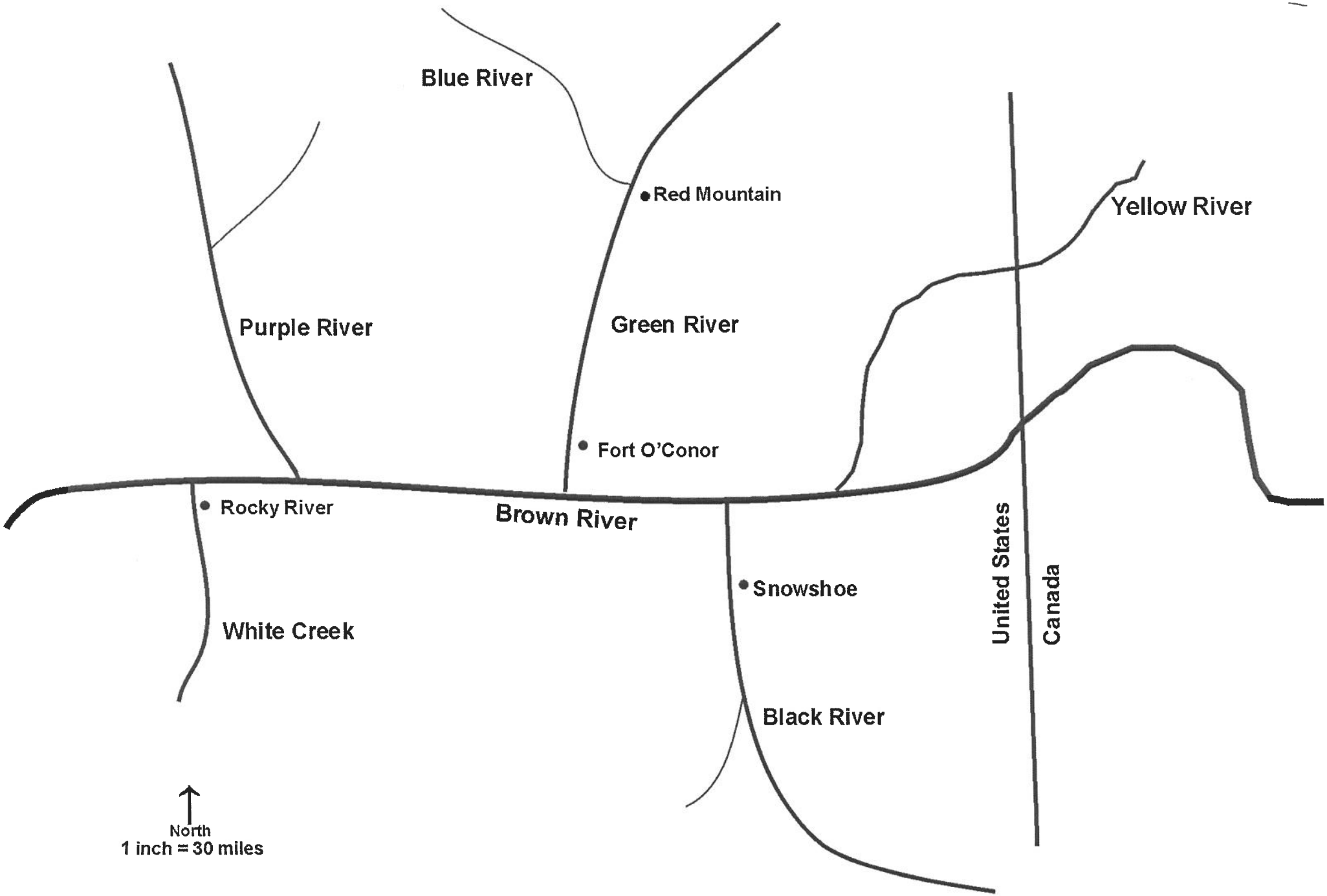

Blue River
Red Mountain
Yellow River
Purple River
Green River
Fort O'Conor
Rocky River
Brown River
United States
Canada
Snowshoe
White Creek
Black River
North
1 inch = 30 miles

Survey Methods

Fisheries biologists have a variety of methods they use to study different species of fish in different areas. The population estimates biologists obtain are used to set fishing quotas and harvest regulations. The goal of fisheries research is to allow the largest harvest possible while assuring enough fish escape and spawn to maintain the population. The following are some research techniques used by fisheries biologists:

Aerial surveys

Description: Biologists fly over a river system, visually estimate the number of fish present, and extrapolate the total number of fish spawning in the river from this number. This is cost-effective and a good way to sample many rivers in a large area. The draw-back is that this method is very inaccurate and weather dependent.
Cost: $800 per stream surveyed
Staff needs: 1 pilot; one experienced observer
Counting Accuracy: Fairly low
Benefits: This is the least expensive counting method. You only need an airplane, pilot, counter, and gasoline. This is also the best way to cover a large area.
Problems: Aerial surveys can give you a fairly inaccurate count. You may have cloud cover over part of a stream, or water reflections, or fish in deep or muddy water might be hard to see.

