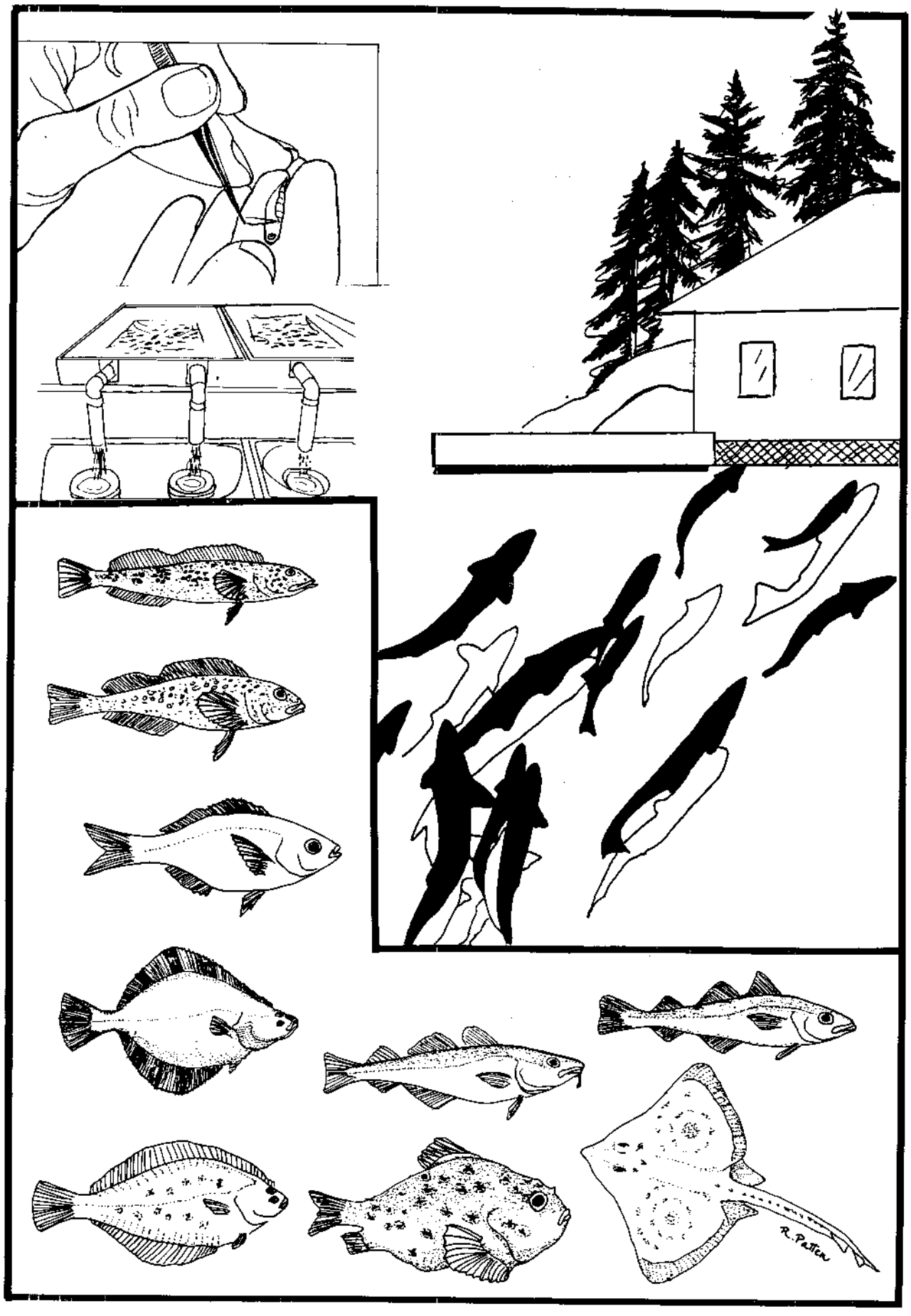
Unit Seven
Fisheries and the Future

Index

Objectives:

To help the student:

- Explore the needs of other countries for fish resources (Activity 1).
- Define and use terms common to hatchery operations (Activity 2).
- Sequence the yearly events in a salmon hatchery (Activity 2).
- Identify ocean whitefish by use of a taxonomic key (Activity 3).
- Read about the difficulties of entering the whitefish industry (Activity 3).
- List solutions to problems involved in development of the Alaska ocean whitefish industry (Activity 3).
- Role-play development and habitat issues in the Mighty Salmon Cannery Game (Activity 4).
- Draw cartoons to influence local issues (Activity 5).



Unit Seven: Fisheries and the future: top left, tagging salmon fry; top right, salmon returning to hatchery. At bottom, some of the white fish involved in Alaskas' fishery plants.

When few people were living in Alaska, everyone could take fish needed for food and have little worry about depleting the resource. Now, however, there are more people to feed, more people fishing, more sophisticated fishing gear, and fisheries habitat losses. Each season, management biologists with state or federal agencies must reevaluate the status of marine resources and determine how much fishing pressure they can bear. These decisions affect all who depend on the resources for food or livelihood.

As pressure increases on fishery resources, four means of keeping them healthy are used.

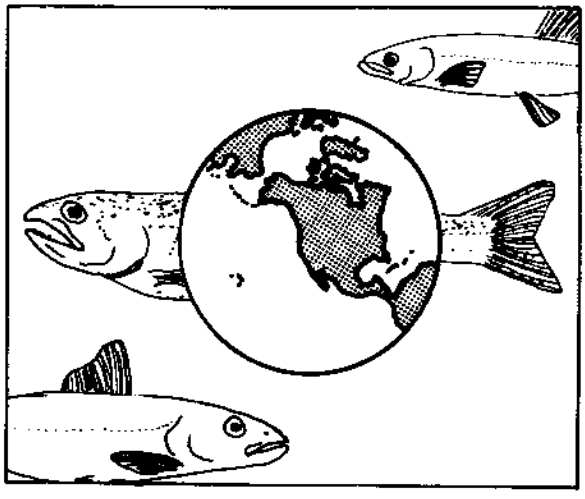
First, managers try to regulate existing fisheries to achieve the maximum sustainable yield. That is, they allow the most possible fish of any one species or run to be taken without decreasing the numbers of fish that will be available in the years to come.

Second, the fishing industry has turned its attention to unfished resources. Here, Alaska's developing ocean industry is an example. Relatively few marine species have been the object of intensive fisheries, and many others may yet become commercially important as public demands make them profitable.

Third, state and private organizations are turning toward aquaculture, the controlled rearing of various aquatic species, usually with the intention of making them available as food.

And fourth, development projects are carefully reviewed for their impact on fish habitat. Subdivisions, shopping centers, logging, oil and gas explorations and drilling, mining, dams, roads, airports and agriculture all can affect rivers, streams, and the fragile coastal environment which is so important for fisheries.

