Handout 9.1

Pacific Salmonids

A dichotomous (pronounced dye-COT-a-mus) key is a diagram that lets you tell one group from another by answering simple questions. The key helps scientists create categories which they can use to organize information. Others can use a dichotomous key to identify plants and animals they do not know. For example, field guides to birds or plants often use a dichotomous key to help people identify species they have not seen before.

One group of closely related animals is the Pacific salmonids (pronounced SAL-ma-nids). Salmonids are members of the Salmonidae family, which includes salmon, trout, char and whitefish. The Pacific salmonids include seven species: sockeye, chum, chinook, coho and pink salmon, steelhead trout and cutthroat trout. Steelhead trout are also called rainbow trout. Scientists used to think they were not salmon, but new studies show that they are. Cuthroat trout are not salmon, but they are members of the Salmonidae family.

Use the illustrations below to create a dichotomous key to the seven species of Pacific salmonids.

Use these steps to create the key:

1. Select a description that separates the illustrations into two groups (e.g., spots vs. no spots, or large eye pupil vs. small pupil).
2. Take each group and divide it into two more groups (e.g., large spots vs. small spots).
3. Continue to subdivide until each illustration is in a group that separates it from all the others.
4. If necessary, go back and change your groups to make the final groups distinct.
5. Create a chart showing how you divided the groups.
6. Have another group follow your chart to divide the illustrations. See if their final division is the same as yours.

Handout 9.2

Adult Salmon

After gaining weight in the estuary and adapting to the salt water, salmon travel along the coastline and then to the open ocean. Here they gain the full size, shape and colour of a mature salmon.

Most salmon spend the first part of their life in coastal waters, then migrate further out to sea. Each of the seven species of Pacific salmon has its own migration route and spends a different length of time in the ocean before returning home.

Young salmon can travel up to 20 km a day, while mature salmon can travel as much as 50 km a day. Salmon usually travel north in summer, often swimming as far as the Gulf of Alaska, and south in winter.

While at sea, salmon feed on a variety of smaller fish and zooplankton. The salmon can gain many kilograms, with mature adults reaching a few kilos to 20 kilos or more, depending on the species. Salmon are prey for seals and orcas, as well as for fish, such as tuna and cod.

The largest number of salmon is probably taken by human fishers. People catch salmon mainly in coastal waters as large schools return from their ocean travels, although some are also caught in huge ocean drift nets. B.C. residents catch millions of salmon each year and nonresidents also catch salmon heading for streams and lakes in B.C.

Recreational fishers catch many salmon using single fishing lines with lures and hooks. Aboriginal fishers use modern and traditional methods to catch fish, both in the ocean and in rivers and streams.

After spending from one to seven years at sea, depending on the species, salmon return to their home stream or lake. Mature salmon form large schools and find their way to the mouth of their home stream. They gather at the mouth of their home river before starting the difficult journey upstream.

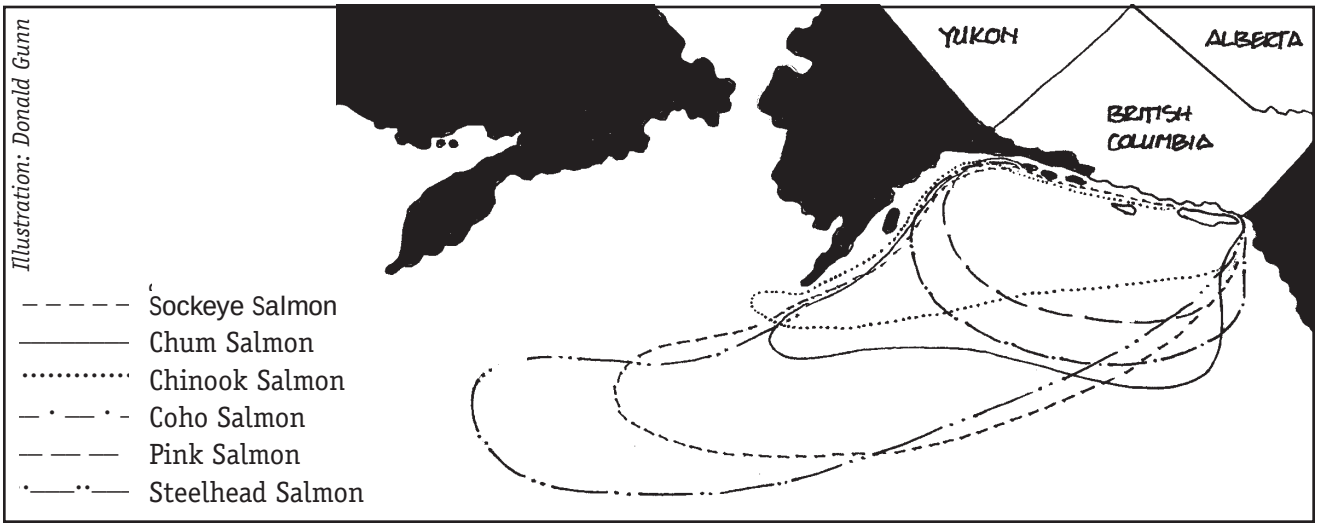
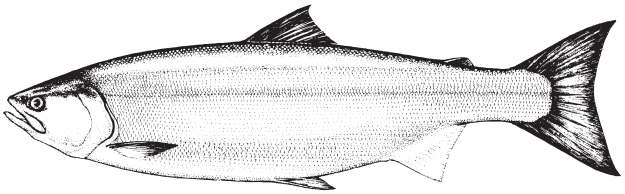


