SALMON QUALITY

Four factors are commonly used to assess the quality of salmon in British Columbia. These factors are as follows:

1. live condition of fish (parasites, scars, flesh integrity);
2. sexual maturity;
3. post-catch age and handling; and
4. storage conditions.

Although these are distinct characteristics, they must be considered together. A prime quality salmon, for example, must not only be fresh and well treated, but must also be relatively free of advanced sexual maturity and other defects.

As indicated in Booklet 2 (Life Cycles), the relationship between salmon quality and sexual maturity is a controversial subject. There can be no doubt, however, that a number of deteriorative changes do occur as the fish approaches and enters the water ecomes distorted. Strong, unpleasant odors may develop, as they do with chums. Because of these developments, the industry prefers to harvest salmon before sexual maturity has become very far advanced.

A three-grade system (Canada Grade A, Canada Standard Grade, and Canada Utility Grade) is applied to commercial salmon catches. Table 2 and the following descriptions are taken from a handout publication prepared by the Fish Inspection Division, Department of Fisheries and Oceans. Reference should be made to that publication for further details.

> Canada Grade A is the highest quality in the grading system. A premium quality fish will have colour typical of sea-run fish of the species. It will be free from defects such as pugh holes, bites, cuts or disfiguring, or open scars in the edible portiorime fish of that species. Dressing must be thorough, with no kidney tissue and no free blood left in the belly cavity. The odor must be fresh, with no abnormalities. Belly walls must be sound, indicating a healthy, well-fed fish. Net marks that do not cut through the skin or bruise or soften the underlying flesh are permitted. There may be evidence of the onset of sexual maturity, but the predominant appearance will show dark above and silvery-white below, although some dulling may be apparent. Water marks (color change caused by two fish resting against one another) and distinctive bars on chums may be evident, but red, brown, or green tints have not developed. Pinks may start to show slight humping. Slight hooking of the nose may also be present in some salmon.

Canada Standard Grade salmon may have lost the color associated with fresh sea-run salmon of the species. The flesh may be softer, so that an impression from finger pressure will be retained. The fish as a whole may be fairly limp. Small clean cuts, bites, pugh marks or gaff marks may be present. The flesh color must be good to fair, characteristic of the species, but appear somewhat bleached. The belly cavity may have cuts, scrapes, or some broken or cut ribs. Some ribs may be protruding as a result of belly burn and subsequent deterioration of the peritoneal lining. The belly lining may appear reddish (flushed) due to advancing belly burn. There must be no sour odor, although a late odor may be evident.

Canada Utility Grade salmon fall below the standard grade, but are still fit for human consumption. Moderate to advanced sexual maturity may be evident. Clean cuts or breaks in the skin are acceptable, and net marks may indent, perforate, and soften the flesh. Cherry belly may be extreme. There may be heavy to extreme scale loss, and slime may be very thick, dull and in copious amounts. Odor may be slightly off (sour, musty, but not putrid), and there may be considerable odor associated with late fish. Only slight rancid odors are permitted.

TABLE 1: QUALITY GRADE CRITERIA FOR FROZEN GUTTED PACIFIC SALMON

CHARACTERISTICS	GRADE A	STANDARD GRADE	UTILITY GRADE
A. External Surface			
1. Colour	Typical of sea-run species: good sheen; good distinction between dark dorsal and light ventral surfaces: water marks on less than 50% of dorsal surface.	Some dulling of colour and sheen: line between dark dorsal and light ventral surfaces is less distinct.	May be very dull; little distinction between dorsal and ventral colours.
2. Cherry belly	None except for very faint reddening near anal and pectoral fins.	Moderate along lower ventral surface only.	May be extreme.
3. Net marks	No indentation nor softening of flesh: no skin perforation.	May indent and soften flesh.	May indent and soften flesh: May perforate skin.
4. Cuts, scars and punctures	No cuts nor punctures permitted; 1 well-healed scar up to 6 sq. cm (1 sq. inch) permitted.	Small clean cuts and punctures permitted; 1 well-healed scar which may exceed 6 sq. cm permitted.	Clean cuts and punctures permitted; scars permitted.
5. Slime	Clear	Dull; cloudy	Thick, dull, copious.
B. Sexual Maturity	No red, brown, or green tints; faint barring on chums; slight hooking of nose: slight hump on pinks; belly wall thickness consistent with the species.	Some colour development; prominent barring; nose hooked; distinct hump; belly walls may be thin.	Red, brown, black, green and yellow colours may be present; belly walls may be very thin.
C. Belly Cavity			
1. Flesh colour	Typical of sea-run species; no bleaching.	Faint bleaching allowed	Noticeable loss of colour
2. Belly burn	None; very slight blush; lining intact.	Up to moderate belly burn; up to 25% of lining may be broken.	Moderate to extreme; lining may be completely disintegrated.
3. Cuts, tears and bruises.	Clean cuts and tears up to 2.5 cm (1 inch) total length; no bruises nor protruding ribs.	Clean cuts and tears up to 5 cm (2 inch) total length: up to 10% of ribs protruding; no more than 1 bruise up to 6 sq. cm (1 sq. inch).	Any number of cuts, tears and protruding ribs; bruises permitted.
4. Cleaning	Thorough; no blood, kidney, heart, gills nor esophagus; reasonably free from residual blood.	Thorough; no blood, kidney, heart, gills nor esophagus; reasonably free from residual blood.	
D. Flesh Quality			
1. Texture	Resilient: no flesh separation observed in belly cavity.	Depression may remain when flesh depressed. No flesh separation observed in belly cavity.	May be soft and limp; flesh separation may be obvious.
2. Odour	Fresh; no abnormal odour	No sour nor abnormal odours	May have slight off odour but not putrid: some late odour
E. Frozen Characteristics to Meet Good Commercial Practice			
1. Glaze or protective membrane	Complete	Complete	Loss shall not exceed 25%.
2. Dehydration or freezer burn	None on final product: must recondition prior to packing, if present.	None on final product: must recondition if present.	May recondition if freezer burn is present.
3. Body distortion	Minimal in individually frozen fish.	Moderate distortion in individually frozen fish.	Fish may be distorted.
4. Oil Migration (Rust)	None on final product.	Must recondition prior to packing, if slight rust is present.	Rust and slight rancid odour may be present.