Counting Tower

Description: This method is used in clear, narrow, and shallow spawning streams. An observer sits in a tower and counts the fish as they pass.
Cost: $2000 to set up. $35,000 per season to run
Staff needs: 1 crew leader and 1-2 technicians
Counting Accuracy: Good if water remains clear and sampling is consistent.
Benefits: You need very little equipment to set up a counting tower. In addition, staff need very little training in order to do accurate counts. This is a great program to hire high school students or other local residents to run.
Problems: This can only be used in a shallow, narrow, clear-water stream. High water or muddy water from storms can interrupt counts. There is no way to stop the migrating fish, so the tower has to be staffed constantly to keep counts accurate.

Weir

Description: This method is also used in clear, fairly narrow and shallow spawning streams. A barrier fence is placed across a spawning stream. The center of the weir has a chute with a gated holding pen. A biologist counts and identifies the species and sex of the fish as they pass through the gate. This method is very accurate but costs more for salaries and equipment.
Cost: $50,000 to purchase equipment and transport it to the site. $50,000 to run each season
Staff needs: 1 crew leader, 2 technicians
Counting Accuracy: Very high
Benefits: This counting method can tell you exactly how many fish you have in the spawning stream along with species, and sex ratio.
Problems: This method can only be used in a fairly shallow, narrow, clear-water stream. High water from storms can overflow the weir and allow the fish to pass uncounted. Muddy water can also interrupt counts.

Sonar

Description: This method is useful in larger muddier river systems where you can't actually see the passing fish. Transducers, which send a sonar beam across the river, are installed along each bank of the river. When a fish swimming up-river travels through the beam, it is recorded on a computer. Weirs, or large panels, are installed along shore to force the swimming fish farther out into the river where they can be counted in the sonar beam. This method is accurate but very expensive. Sonar also fails to identify what species of fish are passing the study site. Additional sampling with nets must be used to verify the species being recorded in the sonar count.
Cost: $200,000 to purchase equipment; $50,000 to operate per season
Staff needs: 1 crew leader, 3 technicians.
Counting Accuracy: Very high IF only one species of fish is traveling through the sonar beam.
Benefits: This method can be used in a wider, deeper, muddy water system. It allows you to count fish that you can't physically see.
Problems: Equipment costs are very high. Staff need to be highly trained to operate the equipment and interpret the data. The sonar system needs to be monitored and calibrated frequently in order to give accurate counts.

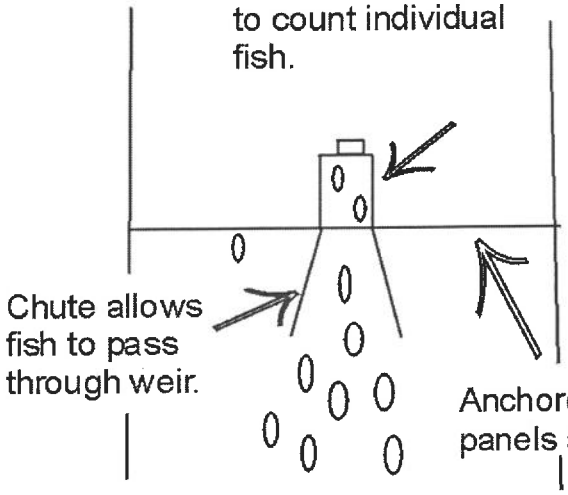
Mark/Recapture

Description: This method is useful in larger muddier river systems where you can't actually see the passing fish. It usually involves capturing live salmon, marking or tagging them, and releasing them back into the water at one location. Attempts are made to recapture both tagged and untagged fish at a second location. Ratios of tagged to untagged fish are then calculated to develop a population estimate relative to the tagging location.
Cost: $30,000 to purchase and ship equipment. $165,000 to operate per season.
Staff needs: 1 permanent biologist, 1 seasonal crew leader, 3 technicians
Counting Accuracy: Good
Benefits: Good method to determine the total fish moving through a very large, wide, muddy river system.
Problems: This method is very labor intensive. 200-300 fish need to be tagged every day and 2,000-3,000 need to be examined every day.