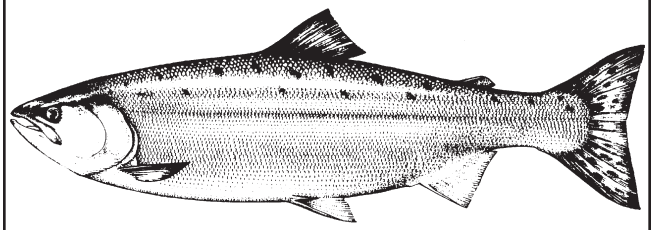
Illustration: Donald Gunn

Handout 9.3

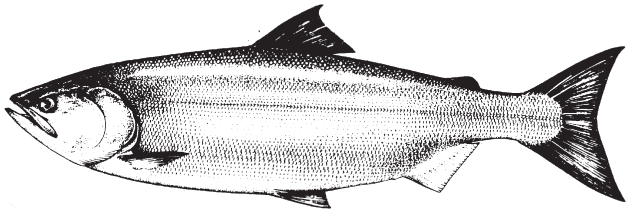
Species of Pacific Salmonids



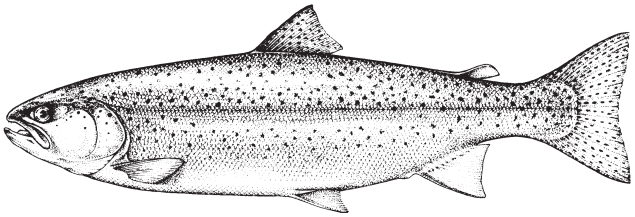
A. Sockeye



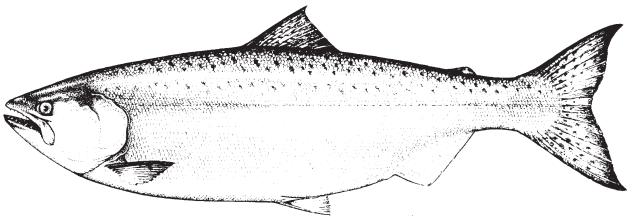
E. Pink



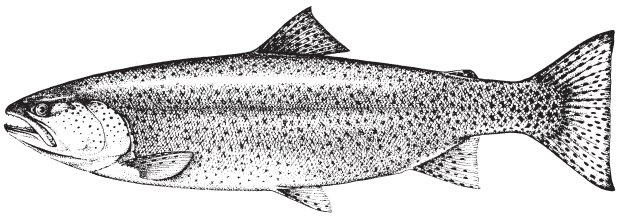
B. Chum



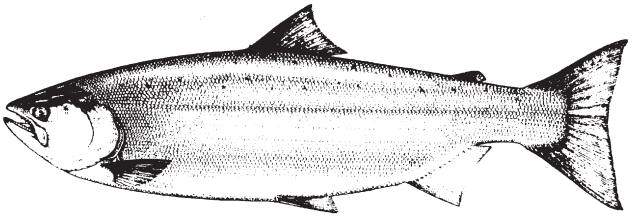
F. Steelhead



C. Chinook



G. Cutthroat



D. Coho

Handout 9.4

Salmon Navigation

B.C. sockeye and chum salmon travel as far as the Aleutian Islands off Alaska and the middle of the Pacific Ocean.

Salmon from different lakes and rivers mingle together in the ocean. They follow schools of plankton and smaller fish, such as herring. Although they follow a general pattern, their position can vary greatly from one year to the next.