FISH INSPECTION

Less than twenty percent of Canada's commercial fish production is sold domestically. The bulk of our catch is destined for very competitive and quality-conscious foreign markets. The Canadian fishing industry occupies a premier position on the international market because it has worked hard to earn a high reputation for the quality of its products.

This enviable position can only be maintained if consumers are assured that Canadian fish products are safe, of good quality, produced under sanitary conditions, and properly labelled and packaged. To this end, the Department of Fisheries and Oceans operates a national fish inspection program, with staff in all ten provinces and the Territories. The Department maintains 130 field inspection centres, supported by 23 laboratories.

Systematic inspection of pickled and salted fish for the export trade began in 1914, with the enactment of the Fish Inspection Act. At that time, domestic consumers were left to a "smell and touch" inspection of their own.

The inspection program for Pacific canned salmon started in 1934, and was stepped up during the Second World War. Today, Canada's fish inspection standards are among the highest in the world.

Federal jurisdiction applies only to inter-provincial and export trade, while production and sale of fish within each province is the responsibility of the applicable Provincial Government. Eight provinces have enacted fish inspection regulations of their own. These regulations are enforced on behalf of the Province by the Federal Department of Fisheries and Oceans.

The Fish Inspector

All fish inspection activities authorized by the Fish Inspection Act are carried out by officers of the Inspection and Technology Branch. The Fish Inspector's job is to identify and correct safety or quality problems. Fish are rejected if they fail to comply with quality standards or if tests indicate a health hazard. Inspectors are alert also for fraudulent practices, such as false information on the labels of fish containers.

Inspections are made of:

1. fishing vessels, to ensure compliance with minimum standards of construction, equipment, protection of fish from sun and weather, temperature control, cleaning facilities, handling, and clean-up;

2. ocean transport, with regard to construction and sanitation, temperature control, and handling;

3. dock facilities, to ensure that fish remains fresh and is handled properly during unloading;

4. processing facilities, for compliance with up to sixty requirements governing construction, equipment, and operation;

5. cold storage facilities, to ensure safety and quality protection from dust, rodents, contaminants, and unfavorable temperatures.

Fish processing plants are not permitted to export fish or fish products unless they have a Certificate of Registration from DFO. If an operating plant fails to maintain the required standards, its management is asked immediately to comply. Failure to obey such a directive may result in withdrawal of the Certificate of Registration.

Defective products at the storage, distribution, or retail level are recalled in co-operation with Health and Welfare Canada and with Consumer and Corporate Affairs.

FURTHER REFERENCES

Useful references include the following.

1. Pacific Fishes of Canada, by J.L. Hart, published by the Fisheries Research Board of Canada.

   This authoritative text has been issued to Fishery Officer recruits for several years now, and should be readily available in all Sub-district and District Offices.

2. The Salmon Our Heritage, by Cicely Lyons

   This is a monumental work, painstakingly prepared by an author who was intimately involved in the canning industry for many years. Contains numerous anecdotes detailing the growth of the industry, its problems with the supply of fish and major developments in the market.

3. Indian Fishing Early Methods of the Northwest Coast, by Hilary Stewart, J.J. Douglas Ltd. Vancouver, 1977.

4. The Salmon Their Fight For Survival, by Anthony Netboy, published by Houghton, Mifflin Co., 1974.

   Written by a man who has spent many years researching the extensive salmon literature and collecting information from fishermen, biologists, researchers and salmon managers throughout the world, this book would make a valuable contribution to the personal library of anyone interested in the Pacific salmon.

5. Turning the Tide A New Policy for Canada's Pacific Fisheries, by P.H. Pearse, Commissioner, 1982.

6. Principles for Handling Salmon on Freezer Vessels, by C. Ann Davies, 1980.

   This is a small (24 pages) book prepared for DFO. It is available from the Regional Office, and will be issued with Booklet 3.

FIELD SERVICES STAFF DEVELOPMENT MANUAL

VOLUME 1: THE PACIFIC SALMON

BOOKLET 4: FISHING AND OCEAN TRANSPORT

Prepared for the Field Services Branch
Training and Career Development Office
Pacific Region
Department of Fisheries and Oceans

March, 1987

TABLE OF CONTENTS

ABOUT THIS BOOKLET

As we saw in Booklet 3, B.C. salmon stocks are subject to the combined pressure of three user groups -- Native food fishermen, sport fishermen, and the commercial fishing industry. This pressure is brought to bear on the resource through fishing technology that grows more efficient almost every year. The more we know about fishing vessels, gear, and methods, the better able we are to appreciate the demands being made on the salmon resource.

In terms of strategy, salmon management is largely a matter of ensuring that fishing patterns support the achievement of biological objectives. What we try to do is control the number, age, size, and species of fish that are taken. This control is achieved by management actions designed to regulate the number of fishermen, the locations in which they fish, the length of time they are allowed to fish, the gear they use, and so forth. Anyone who wishes to understand salmon management must therefore acquaint himself with the capabilities and limitations of different fishing methods and gear.