Activity 1
Fish for the World



Background:

The ocean has been proposed as a food source for hungry peoples around the world. Sometimes forgotten is the fact that the ocean is most productive along its coasts, over the outer continental shelf, and in bays and estuaries. Nutrients are flushed down rivers to shallow coastal waters or are trapped in bays and estuaries by the mixing of salt and fresh waters. These nutrients insure luxurient phytoplankton (plant) growth which in turn produces food for fish. In the depths of the ocean, where light penetrates only so far and not all below 1,700 feet, phytoplankton (plant) growth which fuels the ocean's food web is very low, and hence there are not many fish. The most prolific fishing grounds are already being fished. The ocean can be an important solution to world food problems but we need to:

- Increase the efficiency of fish transportation and fish processing so that fish are kept fresh and all parts are utilized.
- Increase our knowledge of fish biology and ecology and develop workable international agreements so that fish are not overharvested.
- Investigate new fisheries, new fishing gear, and fish farming.
- Decrease ocean pollution from both land and sea sources.
- Protect fragile coastal and riverine habitats where the majority of fish spawn and raise their young.
- Change our eating habits so we eat less and eat lower on the food chain--more seaweed and less tuna; more grains and less beef.

Vocabulary:

- import
- export
- per capita

Materials:

- fish-shaped crackers or cookies
- paper bag
- slips of paper with names of countries written on them
- Ocean Fish Consumption Chart
- Major Ocean Fishing Grounds map
- world map

Make a photocopy of the Ocean Fish Consumption Chart contained in this unit. Cut out the names of the countries and place them in a container.

Procedure:

1. Place slips of paper with names of countries for each class member in a paper bag.

(Cut up a copy of the Ocean Consumption Chart for as many countries as you have students. Pick a variety from the different continents.) Tell students to pretend that instead of being born in the United States, they have been born in a foreign country. As students draw slips of paper from the container, tell them that for today they are residents of that country. Ask them to imagine what it would be like to live there. Have students find their countries on the world map.

2. Hand out the fish-shaped crackers or cookies to students based on the percentage of their countries' fish consumption. Some countries will have many and others will have none. Explain "per capita" consumption. Ask the students:

   - Should you share? (Most countries do not!)
   - Can you see why countries have wars sometimes?
   - What could be done to make everyone feel better? (When students talk about giving everyone the same number of crackers, write the words "import" and "export" on the board. Explain the difference. If the class is going to "even up" the crackers, how many of them think they will be exporting? How many will be importing? As a class exercise, total on the blackboard the number of crackers in the class and divide by the number of class members. Have the exporters reduce their supplies to the average, then have the importers increase their supplies to the average.

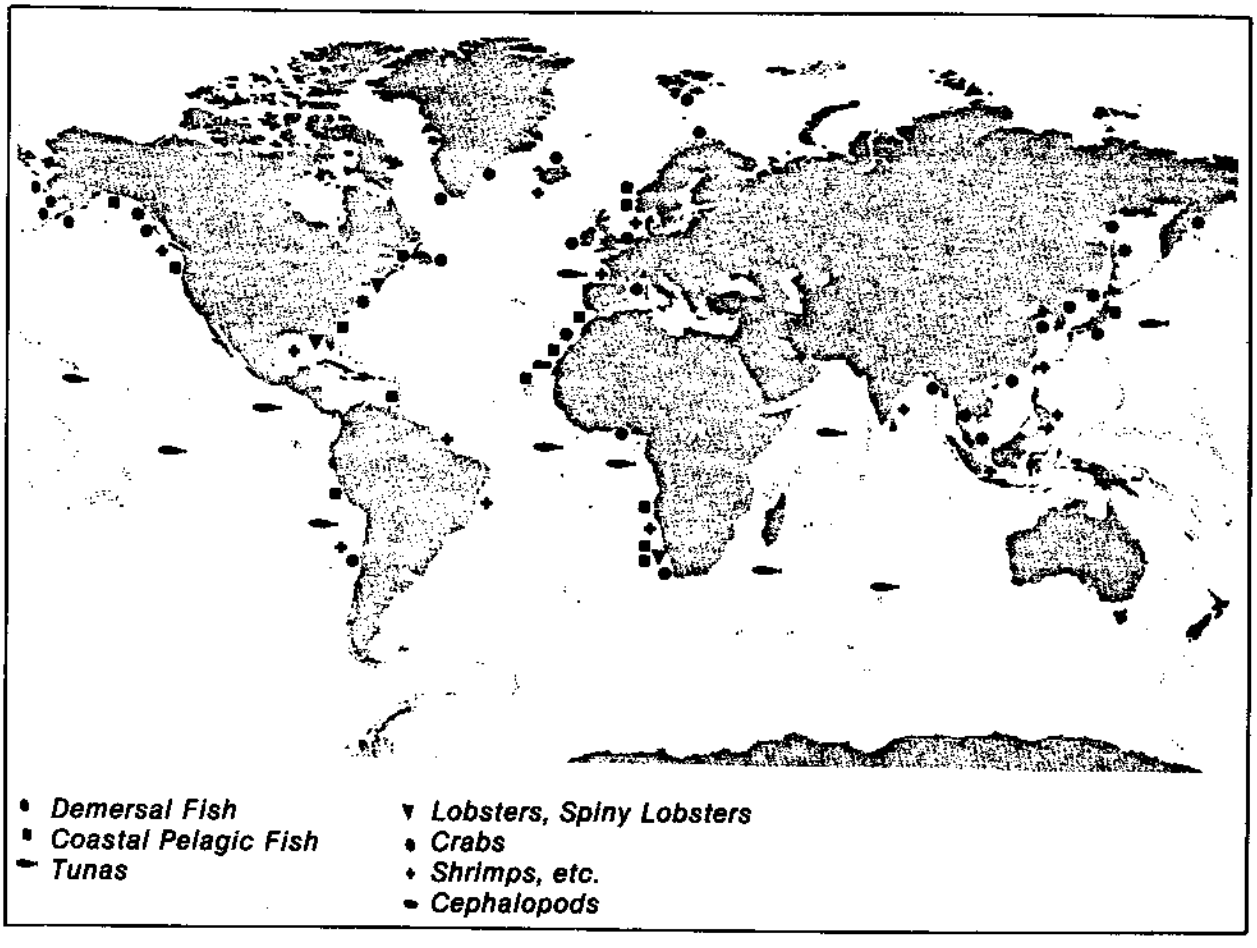
3. For additional discussion, show students the map of the major ocean fishing grounds, plus the list of the 10 largest marine fishing nations.

Additional Activities:

1. Math, Social Studies: Have students figure the effects of population on fish consumption. How many pounds of fish does each country consume?

2. Social Studies. Have each student write a paragraph about his or her country's fishing industry, including an answer to the question of whether most of the fish eaten in that country are imported or exported.

3. Art, Science, Speech: Have students draw a picture of the fish most eaten in their countries, and give a one-minute oral report on the fish, covering such points as its size and color, whether it lives on the bottom or travels in schools, what it eats, whether it is found in shallow or deep water, how it is caught and how it is most often eaten.



The world's major fisheries. Demersal fish are bottom fish, Coastal pelagic fish are open-sea fish caught offshore, and Cephalopods are members of the squid and octopus family.

From *The Cousteau Almanac* by Jacques-Yves Cousteau and the staff of the Cousteau Society, Doubleday & Company, Inc., Garden City, New York, 1981. 838 p.