Migrating salmon seem to know where their home stream is and how to return to it. When they are mature, all those that hatched at the same time in one stream or lake return together to the mouth of their home river. Then they begin their journey back upstream.

No one knows how salmon navigate through the ocean and find their way back. Scientists believe that salmon use a variety of ways to tell where they are and where they are going.

Possible navigational aids for salmon

Possibly salmon use different senses at different times, or rely on all of them together.

- **Water temperature.** Salmon generally head south in winter and north in summer, possibly following changes in the ocean temperature. They may also use temperature to tell where they are in the ocean and when to begin their migration.
- **Scents in the water.** Scientists know that salmon use their sense of smell to recognize their home river and to find their home stream or lake when they travel upstream. They may use similar scents to tell where they are in the ocean.
- **Water pressure and salinity.** The amount of salt in the ocean varies slightly in different places, and pressure can vary too. Salmon are very sensitive to these changes and may use them to tell one place from another.
- **Magnetic direction.** Salmon seem to be sensitive to the earth's magnetic poles. They may use the poles to help in getting their direction.
- **The sun and the North Star.** Salmon seem to have more trouble finding their way on overcast days. Some scientists think this is because they use the North Star or the sun to navigate.

Handout 9.5

A Classroom Thermal Map

The temperature varies from place to place. Some areas are warm, while others are cold. Temperature differences can be very important. Salmon bodies function faster in warmer water. They "live faster", but they may gain less weight and die sooner. Also, salmon predators, like tuna and mackerel, follow warm currents and kill more salmon when warm currents move north.

Even within a room you can record differences in temperature. If you take careful measurements and plot them on a map, you can make a thermal map showing the temperature in each area.

When you draw a line connecting the points with the same temperature, the line is called an isotherm. ("Iso" means equal; "therm" means temperature.) You can use the procedure below to make an isothermal map of your classroom. During the investigation, move as little as you can. Movement will create air currents that make it difficult to get accurate temperature readings.