Fishermen are successful only at times and places where fish can be found. From this simple observation, it follows that a great deal can be learned about fish behavior by observing and talking with fishermen. Marine fishing patterns will often reveal hen, where, how, and with what success different fishing gear is being used, we can often find out what the fish themselves are doing. Again, we can obtain meaningful information only if we are familiar with each form of fishing method and gear.

This manual will provide you with the basic information you need to differentiate between different gear types and begin building your knowledge of how each type is used. It is not, however, a substitute for field experience. To really understand BC salmon fishing gear and techniques, you must be prepared to spend time on the docks, along the river banks, and on the water. Talk to fishermen as often as possible, watch closely as they handle their gear, and take advantage of every opportunity to accompany fishermen on working trips. Use these trips to learn about the local area, its fishermen, their language, their fishing techniques, and their gear.

Learning Objectives

Readers who would like a more formal and detailed account of what they can expect to learn from this booklet are encouraged to consider carefully the learning objectives listed below.

Persons who master the information presented in this booklet will be able to do the following things.

1. Identify the salmon fishing techniques and gear used by Native food fishermen.

2. Identify the salmon fishing techniques and gear used by sport fishermen.

3. Distinguish between the salmon fishing techniques and gear used by commercial fishermen.

4. Compare, in general terms, the capabilities, limitations, and major operational problems of the three types of commercial salmon fishing gear.

5. Identify the vessels and facilities employed in the ocean transport of commercial salmon catches.

6. Briefly describe major economic and structural trends in the commercial salmon fishing industry.

FOOD FISHING METHODS AND GEAR

Many Native Indians still fish for salmon at sites frequented for generations by their ancestors. Moreover, they still employ some traditional techniques and rely on time-tested skills and knowledge. Even some of the gear remains the same in design, although constructed of modern materials.

As is the case with all fishermen, the traditional techniques and gear used by the Native peoples of this region were adapted to the environmental conditions and behavior of their prey. Certain methods -- e.g., trolling from a canoe with a baited hook and line -- were employed in deep ocean water, while others -- e.g., weirs and traps -- were effective in shallow river mouths. Similarly, the techniques appropriate at a downstream site might not be feasible in a fast-running headwater channel. No matter where they were used, however, the predominant fishing techniques took advantage of the relative ease with which salmon are caught while moving inshore, holding off the mouths of rivers, or struggling upstream on the return migration.

The following pages very briefly outline the major types of Native fishing gear. For detailed descriptions and illustrations of gear construction and operation, the reader is referred to Hilary Stewart's authoritative book on Northwest Coast fishing methods. When one looks at the size and power of the modern commercial fishing fleet, it is sometimes easy to forget that the Native peoples of this region flourished here for 9000 years or more, building a rich and complex culture on the marine resources available to them. Their technological achievements are aptly summarized in the foreword to Stewart's book.

> What we see ... is an incredibly varied and highly refined assemblage of tools, techniques, and knowledge, the culmination of thousands of years of evolutionary development. These tools and techniques were not imported ready made, nor did they suddenly spring into being. They developed slowly and painstakingly as more effective variations were invented or introduced and applied to achieve more rewarding ends. The final result adds up to one of the most elaborate and productive fishing technologies achieved by any non-industrial society.

Hook and Line

Northwest Coast Indian peoples developed a very wide range of hook and line gear, including baits, lures, sinkers, floats, and lines. Each type of gear often was adapted to fish of a particular species, size, habitat, and behavior.

Fishing lines were made from many different materials. The solid part of the stems from bull kelp was soaked in freshwater, stretched, twisted, and joined with a special knot to make a very strong line. Also used were whale sinew, and nettle fibres. A leader of doe skin, cedar bark, or braided human hair -- almost invisible to the fish -- was attached at the end of a heavier line.

Barbs made of bone, wood, and (more recently) iron, were lashed to a wooden or bone shank and tied to the leader.

Sinkers were fashioned from pebbles, ranging in size from small to medium. These were used to ensure that the baited hook dropped to a depth at which it could be seen by a passing salmon.

To attract the attention of passing salmon, an Indian fishermen might use a lure. These were sometimes made of willow wood, carved in the shape of a fish with a slight curve so that the lure would simulate the action of a swimming fish as it moved through the water. Alternatively, a piece of abalone, glittering in the sunlight, might be used.

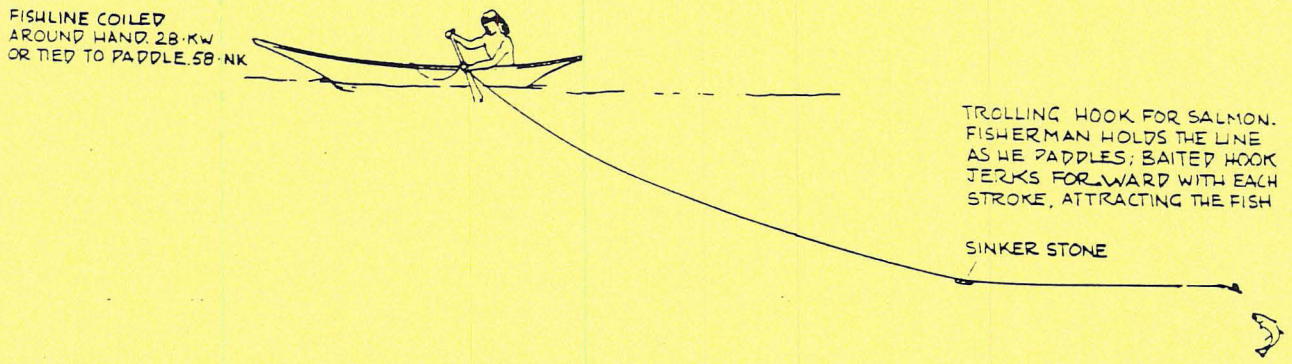

Figure 1: Traditional Trolling From a Small Canoe

Salmon trolling was conducted from a small canoe. The fisherman would bait his hook with a fresh fish, coil the line around his hand or fasten it to the paddle handle, and resume paddling. The bait was thus drawn through the water in such a way as to keep it in constant motion. The hooked salmon was drawn quickly on board.