THE TEN LARGEST MARINE FISHING NATIONS

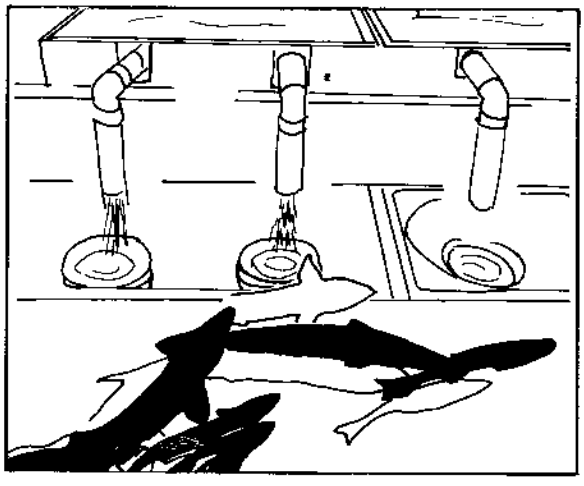
Rank	Country	Catch in Metric Tons
1.	Japan	10,508,451
2.	USSR	9,876,173
3.	China	6,880,000
4.	Peru	3,447,485
5.	United States	2,798,703
6.	Norway	2,550,438
7.	India	2,328,000
8.	South Korea	2,133,371
9.	Denmark	1,767,039
10.	Spain	1,532,878

SOURCE: Fisheries Yearbook, U.N. Food and Agriculture Organization, 1977.

Ocean Fish Consumption Chart

Country	(Millions) Population	(lbs) Per Capita	Crackers
United States	216.8	35.1	5
Canada	23.3	40.1	6
Peru	16.6	37.9	5
Chile	10.7	34.8	5
Guatemala	6.4	1.5	0
Columbia	25.1	7.5	1
Venezuela	12.7	22.5	3
Cuba	9.5	46.1	7
Argentina	26.1	9.0	1
Costa Rica	2.1	9.9	1
Panama	1.8	21.4	3
Italy	56.5	27.3	4
France	53.1	48.9	7
Portugal	9.7	85.1	12
Sweden	8.3	71.6	10
USSR	240.0	63.3	9
Austria	7.5	17.2	2
West Germany	61.4	41.0	6
Ireland	3.2	31.3	4
Norway	4.0	103.6	15
Burma	31.5	28.7	4
China	865.7	13.0	2
Hong Kong	4.5	111.3	16
Malaysia	12.6	76.5	11
Nepal	13.1	.4	0
Vietnam	47.9	48.1	7
Indonesia	143.3	23.6	3
India	625.8	7.0	1
Japan	113.9	148.6	21
Philippines	45.0	73.	10
Afghanistan	20.3	.2	0
Iran	33.6	1.1	0
Iraq	11.9	6.2	1
Israel	3.6	24.5	4
Libya	2.4	16.1	2
Saudi Arabia	9.5	11.5	2
Turkey	42.1	9.7	1
Egypt	38.7	9.3	1
Algeria	17.9	4.8	1
Kenya	14.3	5.7	1
Senegal	4.2	89.3	13
Togo	2.3	25.4	4
Nigeria	66.6	23.4	3
South Africa	26.1	15.4	2
Ghana	10.4	60.8	9
Ethiopia	28.9	1.3	0
Morocco	18.2	9.7	1
Uganda	12.3	32.6	5
Australia	12.4	32.2	5
New Zealand	2.7	37.3	5

Activity 2
Aquaculture



Background:

"...Down through the centuries, people have tried their luck at cultivating- or farming-aquatic plants and animals. As early as 475 B.C., a gentlemen named Fan Li raised carp in a small freshwater pond in China. Trout farming began in Europe in the 15th Century; and today, aquaculture is practiced all over the world.

"Shrimp are penned and raised in the backwaters and estuaries of such far distant places as the South China Sea and the Mediterranean Sea. Salmon, trout and even catfish are cultivated in the U.S., Canada, Russia, Spain, and many other countries.

"In the island nation of Japan, everything from eels to seaweed to salmon to shellfish is farmed. Oysters, scallops, clams, and mussels are cultivated on neat hanging underwater racks and lines, well out of reach of sea bottom predators. And the network of salmon hatcheries which Japan has developed over the past 100 years recently yielded a harvest of chums that was greater than the natural chum runs of Alaska.

"In aquaculture, the "farmer" controls the elements that are vital to the growth of marine life: light, shelter, weather, oxygen, water flow, and food. The "crop" is protected from disease and from other animals that might prey upon it. Under ideal circumstances, the survival rate increases, the growth cycle is speeded up, and healthy fish are produced.

"It takes solid scientific knowledge, however, to determine just these ideal circumstances might be. Care must be taken not to tip the delicate balance of food and life support systems in the sea by building up one species at the expense of others. Inferior stock should not be turned loose to interbreed with, and weaken or disease natural runs of fish."

-from "Aqua (water) + Culture (cultivate)," Tidelines, Vol. 1, No. 1, September 1978

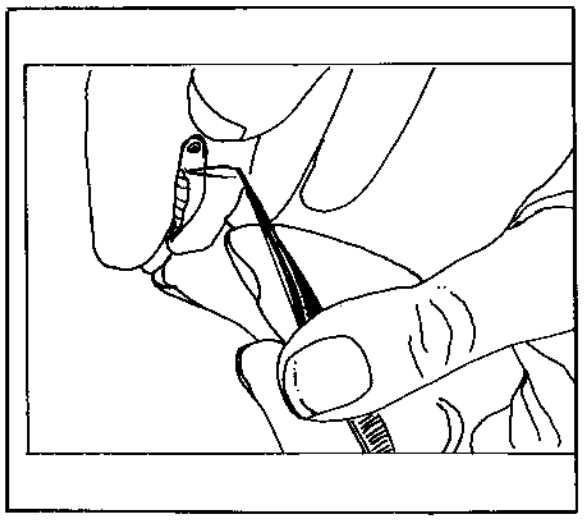
In Alaska, salmon hatcheries are the most prevalent form of aquaculture. Some are government operated and involved in researching aquaculture techniques. Others are run by aquaculture associations, private individuals, schools, or Native associations.

Establishing and operating a hatchery is a demanding task. Water circulation, temperature, food and disease control are all factors that can decide the success or failure of fish rearing.

Hatchery schedules and activities vary with the species being reared. The general sequence of activities

in a salmon hatchery goes something like this:

> Mature fish are taken in the fall when they are ready to spawn. Eggs are stripped from females and milt, or sperm, from mature males are added. Immediately after this procedure, fertilized eggs are placed in incubators and bathed with a continuous flow of fresh water. Eggs are tended until they hatch into alevins with a large yolk sac that will supply them with all the food they need for two to four months. In many hatcheries, fry (young fish that have now absorbed the yolk) emerge and voluntarily leave the incubation boxes on their way to holding pens where they will be fed until the time is right to release them. Upon release, the fish make their way downstream and out to the open ocean to feed and mature.



Fish tagging is one way fish managers gauge the success of their operation. Any types of visible markings can also be seen by predators, so the numbers of returning fish are naturally reduced when outside markers are used. Fin clipping has also been used but fish need all their fins except the adipose fin for swimming or resting.

So, lately, hatchery managers and fish biologists involved in other studies have begun placing magnetized stainless steel wire bearing a code number into the nose cartilage of the fish. To indicate the presence of this tag, the adipose fin is clipped.

Advise your students to save the head of any salmon they catch that has the adipose fin missing and turn the head of the fish over to the Alaska Department of Fish and Game. Tagged salmon are a real prize for hatchery managers and biologists, especially if the fish is ocean caught, because comparatively little is known about the ocean migration of salmon.