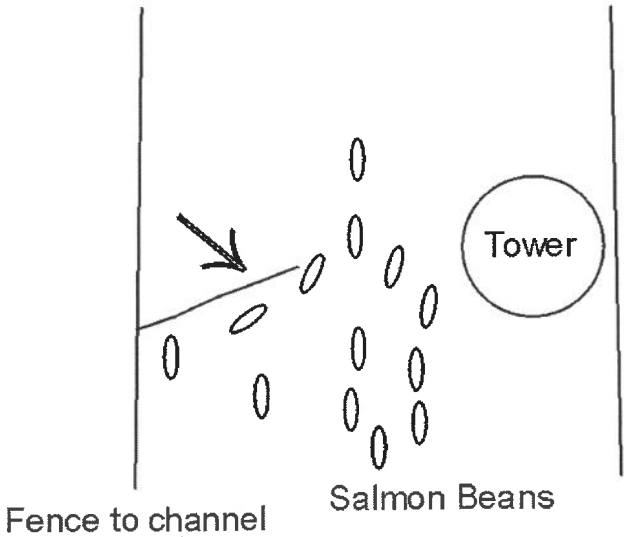
Research Techniques
(For Overheads)

WEIR

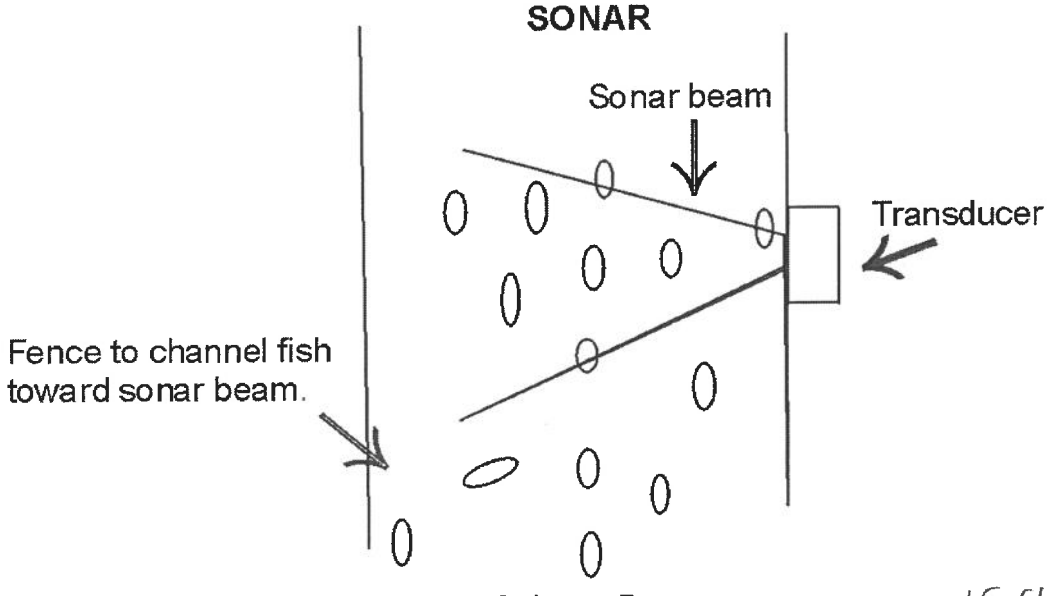
Trap to hold fish for sampling; also allows biologist to count individual fish.