Where plentiful, salmon might also be taken by jigging. Using this method, the hook is alternately raised and lowered through a zone just a few feet off the bottom. The bait sometimes was made to "jig" by pulling on the line by hand.

The jigging motion could also be achieved by the wave action on a float to which the sinker and bait were attached by a long line.

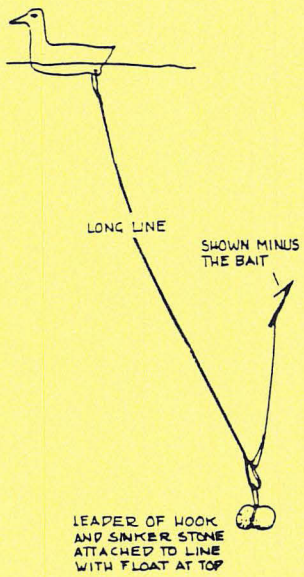

Figure 2: Jigging Gear

Hook and line methods are seldom used by present-day food fishermen.

Weirs and Traps

A weir is essentially a fence, built across a water-course to control the upstream passage of migrating salmon. Some weirs were used to block upstream fish movement, while others were designed to guide the fish into a trap. Spears and dipnets were used to catch the salmon massed below a weir or contained in a trap.

Weirs typically were built in shallow estuaries, rivers and streams. These structures were made of latticework sections, branches, or saplings suspended on a framework of stout posts driven into the river bed.

Downstream villages sometimes completely blocked an entire stream. Once they had sufficient fish, sections of the weir were removed to allow the salmon to continue upriver.

Salmon were often funnelled into a trap through a gap in the weir. Once inside, the fish would become confused and unable to find their way out through the small entrance opening.

Traps might also be constructed across the narrow neck of a lagoon or river mouth. The trap was left open during the incoming tide and then closed when the tide receded.

Traps made of river boulders were sometimes built near a river mouth. The fish would drift shoreward on the rising tide, swimming over the top of the obstacle. As the tide receded, they became stranded behind the stone walls, unable to retreat to deeper water.

Weirs and traps were probably the most effective way of catching salmon in the pre-contact era. They are not used today, probably because other techniques require less labour and yield a higher catch.

Spear

Spears are most efficient with the smaller species of salmon at sites where the fish are close to shore and readily visible. The weapon must be thrust with enough power to impale the fish, but not enough to break the shaft or head should the fish be missed. The fisherman must judge the depth of the water, the speed of the swimming fish, and the allowance for light refraction.

A variety of fishing spears are used by Native Indians. One of the most efficient is the leister spear, in which the fish is held by reverse-angle barbs. This weapon is used with a downward, vertical thrust. The leister spear is especially useful to capturing salmon hiding beneath a river log jam or other form of cover.

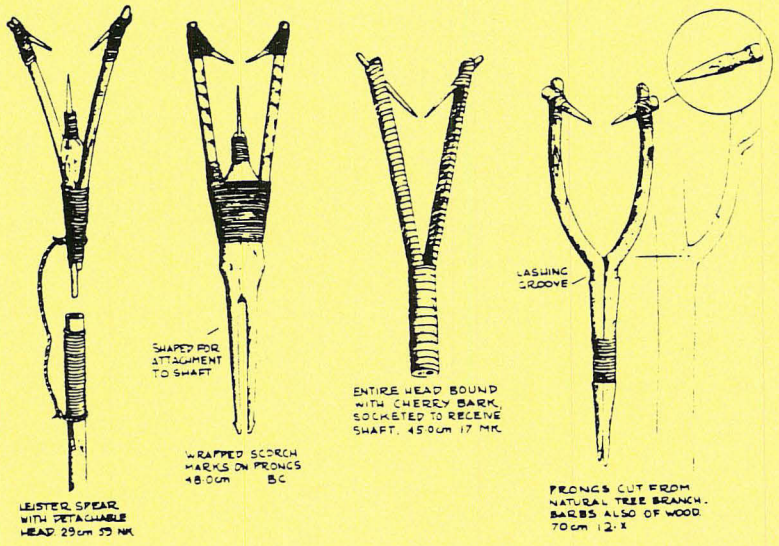

Figure 3: Leister Spear

Harpoon

A harpoon is either thrown or thrust at its target. On impact, the head comes away from the shaft, to which it is attached by a thong. Harpoons are useful where the salmon cannot be reached with a spear -- e.g., in deep river pools, in wide streams, and in the ocean. They are also more effective in retrieving heavier fish, such as chinook, which might either escape or break the shaft or point of the weapon if caught on a spear.

Harpooning was best done in clear-water rivers and streams. It could also be conducted in bays and inlets, particularly where the fish were schooled prior to entering freshwater.

Harpoon types were developed for different conditions. The Nootka, for instance had one kind of harpoon for use in small streams, a second for deep pools, a third for shallow rapids, and a fourth for wide rivers.

Harpoons are seldom, if ever, used by present-day food fishermen.

Gaffs

Unlike the spear, which is thrust downwards and away from the fisherman, the gaff hook is jerked upwards to impale the fish. The gaff can be used from a platform at an eddy or rapids, or it can be handled while standing in a boat. In a heavy run of fish, the weapon is raked quickly along the stream bottom. This implement can also be used at night or in murky water; in such conditions, the fisherman strikes when he feels a fish brushing against his hook. The gaff hook remains one of the favorite tools of Native fishermen.