Vocabulary:

- egg
- sperm
- fertilization
- spawn (review)
- alevin (review)
- hatchery
- aquaculture
- mature
- incubator
- egg box
- fry (review)

Materials:

- hatchery manager or fish biologist
- worksheets:
  ...You've Just Got a Job in the Hatchery (7A)
  ...Hatchery Basics (7B)

Procedure:

1. Use the worksheets You've Just Got a Job in the

Hatchery and Hatchery Basics. Explain tagging and go over the dictionary definition of each word. Students may need fishery books or an encyclopedia for some terms. Go over what happens in a hatchery. Then ask the students:

- What are some ways we can help fish production without hatcheries? (Protect fish habitat and natural fish production.)

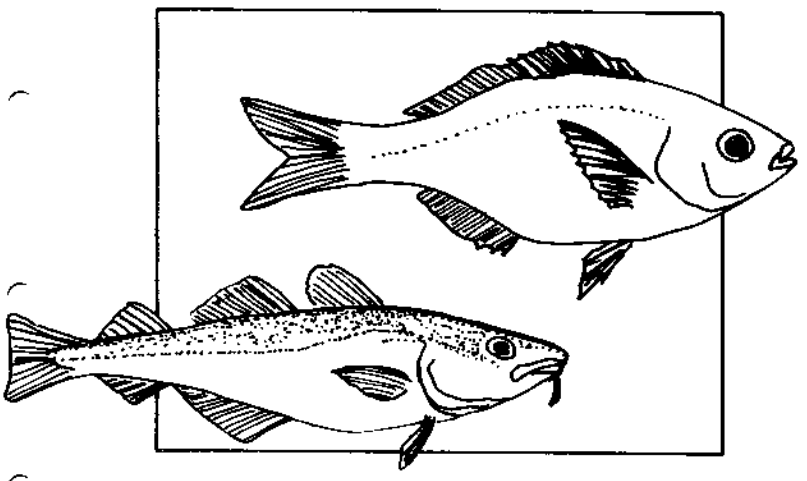
- Why is aquaculture important to us? (As a source of food, a way to replenish fish stocks, a source of employment.)

- What are some of the reasons we have to be careful with aquaculture? (To not tip the balance of food webs of the sea by building up one species at the expense of others. Also, if hatchery fish are inferior for any reason, they should not be turned lose to interbreed and weaken or disease natural fish runs.)

- What promise does aquaculture offer? (Increased fish runs by increased survival of young, and return of salmon to formerly empty streams or streams where salmon numbers are few.)

2. Invite a hatchery manager or fisheries biologist to visit your class and discuss hatchery management and their fish tagging procedures. If a hatchery is located in your community, try to visit the facility. As an alternative, have students research hatcheries and fish tagging in your local library or write letters to the Alaska Department of Fish and Game or private aquaculture associations asking for additional information.

Activity 3
New Fisheries



Background:

As more fishing pressure is exerted in existing fisheries and as regulation of these fisheries stiffens, many fishermen are beginning to explore alternatives. Some are gearing up to harvest "whitefish"--the great bulk of finfishes of the sea--and the main food fish of the world. Sometimes they are called "bottomfish" or "groundfish"--which they really aren't, since only a few spend their lives on the bottom.

There are billions and billions of commercially important whitefish in the Bering Sea and Gulf of Alaska. So far, these stocks have been harvested almost entirely by foreign fishermen. But now that the United States has extended its fisheries management zone to 200 miles off our shores, Alaskans and other U.S. fishermen are getting more interested in what could be a multi-million dollar year-round industry.

The 200-mile zone was established in 1976 with the passage of the Fisheries Management and Conservation Act. Until that time, except for a few international treaties, high seas fishing was a wide open affair. Fishermen could go after anything they wanted and take as much as they pleased. And the whitefish stocks off Alaska were being harvested so heavily by foreign fleets that some species had dropped to dangerously low levels. The goals of the act were (1) to bring foreign fishing under control and set up management plans so the stocks could build back, and (2) give Americans a reasonable chance to develop fisheries off their own coasts.

The law did not say that foreign fishermen would have to stay out of the 200-mile zone. But it did say that foreign harvests would be limited to those fish that Americans are unable to catch. In other words, if we don't take them, they will.

The tricky task of setting up management plans, including quotas for foreign and domestic (U.S.) fishermen, belongs to regional councils - whose actions must be approved by the U.S. Secretary of Commerce. In Alaska, this council is the North Pacific Fisheries Management Council.

The Fisheries and Management and Conservation Act is designed to fill a gap until the nations of the world can agree on a Law of the Sea treaty to cover the ocean's resources. (Information for this activity was taken from "What's That Funny-Looking Fish?," Tidelines, Vol. III, No. 5, Feb. 1981.)

Materials:

- library books, encyclopaedias
- map of Alaska

- person involved in a new fishery
- worksheets:

...What are Those Funny-looking Fish? (7C)

...Gearing Up for Whitefish (7D)

Procedure:

1. Have students try the worksheet What are those Funny-looking Fish?. (Answers: 1: Pacific (true) cod; 2: Alaska (walleye) pollock; 3: sablefish; 4: rattail; 5: smooth lumpsucker; 6: Pacific Ocean perch; 7: ling cod; 8: greenling; 9: skate; 10: yellowfin sole; 11: starry flounder)

2. Follow-up with class mini-research on the kinds of whitefish found in local waters. How many can students name without doing research? How many additional names of fish can they list by consulting books, encyclopaedias, local fishermen, their parents or friends? Students might want to learn something about some of these fish (where they are found, what they look like, what they eat, how they might be used).

3. Then have students read the worksheet Gearing Up for Whitefish. You will need a map of Alaska for the last question. (Answers: 1: pollock, cod, ocean perch, etc.; 2: salmon, shark; 3: human food, fertilizers, pet food; 4: fishermen would rather fish salmon, crab, shrimp, halibut, processing plants and fishing boats would have to change gear, bigger boats required for many tons of fish, some Alaskan ports would have to be enlarged for these deep water ships, a fish must be processed immediately, high labor costs, gutting machines don't fit fish, little is known about whitefish biology, developing a market; 5: individual answers to above solutions; 6: The Pribilofs are in the Bering Sea north of the Aleutian Islands and west of Bristol Bay. In the discussion of predicted changes, one of the main ones would be the increased numbers of people coming to the islands, plus increased noise activity, jobs, stores, along with social problems such as alcoholism and crime. The Aleut young people would probably tend to stay on the islands because they could get jobs. There would be some loss in wildlife habitat and disruption of some birds and animals used for subsistence lifestyle. One of the few alternative vocations would be to build up the tourism industry to get people to come to watch birds and marine mammals and buy Native crafts. These similar options for development are being faced by many other rural Alaskan communities.