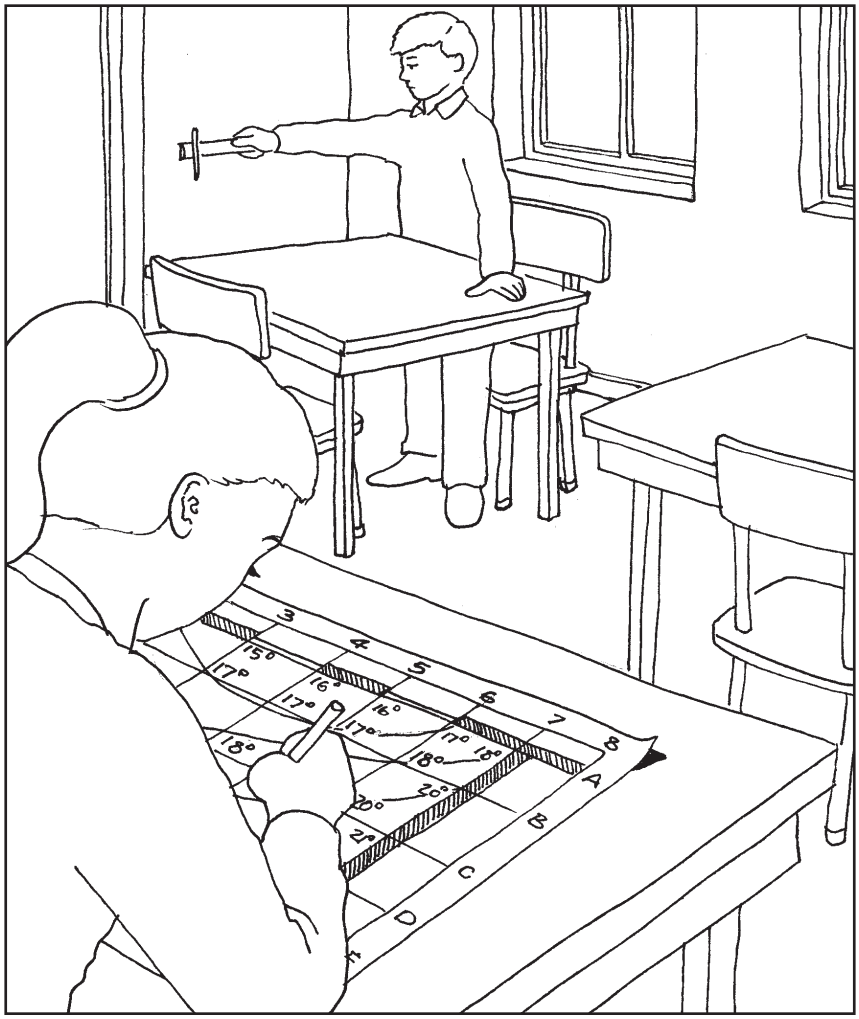


Illustration: Donald Gunn

Handout 9.5

A Classroom Thermal Map

1. Tape a thermometer to a ruler. Use the ruler as a handle so that your hand does not affect the temperature reading.
2. Make a map of the room, including walls, windows, doors, heating vents, desks, etc. (Your teacher may have a map you can use.)
3. Use your knowledge of the room to make a hypothesis about where the warmest and coolest parts of the room will be. Write your hypothesis on the next page.
4. Position yourself through the room in rows, giving each position a row number and letter. (For example, in the first row, the first position is A1, the one beside it is A2, the next is A3. In the second row, the first position is B1, the one beside it is B2, etc.) Draw each position on the map of the room.
5. Hold a thermometer above your head for two minutes. On the data form, record the temperature for each position in the classroom under the title "Ceiling Reading".
6. Hold a thermometer at waist level for two minutes. On the data form, record the temperature for each position in the classroom under the title "Waist Reading".
7. Hold a thermometer about one centimetre from the floor for two minutes. On the data form, record the temperature for each position in the classroom under the title "Floor Reading".
8. Transfer the data from the ceiling readings to the appropriate position on the classroom map. Then transfer the data from the waist readings and the floor readings onto separate maps.
9. Use coloured markers to connect the positions with similar temperature readings. The result will be an isothermal map of your classroom. With the three maps, you can compare the temperatures near the ceiling, middle and floor of the room.

Handout 9.5

A Classroom Thermal Map

Name _____

Hypothesis

My hypothesis is that the warmest area of the classroom will be: _____

And the coolest areas of the classroom will be: _____

Data Form

Ceiling Reading

Position	1	2	3	4	5
A					
B					
C					

Waist Reading

Position	1	2	3	4	5
A					
B					
C					

Floor Reading

Position	1	2	3	4	5
A					
B					
C					

Conclusions

State whether or not the data support your hypothesis, and any other conclusions you can draw from the data. _____

_____

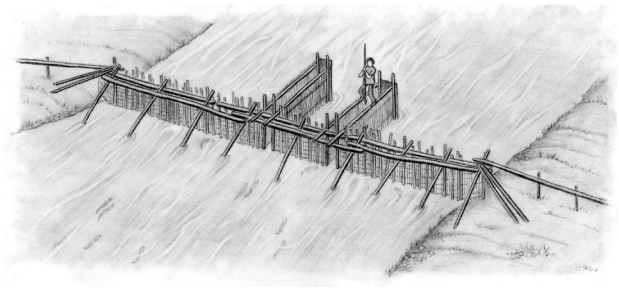
_____

_____

Handout 9.6

Salmon Harvesting in B.C.

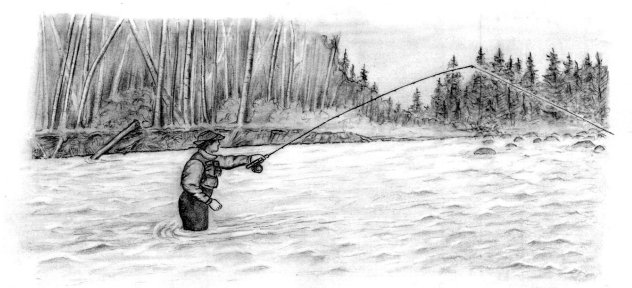
Many people fish for salmon in British Columbia, both as a sport and as a way to make a living.



Aboriginal fishing

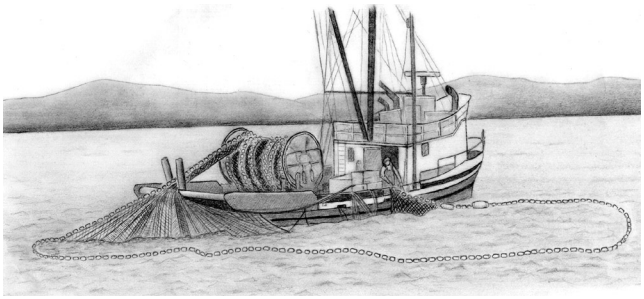
Canadian laws give Aboriginal people the right to catch salmon for food and ceremonial purposes using both modern and traditional methods. In some cases, agreements also allow them to sell their catch. Many Aboriginal people also fish commercially. About one third of all salmon licence holders are native and the fishing industry is the largest single source of jobs for B.C.'s Aboriginal peoples. Although some Aboriginal fishers use traditional methods, such as fish wheels, spears, hooks, dipnets and weirs, they take most of their catch using modern seine nets and gill nets.