Dipnet

Traditionally, the dipnet was useful in capturing fish trapped by weirs or traps. Today, as in the past, it is still commonly used to take migrating salmon from a river. To use the dipnet in this way, the fisherman must stand on a boulder or other convenient platform jutting out into the stream. The net is repeatedly dipped downstream into the river and lifted out in a slow, steady rhythm. With the traditional Fraser River dipnet, a tight string holds the mouth of the net open until it encloses a fish. The string is then loosened to let the net close into a bag.

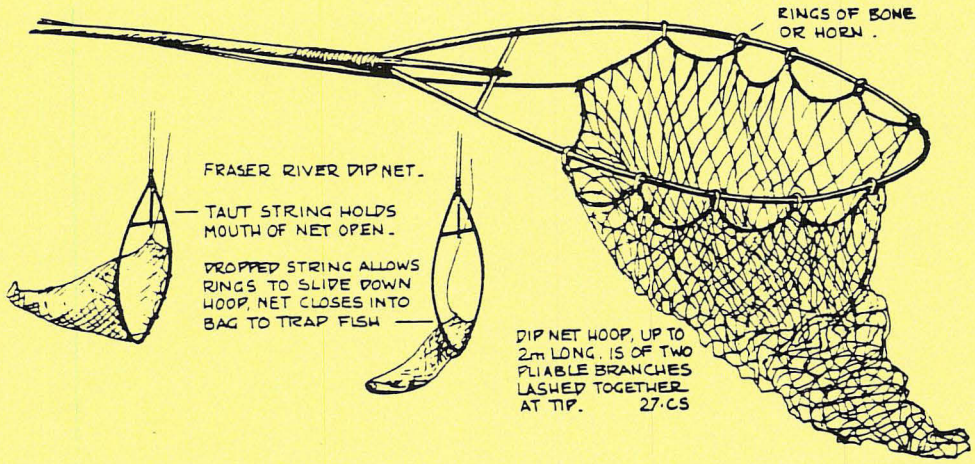

Figure 4: Traditional Fraser River Dipnet

Gillnet

Salmon migrating upstream can be caught by gillnets, frequently set in quiet backwaters, where the fish pause to rest. Traditional natural-fibre nets were supported by wooden floats, and held down at the bottom by stones. Today the floats are cork, the nets are nylon, and the weights are lead.

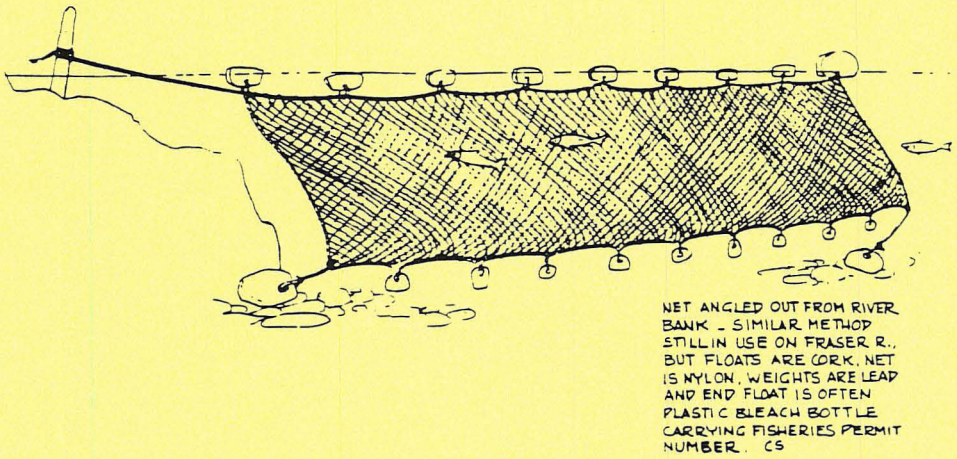

Figure 5: Traditional Fraser River Gillnet

The gillnet is most effective when the mesh is least visible to fish -- e.g., in turbid waters. Fish swimming into the net are unable to force the wider parts of their bodies through the mesh. As they attempt to back out, they are caught by their gills. The gillnet must be removed from the river periodically and emptied of caught fish.

Beach Seine

Traditionally, the beach seine was set at high tide. A man on the shore held a line attached to one end of the net, while his companions paddled out from shore in a canoe, paying out the line as they went. The net was set as parallel as possible to the beach, and was anchored at both ends by large stones. The men in the canoe returned to shore with a set of lines attached to the second end of the seine. The entire fishing party then pulled on the lines, trapping their quarry within the semi-circle formed by the net.

Beach seines are still used by food fishermen in some rivers.