4. If a new fishery has recently started in your community, find someone who is involved in it and arrange for them to address the class. Before the speaker comes, prepare students by having them think about the kinds of things they would like to learn from the speaker. For example:

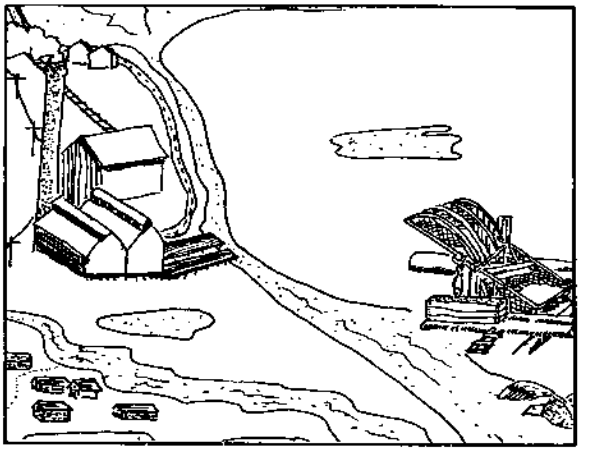
   - What kind of gear is used?
   - Is it hard to change over

from some other kind of fishery?

- What time of year must the fishing be done?
- Is it expensive to prepare for fishing?
- What will be the market for the fish?
- Do the fish require any special handling?
- What are sources of information about the new fisheries?
- Is a state or federal agency helping fishermen get started in it?

If possible, arrange for students to visit a vessel engaged in the fishery in question. Be sure the vessel captain or a crew member is present to answer questions and explain the gear to students.

Activity 4
The Mighty Salmon Cannery Game



Background:

Throughout Alaska, every community is facing development issues. Sometimes there are possibilities for compromise. Other times inhabitants have to decide on development or the status quo. In any case, residents have to decide on their own priorities and live with the consequences.

Many times, decisions are made in Juneau or Washington, D.C.--or Tokoyo or Cairo. But Alaska is famous for the "coffee cup decision"--whether made over coffee at a hotel in Anchorage or someone's kitchen table in a village.

Hopefully, as Alaskans become more cognizant of all the results of decisions, and more astute politically, Alaskan resources and Alaskans will benefit. Our young people need to learn at an early age what's going on in their community and the world in general, and that they can have an effect on their own lifestyles and surroundings. One fun way to get started is to role play

different points of view in a simulation game.

Materials:

- butcher paper
- felt-tip markers
- sets of role cards
- copies of Mighty Salmon Cannery Map

Procedure:

1. Ask students to name planned local development projects. Pass out copies of the Mighty Salmon Cannery Map and go over the proposal. Ask them how they would imagine people in Eekoute Village feel. Tell them that there will be a public hearing on this issue soon.

2. Divide the class in seven groups and hand out the role cards. Each group represents the point of view typified by the role on the card. Have each group tell the rest of the class its name and title. Then tell them to read over the card and elect one of their group to the village council and elect one person spokesperson. The village council should meet up front while the rest of the group helps the spokesperson put together a two minute speech for the public hearing which will be occurring in 15 minutes (or so). Go over techniques for making a presentation (outline the points you want to make, develop charts and graphs, speak clearly and convincingly, etc.)

3. Have the village council elect a mayor (who will chair the hearing), recording secretary, and timekeeper; and arrange the room for the hearing. Brief the village council on its role. The council members need to listen to all sides and ask questions that might give them better information to make the decision. After the public hearing, they will go outside the room briefly to make their decision. Then they'll come back and announce their decision and reasons.

4. During the hearing, allow each speaker two minutes, followed by questions from the council and audience.

5. After the hearing is over and the council has made its decision, debrief the group by talking about the way decisions are made. Ask the students:

   - What would have happened if everyone had tried to influence everyone else?
   - Does everyone have equal influence?
   - Who else might have affected the decision? (The governor, legislature, Congress.)
   - What are important things to know before a decision is made? (Affects on natural resources, the economy, people's feelings, traditional ways, new opportunities.)

   Mention several local examples of past development decisions, the roles of community residents, and decision results. Compare these with current local issues.

The Mighty Salmon Cannery Game Role Cards

FRED FRIDAY - manager of the Native Company Store and Corporation Board member.

Fred is excited about the idea of the Mighty Salmon Cannery Corporation locating a cannery at Eekoute. There should be jobs for corporation members in the cannery plus the local fishermen and women could sell their catch locally instead of having to take it down the coast. He likes the idea of the dam, because the excess electricity could be used for other corporation development projects. Plus electricity would be a lot cheaper for everyone in Eekoute, and they wouldn't have to worry about breakdowns all the time on the village's diesel generators. He doesn't care where the cannery is located, just so it comes!

CATHY COHO - fisheries biologist with the Alaska Department of Fish and Game

Cathy would like to see the cannery located over by the airstrip instead of by the Big Riley River. A lot of good wetland habitat would be lost at the river site. The Eekoute Village area is famous for its duck and goose production as well as salmon runs. Oil and gas from the road might seep into the river and, also, there could be erosion that would cover up the salmon eggs. Though the dam would be located above the place where salmon are spawning, nutrients that the fish need would be trapped up above the dam and the water below the dam would be much warmer than it should be for good salmon runs.

THORNE THURBER - cannery owner

Thorne has just come to Alaska from Seattle. He's anxious that everything will go well. His company has put a lot of money into planning the cannery already and this is definitely the cheapest and best design. The cannery will boost the local economy and he's promised to hire local people as much as possible. The barge can bring all the materials right to the cannery site. Once the fish are processed, the majority will be flown out fresh to the Lower 48. The rest will be canned and barged to Seattle at the end of the summer.

NELLIE NIKOLAI - postmistress

Nellie is quite concerned about the situation. She thinks should be studied a lot more. She likes the idea of the wind generator. As a government employee, she's sure that the village can get money from the government to build it and maybe that would be a source of cheap electricity. The wind's always blowing! She doesn't really like the idea of the dam but the road sounds great. She'd just like to be able to drive, drive, drive!

RIP RYEBACK - old timer hunter and trapper

Rip likes it just like it is. He doesn't want to see any development around Eekoute. Any development will hurt the hunting, fishing, and trapping. And development would bring more people which he dreads. He's comfortable in his cabin in Eekoute, just like he's comfortable in his long underwear which he wears all winter.