Illustrations: Karen Uldall-Ekamn



Recreational fishing

Many British Columbians – as well as many tourists – love to fish for salmon. Besides individual sport fishers, the recreational fishery is also big business. Many charter and fishing lodge operations are located in the Gulf of Georgia and also in more remote places like the Queen Charlotte Islands.



Commercial fishing

Commercial fishers catch salmon and other fish for a living using long steel lines, gill nets and seine nets. (See separate information sheets.) The table on page 214 summarizes the number of fish caught in the commercial fishery.

Fish harvesters contribute to B.C.'s economy, but they also take many salmon before they can return to their spawning grounds.

HANDOUT 9.6

Salmon Harvesting in B.C.

1997 and 1998 Salmon Catch

(Estimates, in numbers of salmon caught)

	Year	Chinook	Chum	Coho	Pink	Sockeye	Total
Gillnet	1997	50,000	670,000	40,000	700,000	3,710,000	5,170,000
	1998	20,000	1,080,000	2,982	180,000	790,000	2,072,982
Seine	1997	3,081	1,160,000	10,000	4,680,000	4,840,000	10,693,081
	1998	638	3,270,000	995	2,160,000	550,000	5,981,633
Troll	1997	140,000	40,000	160,000	1,100,000	2,110,000	3,550,000
	1998	120,000	100,000	0	50,000	410,000	680,000
TOTAL	1997	193,081	1,870,000	210,000	6,480,000	10,660,000	19,413,081
	1998	140,638	4,450,000	3,977	2,390,000	1,750,000	8,734,615

Source: B.C. Salmon Market database (http://www.bcsalmon.ca)

B.C. Nanufacturing Shipments

(Value in millions of dollars)

	1990	1991	1992	1993	1994	1995	1996	1997
Fish	784.5	709.7	634.6	689.8	862.8	793.7	949.1	914.6
All	25,329	23,259	24,839	27,142	31,048	35,040	33,933	34,671
As %	3.10%	3.05%	2.55%	2.54%	2.78%	2.27%	2.80%	2.64%

Source: B.C. Statistics

HANDOUT 9.7

A Code of Responsible Fishing for Canada

Less than 100 years ago, many people thought that the number of salmon was so great that salmon would always survive. Since then, human activities have damaged lakes, streams, estuaries and even the ocean – places essential for salmon to live. At the same time, methods of catching fish improved, allowing people to catch more and more salmon every year. Today, in hundreds of B.C. lakes and streams, salmon no longer return to spawn.

Other countries and regions have faced a similar problem, both with salmon and with other fish species. In 1995, Canada and 79 other countries accepted a United Nations code of conduct for responsible fishing. In a series of meetings, fish harvesters from across Canada discussed how to meet the goal of responsible fishing locally. In 1998, they agreed to a code for responsible fishing operations for commercial fishers. Canada will also develop a code for recreational fishers.

The Canadian Code of Conduct for Responsible Fishing Operations identifies nine broad principles to protect fish while allowing a careful harvest. The code says that fish harvesters should:

- conserve and protect fish and their habitats for future generations;
- balance their fishing against the supply of fish and the economic needs of fishing communities;
- use gear that catches only the intended species;
- attempt to retrieve any lost gear that might trap or endanger fish;
- reduce the number of fish that go to waste (known as the by-catch);
- avoid polluting fishing grounds;
- look for solutions to fishing problems;
- share responsibility and cooperate with other fishers and regulators;
- educate the public and other fishers about fishing issues and ways of fishing wisely.

You can find current details from the Internet site of the Canadian Responsible Fisheries Board (www.responsiblefisheries.com).

What would you add to the code to ensure that salmon fishers can continue to catch salmon responsibly while protecting salmon for future generations? Consider the needs of fish harvesters, fishing communities and the fish themselves. Here are some suggestions:

- Know the regulations about when and where salmon fishing is allowed and follow the regulations.
- Catch only the fish you need.
- Use lures and baits that will catch the kind of fish you want (e.g., use large baits so that only mature fish will bite them).
- Use fishhooks with no barb so you can release fish without harming them.
- Release any fish you catch that are too small or the wrong species.
- Handle all fish carefully so that you can release them safely.