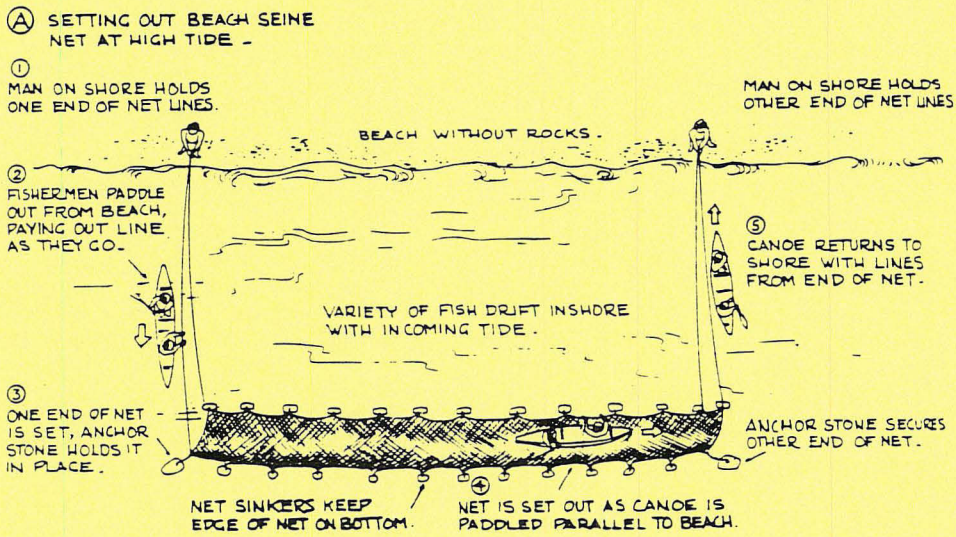

Figure 6: Beach Seine

Drag Net

This type of net is seldom used today. It is designed to be drawn along the bottom of a muddy river. In pre-contact times, the net was pulled behind two canoes, moving downstream and angled away from each other to keep the net mouth fully open. A line passing through horn rings installed at opposite corners was pulled to close the net before it was hauled up. Wooden floats held up the top edge of the net, and stone sinkers held the lower edge on the stream bottom.

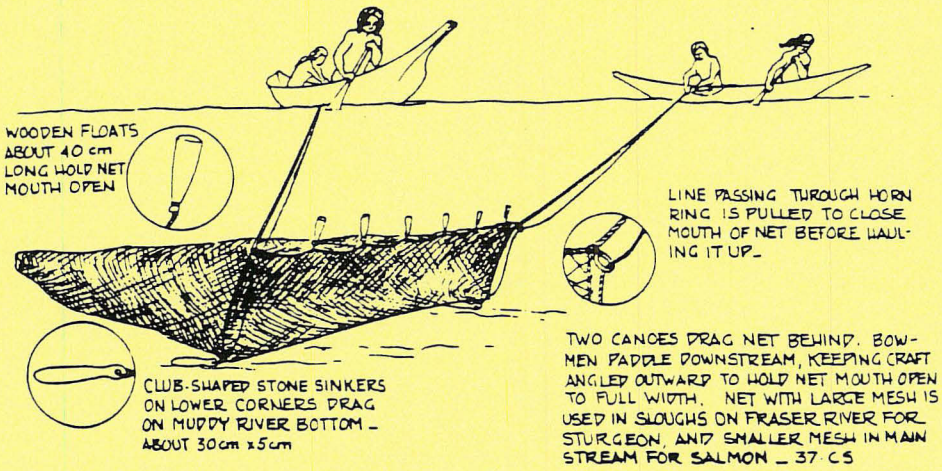

Figure 7: Drag Net

Reef Net

Like the drag net, the reef net has fallen into disuse. The gear was usually set just off shore, over a kelp-covered reef in the path of migrating salmon. The water had to be clear and calm, so that the fish could be seen as they entered the net. A channel was cut in the kelp to guide the fish towards the net. Two canoes were used, one on each side of the gear. When a watchman was satisfied that enough fish had been caught, the net sides were simultaneously lifted and the canoes were allowed to drift together. The fish were emptied into the inshore canoe.

Reef nets used in deep water were extended by an elaborate system of side and floor lines which helped to funnel the fish into the mesh structure.

Contemporary Trends

Traditional fishing gear -- i.e., the dipnet, spear, and gaff hook -- is used most extensively along salmon rivers and streams in the Interior. The bulk of the Coastal food fish catch is now taken by commercial gillnet and seine vessels, many of which are owned or operated by Native Indians.

Surplus spawners are delivered to Native groups by some hatcheries. This is accepted practice at the Big Qualicum hatchery, for examples, which makes its excess fish available to a Native organization. This organization, in turn, distributes the salmon among a number of Indian communities.

SPORTFISHING

Sportfishing is a form of outdoor recreation which, as Roderick Haig-Brown observes, "... means different things to different people." Some sport fishermen enjoy the peace and quiet of a solitary, wilderness stream or lake. Others prefer the companionship of a crowded campground. The enthusiast happily spends many hours and a good deal of money preparing himself and his gear for an activity that occupies nearly all his spare time. The casual fisherman throws his tackle into the trunk almost as an afterthought when taking his family for an outing on or near the water. While one man patiently waits at his favorite fishing spot for the fish to start biting, another must always be on the move, constantly looking for the most productive site. The variations, it seems, are endless.

The reasons why people go fishing have been investigated in numerous surveys. Haig-Brown considers five of these reasons, as follows:

a) to eat fresh fish;
b) to be outdoors;
c) to relax away from the pressures of work;
d) to be with friends;
e) to observe nature.

Noting that these and other factors are typically rated differently by the respondents in each survey, Haig-Brown underlines the "... difficulty of finding simple answers to questions that involve highly complex and variable human factors." His concern, both for the resource and for the sport, leads him to conclude that the fisherman must "... bring something more with him than a rod, a line, and a desire to kill fish."

Yet, as Haig-Brown acknowledges, all sport fishermen have in common the wish to catch fish. A sport fisherman who frequently comes home empty-handed or with only a few small specimens may have had a wonderfully relaxing time in the great outdoors, but in all likelihood he will not be satisfied. What he seeks is the challenge and thrill of catching fish. If the fish he catches are large, numerous, and inclined to fight vigorously on the end of the line, he will have what is termed a "quality fishing experience." For that experience, he will spend far more per pound of fish than any commercial fishermen would consider reasonable.