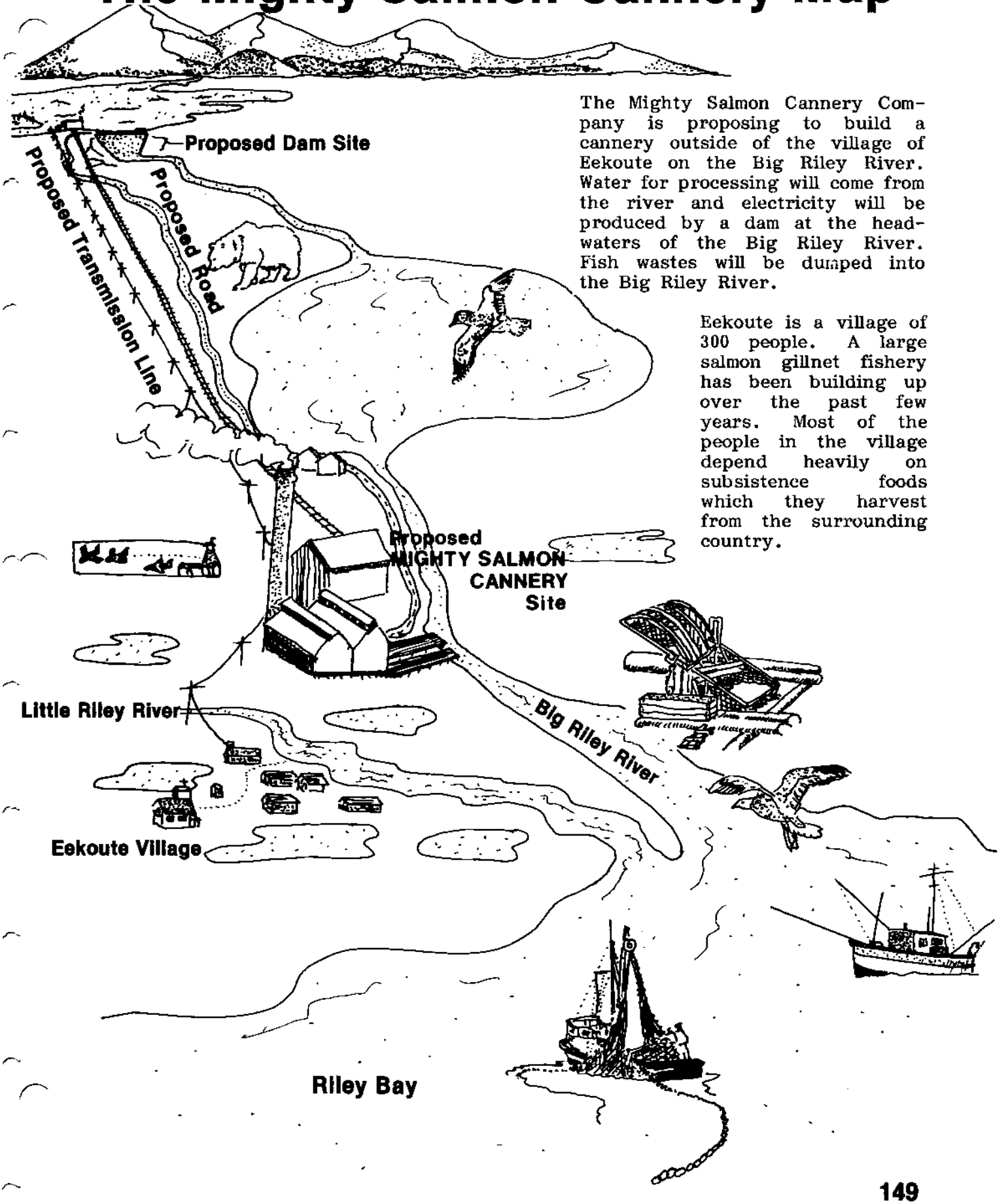
PAUL PANNIYAK - local conservationist

Paul grew up in Eekoute and just graduated from the University of Alaska. He's not sure what he's going to do back in the village, but he'd sure like to see a wind generator go in. He sees this as the perfect opportunity to get a wind generator. The dam sounds like a poor idea to him and he agrees with the new fish biologist, Cathy Coho, that the site by the airport would be much better. With the wind generator, they wouldn't need a road--which would save a lot of fish and wildlife habitat.

WILLIE WEBER - long-time fisherman, head of the fisherman's co-op

Willie is really happy to hear about the cannery as that will save local fisherman a long trip down the coast to deliver fish. He is concerned about anything that would damage fish habitat and is especially concerned about the dam. He would also hate to see the loss of wetland habitat, so favors the airstrip site for the cannery. The little Riley River is big enough to handle the fish wastes and all the fishermen could run the materials from the barge up to the airstrip site on a high tide. Also, the cases of canned salmon could be boated down to the barge after the cannery is built.

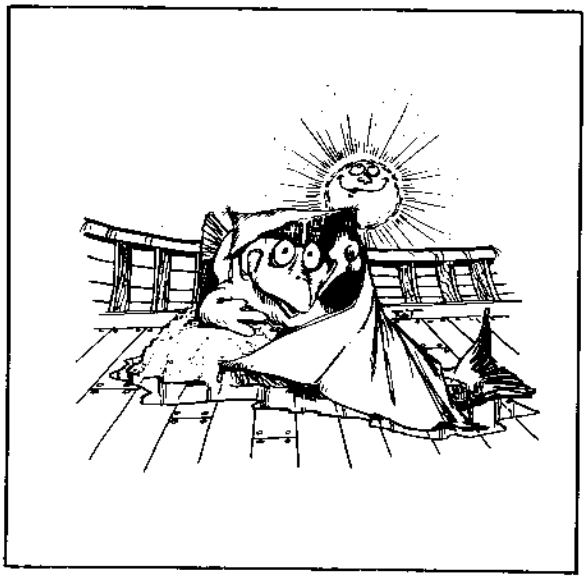
The Mighty Salmon Cannery Map



The Mighty Salmon Cannery Company is proposing to build a cannery outside of the village of Eekoute on the Big Riley River. Water for processing will come from the river and electricity will be produced by a dam at the headwaters of the Big Riley River. Fish wastes will be dumped into the Big Riley River.

Eekoute is a village of 300 people. A large salmon gillnet fishery has been building up over the past few years. Most of the people in the village depend heavily on subsistence foods which they harvest from the surrounding country.

Activity 5
Cartooning Local Issues



Background:

Oftentimes a cartoon or a sense of humor can be very effective politically. Plus, humor makes life more bearable and enjoyable for all of us.

Materials:

- paper
- pencil
- sample cartoons

Procedure:

1. Brainstorm with your class a list of local fisheries issues. These might include disregard of a fisheries regulation, potential losses in fisheries habitat by proposed developments, lack of knowledge of how to hold a fish, the importance of fish spawning habitat, or the need to be careful with incidental fish and crabs caught in gill nets, seines, or trawls. The class might be interested in helping the community obtain an aquarium, hatchery, or education program.

2. Select and research one issue. Students may interview or invite speakers.

3. Decide on a point of view or proposed solution. Then draw cartoons to illustrate your point.

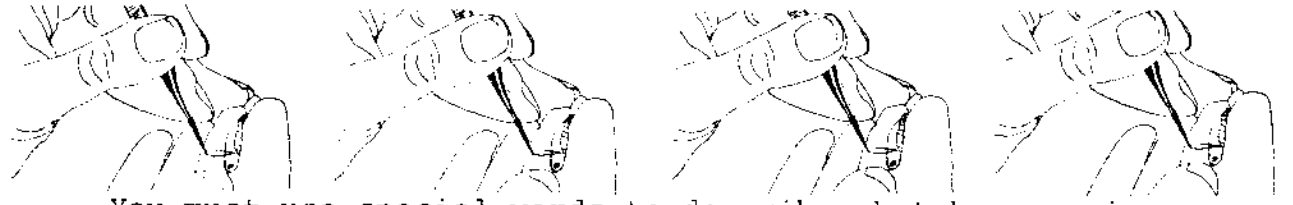
4. Show your results to the decision makers or people involved in the issue. Offer your help in resolution of the issue. Students can make a difference!

Additional Activities:

1. Art, Social Studies: Have students make T-shirts with a fish cartoon or saying on the front. They can silkscreen the shirts themselves or order them from a specialty company. The students might want to make enough to sell and to spread their points of view to the community!

2. Art, Social Studies: Have students design postage stamp posters as another way of conveying their ideas to the community.