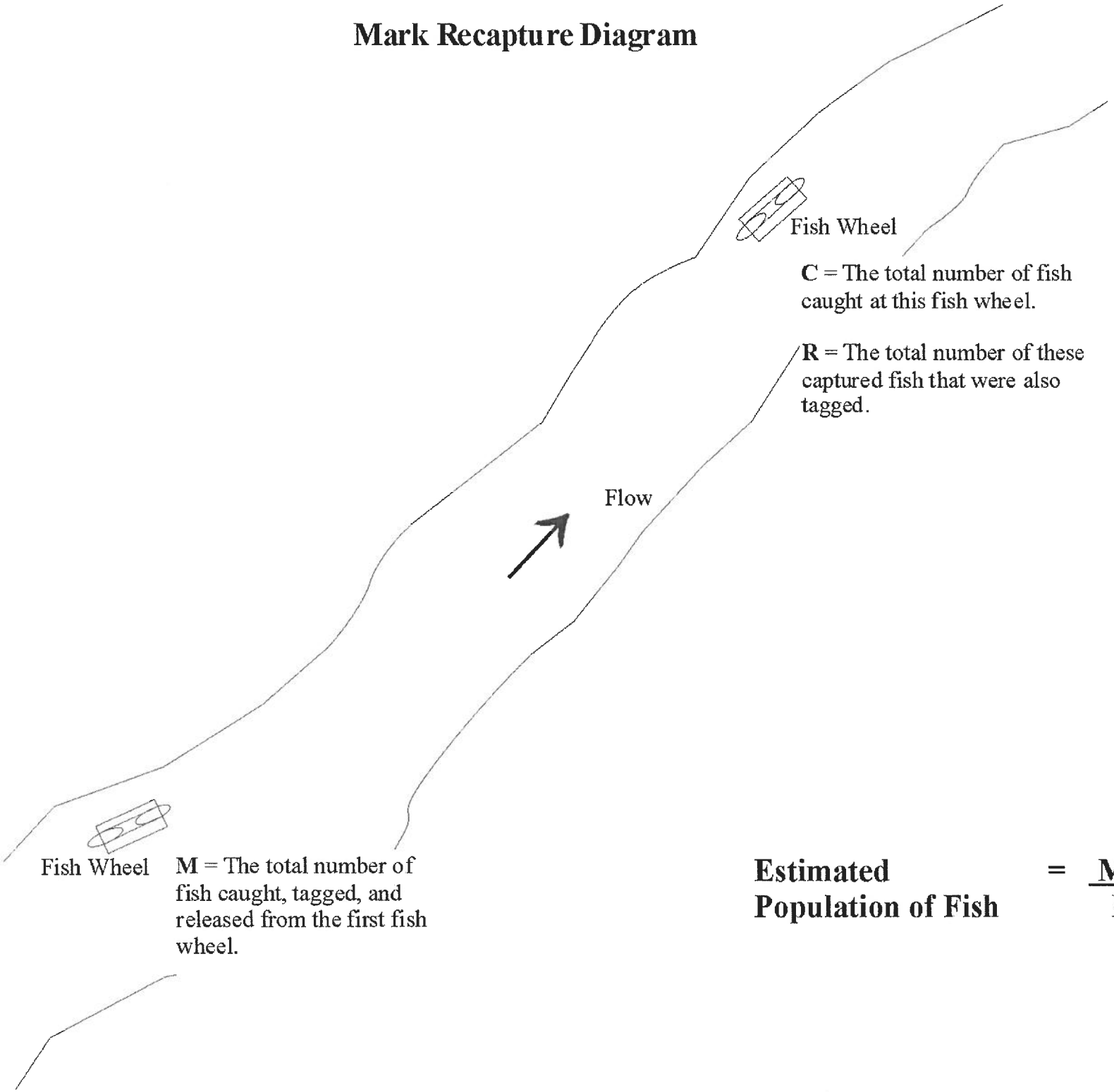
COUNTING TOWER



SONAR



Mark Recapture Diagram



Estimated Population of Fish $= \frac{M\,C}{R}$

Yukon River Panel Activity

Objectives:
Students will learn about the Yukon River Panel (Panel) and its role in fisheries management
Students will learn how fisheries and cultures differ throughout the Yukon River drainage
Students will learn how people depend upon these different fisheries

Subjects: Social Studies
Grade Level: 6-12
Group size: Any
Duration: Two to three class periods.

Materials:
Yukon River Panel Handbook (available at www.yukonsalmon.org/whatwedo/YRSA.htm)
Yukon River Panel Video: *No Boundaries*

Method:
Students learn by reviewing materials developed by the Yukon River Panel and then expand on this knowledge through research into other Yukon River communities and subsequent discussion.

Background:
The Yukon River Salmon Agreement of 2001 mandated the Yukon River Panel's creation. It is a cooperative panel made up of state, federal, provincial, non-governmental, and tribal entities with the primary task of making recommendations to management agencies on both sides of the border concerning the conservation and management of salmon originating in the Canadian portion of the Yukon River drainage. Additional information on the Panel's role may be found in the Yukon River Panel Handbook and the Yukon River Salmon Agreement.

One of the challenges the Panel faces is the vast and changing nature of salmon fisheries throughout the Yukon River drainage. Differences in how Yukon River salmon are harvested and utilized has lead to much discussion and, at times, conflict. This may be in part due to a lack of breadth in understanding on the part of individual residents and fishermen living and utilizing the resource in one particular area.

Better understanding among residents and fishermen along the Yukon River on how fisheries differ regionally and how each affects Yukon River salmon will hopefully reduce conflict and foster effective conservation efforts.

Pre-activity:
In order to gain understanding of the Yukon River Panel and its role, students first watch the video *No Boundaries* and review the Yukon River Panel Handbook.

Procedure:

1. Have each student pick a community along the Yukon River not in their immediate region.
2. Once a community is chosen have the student research the community. They should address population, local jobs, demographics, and culture. Some sources of information include:
    a. Internet - Alaska Community Database Community Information Summaries. http://www.dced.state.ak.us/dca/commdb/CF_CIS.htm.
    b. Friends, families, schools, or tribal councils in other communities.
    c. Visitors from other communities.
3. Have the student research the role and importance of salmon in the community. The student should develop a list of questions to answer, possibly including: how are salmon utilized and why are they important? How has fishing changed in the community over the years?
4. Have each student summarize their findings into a one-page report and have them present it to the rest of the class. Alternately, if the student interviewed a visitor from another community, ask that individual to come to come to class and answer the questions in person.

Extensions:

- Have a fisheries biologist, manager, or Yukon River Panel member or advisor visit the class to discuss their work and Yukon River salmon conservation.