Today's sport fisherman is much more mobile than his predecessors of fifty or even thirty years ago. Given a motor-vehicle, an extensive network of highways, and the ready availability of small craft powered by outboard motor, the present-day fishing enthusiast has literally thousands of points at which he can access the resource. Widespread affluence and increased leisure time, combined with the internal combustion engine, have brought the resource within the reach of millions. BC salmon stocks are thus exposed, not only to local fishermen, but to sportsmen from all over North America.

Recent decades have seen an unprecedented growth in the number of sport fishermen. Indeed, while the number of persons involved in commercial fishing has been dropping, the number of sport fishermen continues to rise. As many as 300,000 individuals go sport fishing in B.C., as opposed to the estimated 5000 to 10000 persons who participate directly in the commercial fishing industry.

There is, however, at least one critical point of similarity between commercial and recreational fishing -- i.e., the increasing sophistication and efficiency of the gear. As recently as the 1920's, in the words of Lee Straight, "fishing tackle was poor and not very deceptive. Only the swarms of fish and the sparseness of angling pressure maintained the chances of a hookup." Trolling in those days, for example, was conducted with a coarse, natural-fibre line which ended in a wire or an unpredictable leader made of thick silkworm gut.

Nylon monofilament appeared on the market following World War II. From this material, fishermen were equipped with very fine, strong, and durable leaders. Fish were less readily alarmed, and when hooked were less likely to escape. New forms of fishing, such as stripcasting, could be done easily and skillfully. Following this, fibreglass fishing rods (strong, durable, and cheap) became available. The old fishing reels of hardwood and brass were replaced with aluminum counterparts, and literally thousands of new lures have been developed. When the increased efficiency of their gear is added to the rapid rise in the number of highly-mobile sport fisherman, it is easy to see why in some areas the sport catch of chinook and coho equals or exceeds the commercial catch of those species.

Target Species

Most of the recreational fishing in tidal waters occurs in the Strait of Georgia -- i.e., around the Gulf Islands and the bays and coves of Vancouver Island and the Lower Mainland. In tidal waters, all five species of Pacific salmon, as well as steelhead and cutthroat trout, may be taken legally by sport fishermen. Chinook and coho, however, are the principle species taken -- chinook because they are very large, and coho because they are numerous and have a reputation for fighting vigorously when hooked. Pink salmon returning to the Fraser river create intense angling interest, but mainly in odd years when they are most abundant.

Sport fishing is also popular in non-tidal waters. Most of the coastal systems on Vancouver Island and the Mainland contain steelhead and cutthroat trout, coho, and chinook salmon. Fishing for pink, chum, and sockeye is prohibited in most non-tidal waters, and coho and chinook may be taken only with sport fishing gear.

Trolling

Trolling is usually thought of as a fishing technique in which a bait or lure is towed behind a moving boat. Heavy weights (200 to 400 grams) take the hook down

to the desired depth. The device used to attract fish may be an artificial lure, such as plug or spoon. Alternatively, natural food such as herring might be used as bait. Some fishermen install a herring dodger, or "flasher," a short distance from the bait. Drop-away rigs and downrigger gurdies (see below) equipped with quick-release devices are favourites with many fishermen.

Trolling is the most popular form of salmon fishing in marine waters. Its primary advantage as a fishing technique is the action which it imparts to the bait or lure. This feature is important in the case of predatory fish, such as salmon, which prefer to actively hunt and pursue their prey. By varying the depth of his bait or lure, the fisherman is able to explore for fish at any number of different levels in the water column. Because the boat is constantly travelling, the gear searches a lot of water, increasing the chances of attracting fish. Trolling is therefore a particularly appropriate technique for contacting fish that are scattered, isolated as individuals or in small groups, or are frequently moving.

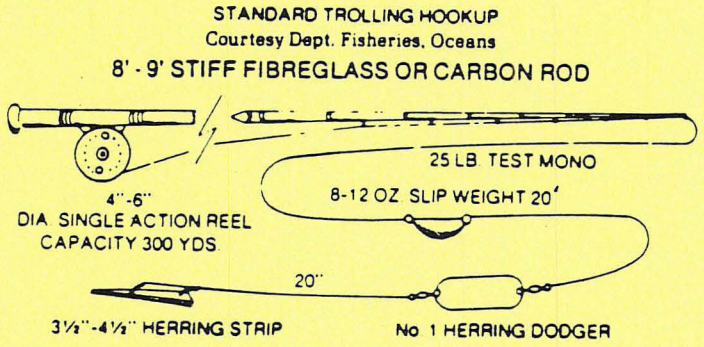

Figure 8: Sportfishing Troll Tackle

As indicated in Figure 8, troll tackle typically includes the following:

a) a stiff fibreglass or carbon rod, some 8' to 9' in length;
b) a reel, generally of the conventional revolving-spool type;
c) about 300 yards of 25 pound test monofilament line;
d) a slip weight;
e) a herring dodger; and
f) the bait or lure.

Deepwater trolling is assisted by a device known as a "downrigger." This is a large, hand-cranked spool, permanently mounted on the stern of the boat, and equipped with a special line. To this is attached a heavy (5 to 10 pounds) weight, often called a "cannonball." A short arm extends out below the spool to keep the line clear of the boat. The fisherman's regular troll line is connected to the downrigger by a clip, and is thereby held down at the desired depth. When a fish hits the hook, the angling line pulls free of the clip to prevent entanglement.