You've Just Got a Job in the Hatchery



You must use special words to describe what happens in a salmon's life cycle and to talk about your work. Here are some of those words. Use your dictionary to look up a definition for each one. Write down the definition, then write a sentence for each word, using that word to describe something that might happen in the hatchery.

egg _____

_____

sperm _____

_____

fertilization _____

_____

spawn _____

_____

alevin _____

_____

fry _____

_____

mature _____

_____

incubator _____

_____

Hatchery workers often talk about "tagging" fish. Tagging fish helps them learn where fish from their hatchery travel and where they are caught by fishermen. Look up the world "tag" in the dictionary. Now think about how you might be able to tag a fish. Write down your ideas!

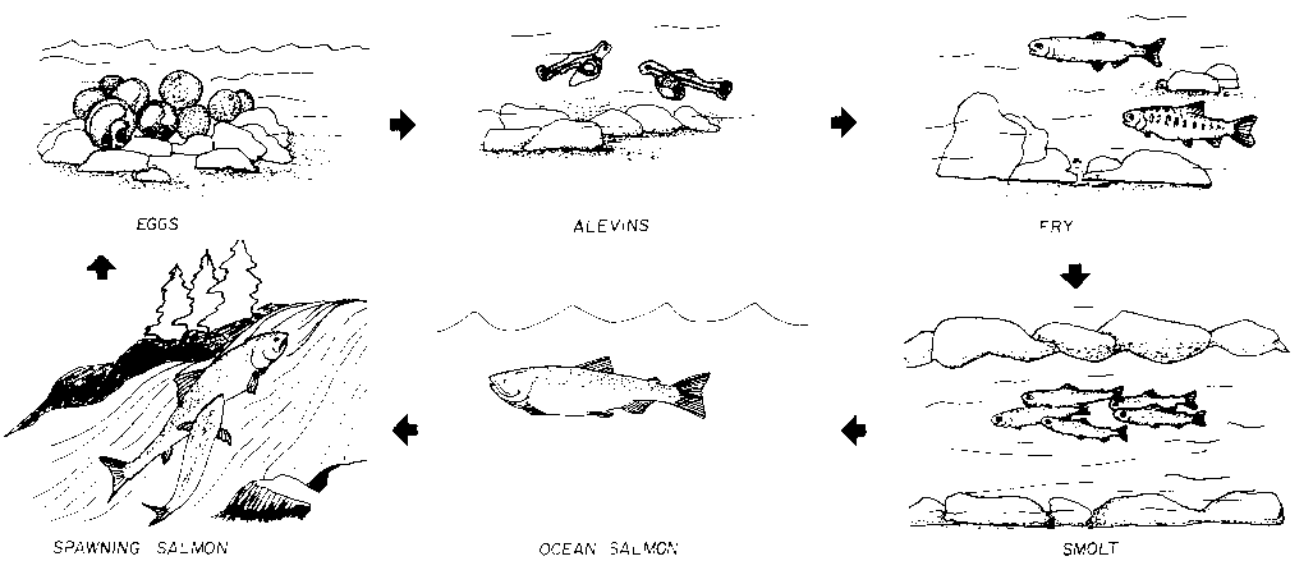
_____

_____

_____

Hatchery Basics

You've just been promoted to hatchery manager and you need to explain how a hatchery works to some new employees. Here is a diagram of the <u>natural</u> life cycle of pink salmon.



Then cut out the seven squares below. On another sheet of paper paste them in a circle that show the order of events in your hatchery during one year. Under each event write the name of the month or months in which the event described in the square might take place.

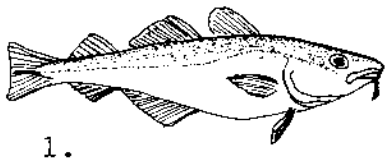
fry are counted, tagged and released to swim to the ocean month(s) _____	2-year-old fish return to hatchery, are captured and spawned. Fertilized eggs are put in trays with circulating fresh water. month(s) _____
fish leave incubators as fry and to to holding pens where they are fed month(s) _____	incubators cleaned and readied for return of mature fish in fall month(s) _____
eggs begin to hatch to alevins month(s) _____	eggs mature enough to be handled, eggs sorted and put in large incubators month(s) _____
eggs and alevins held in incubators month(s) _____	

What are those Funny-Looking Fish?

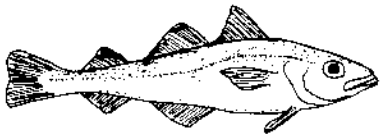
The easiest way to identify fish and other living things is with a kind of yes/no system called a "key." The idea is to compare your fish with the two-part descriptions--body shape, number of dorsal fins, etc.---choose the one that fits best and follow the directions until you get the answer.

Study the parts of a fish in the drawing above. Then pick out a fish to identify. Start with 1a and 1b. Does the fish look round like a salmon? (Go to 2 and repeat the process.) Does it look flat lake a halibut? (Go to 11, etc.) When you find its name, write it on the line. Continue until all are identified.

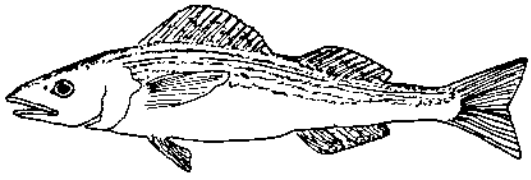
1.	a)	Body round.....Go to 2
	b)	Body flat.....Go to 9
2.	a)	3 separate dorsal fins.....Go to 3
	b)	Less than 3 dorsal fins.....Go to 4
3.	a)	Barbel (whisker) on chin.....Pacific (true) cod
	b)	No barbel on chin.....Alaska pollock
4.	a)	2 dorsal fins.....Go to 5
	b)	Less than 2 dorsal fins.....Go to 6
5.	a)	2 separate dorsal fins that look alike.....sablefish
	b)	Front dorsal fin high and narrow; rear fin long like a pointed ball.....rattail
6.	a)	One small dorsal fin set far to rear.....smooth lumpsucker
	b)	One long dorsal fin, but different front and back.....Go to 7
7.	a)	Front part of dorsal fin with sharp spiney spikes; back part smooth.....Pacific Ocean perch
	b)	One long dorsal fin, notched (like a "V") in the middle.....Go to 8
8.	a)	One lateral line and large mouth with big sharp teeth.....lingcod
	b)	Several lateral lines; small teeth.....greenling
9.	a)	Flat fish with one eye on either side of head; winglike pectoral fins.....skate
	b)	Flat fish with both eyes on one side of head.....Go to 10
10.	a)	Eyes on right side of head only....yellowfin sole
	b)	Eyes may be on either right or left side of head.....starry flounder



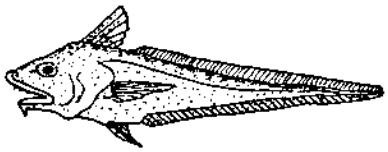
1. Godus = codfish macrocephalus = large head. Gray-brown with spots. To 3 feet 3 inches. Fine food fish; big commercial fishery.



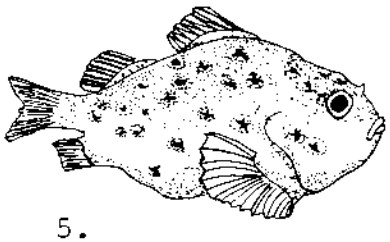
2. Theragra = beast food (for fur seal) chalcogrammu = brass mark. Brown back with silvery sides. To 3 feet. Now most heavily harvested white fish in Alaska waters.



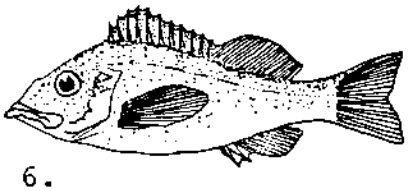
3. Anoplopoma = unarmed gills fimbria = fringe. Grayish black or green. To 3 feet 4 inches. Next to halibut, most highly prized white fish; especially good smoked. (Also called black cod.)



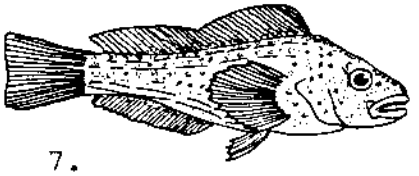
4. Coryphaenaides = dolphin-like. Gray-brown with black-edged scales. To 3 feet 3 inches. Good eating (like cod) but found only in very deep waters.



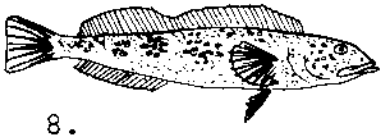
5. Aptocyclus = touching circles ventricosus = large bellied. Brown with big spots. To 11 inches. Flesh and eggs prized by Japanese who harvest them with gill nets.



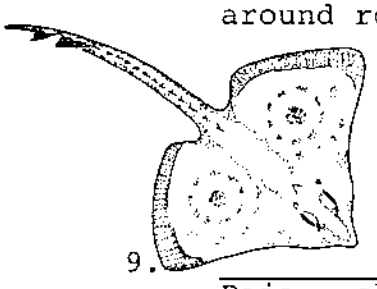
6. Sebastes = magnificent alutus = speckled. Light red with speckles near tail. To 18 inches. Most sought-after rockfish for fillets (boneless steaks).



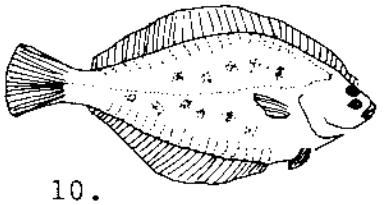
7. Ophiodon = snake tooth elongatus = long. Splotchy gray-brown and green. To 5 feet. Large size and fine flesh make this a prized sport and commercial fish.



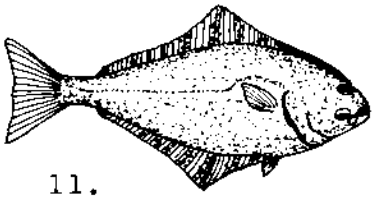
8. Hexagrammos = six line (lateral lines). Green, brown, blue with spots. To 21 inches. Good food fish; found around rocks and reefs.



9. Raja = skates binoculata = two-eyed. Dark brown-gray to black. To 8 feet. Flesh in the "wings" delicious; tastes like scallops or crab.

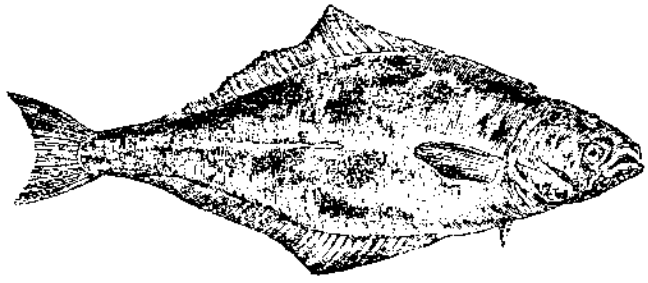


10. Limando = old man aspera = rough. Light brown with yellow fins. To 18 inches. Stocks building back after heavy over-fishing by foreign fleets. (Called "long-nosed flounder" in Chukchi Sea.)



11. Platichthys = flatfish stellatus = starry. Dark brown with spots on fins. To 3 feet. Good flavor; firm texture. Most important flounder being caught in Alaska.

Gearing Up for Whitefish



What are whitefish?

Defining whitefish isn't easy, but one definition that can be used is...."all the white-fleshed finfish except the small bait fish, like herring or smelt, and perhaps excluding halibut." Because the definition says "finfish," that leaves out sharks, and because it says "white-fleshed," that leaves out salmon. Some people call whitefish "bottomfish" or "groundfish" which they really aren't, since only a few species spend their lives on the ocean floor.

What whitefish does include are all the flatfishes, and rockfishes, pollock, cod, black cod and lots of others. Instead of catching a few high value fish such as salmon, the whitefisherman must catch many tons of cod or flatfish, knowing that the price received for each fish will be low.

Whitefish have as many uses as there are different kinds of fish. In England and Northern Europe, these tasty fish are favorites on seafood menus. And they are beginning to catch on in this country, too. Some, like rockfish, red snapper and Pacific Ocean perch are sold in fish markets or grocery stores. Some, like cod, are cut up into small pieces and are covered with a coating or breading, and then used for fish sticks, fish and chips or fish sandwiches. Some are used for bait, and some find their way into fish fertilizers or pet food.

Government people involved in fisheries in Alaska hope more and more people and vessels will become involved in whitefish harvesting, but this may come about slowly. For one thing, many Alaskan fishermen would rather fish for salmon or halibut when the seasons are open. If these fishermen only fish for whitefish in the winter, when they can't fish for salmon or halibut, then the processing plants don't find it worthwhile to change all their equipment and people over to take care of these bottomfish for only a few

months out of the year. Another problem is that operating a fishing boat large enough to handle the many tons of whitefish a fisherman has to catch is expensive. Some Alaskan ports would have to be enlarged for deepwater ships. And whitefish have to be gutted immediately because otherwise, they spoil rapidly. Labor costs in America are much higher than in foreign countries. Gutting machines are available, but it's difficult to get them to fit the many sizes and shapes of whitefish. Many fishermen are not sure it makes financial sense for them to fish for whitefish. And not too much is known about whitefish ecology and biology, so it is easy to overharvest them. Plus, people across the United States need to learn about these fish so they will know how good they are to eat and will buy them. Then, if there are more people eager to buy these fish, fishermen will be able to sell more of their catch for a better price.

Don't be too surprised, however, when sooner or later Alaskan fishermen come up with solutions to these problems. In recent years, Alaska's old standby fisheries have become increasingly crowded. Limited entry laws have cut down on the number of salmon fishermen, and shortened seasons for crab and shrimp have left many boats idle for much of the year. Already, there are many different ways in which whitefishing is now being tried in Alaska, including some cooperative fishing with vessels from other nations.

1. Name three kinds of fish that might be called whitefish.

_____

2. Name two kinds of fish that are NOT whitefish.

_____

3. List the uses for whitefish.

_____

_____

_____

4. List at least four problems in the development of the whitefish industry.

_____

_____

_____

_____

5. How would you solve these problems in the development of the whitefish industry?

6. The Pribilof Islands may be one site of future whitefish development. Can you find them on a map of Alaska? Where are they? _____
Until recently, the Aleut people on the islands have lived a subsistence lifestyle, depending primarily on a federal government-supported fur seal harvest for their yearly income. Those funds are being cut off and islanders are looking for new sources of income. One possibility is the development of a deepwater port and fish processing plants for whitefish. Some local people are worried about the changes in their lifestyle and the effects on the huge colonies of seabirds and marine mammals that live on and around the islands.

What changes do you predict will happen on the islands if the whitefish industry is developed?

How do you suggest the local people handle this development?