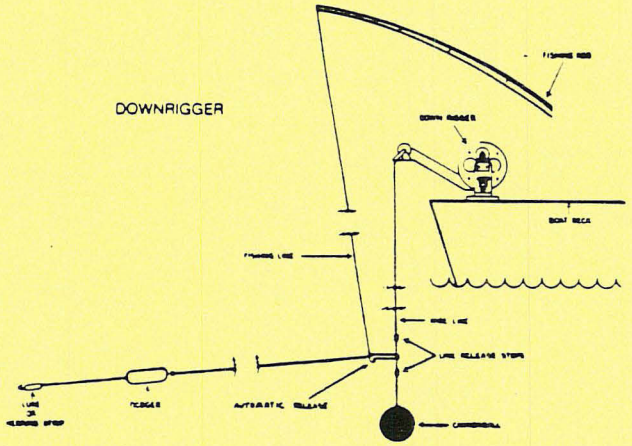

Figure 9: Boat Equipped With Downrigger

Troll fishermen frequently vary their tackle and techniques according to such factors as fish behavior, weather, and tide. Different baits or lures may be tried, as well as trolling depths ranging from the surface to a level barely above the bottom. Trolling speed also may be adjusted, as can the distance between the hook and the boat.

Mooching

Mooching is a form of trolling that is particularly popular on the Pacific Coast. In operation, it is differentiated from conventional trolling by a deliberate start-and-stop motion imparted to the bait or lure. The hook is alternately allowed to settle at the desired depth and then pulled rapidly forwards and upwards at an angle, simulating the behavior of salmon prey attempting to escape.

While some moochers prefer outboard power, others insist on rowing. Any one of three alternative procedures may be followed.

1. When the hook has sunk to the desired depth, the boat moves ahead briskly for ten or twenty feet, pauses to let the hook settle again, and then repeats the procedure. This technique repeatedly puts the hook in motion and at the same time brings it upward at an angle.

2. The fisherman makes a long cast, lets his rig settle, then retrieves the line in arm-length jerks.

3. From an anchored or drifting boat, the moocher pays out line, letting the current work his bait or lure.

Herring are the major salmon-mooching bait. Small herring may be attached whole. Larger herring are rigged as plugs -- i.e., with the head cut off at an angle behind the gills. Still bigger herring are cut into strips which flutter and spin when moved through the water.

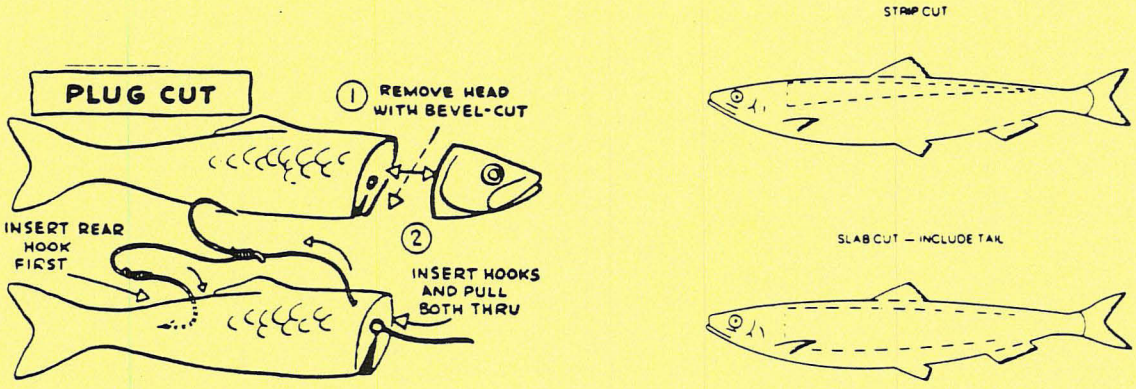

Figure 10: Plug-cut and Strip Herring

A long monofilament line (400 yards) is used, carrying sinkers with sufficient weight to ensure that the bait is about 5 metres above the bottom. The mooching rod is typically longer (9' to 12') than the average trolling rod.

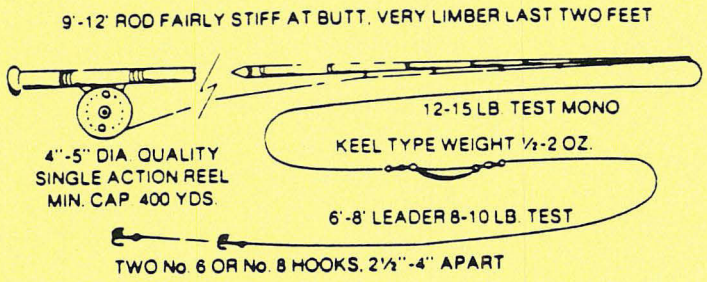

Figure 11: Standard Mooching Gear

Saltwater Fly Fishing

The fly fisherman stands on the shore or in a boat, alternately casting his lure over the water and retrieving it by means of a special rod and reel.

The few fly fishermen who seek salmon in marine waters are often hoping to catch pink or young coho. The reason is that these are easily seen, surface-feeding fish which will take flies resembling whatever they are feeding on.

A favorite among saltwater fly fishermen is the bucktail fly, which imitates the darting, erratic movements of the smaller fishes (such as minnows) on which salmon feed. The bucktail is classed as a "wet fly" -- i.e., one that is designed to attract fish below the surface. Despite the nature of the lure, bucktailing is technically considered a form of trolling rather than fly fishing.

Strip Casting

In this method, the bait and weights are cast (usually from an anchored or drifting boat) and then retrieved in quick, arm-length pulls. Strip casting requires a strong, fibreglass fly fishing rod with 300 metres of line and 10 to 75 grams of weight. The bait, as suggested by the name of the method, is herring strip.

Freshwater Fly Fishing

As indicated earlier, freshwater anglers are permitted to take steelhead, cutthroat trout, coho, and chinook salmon.

When fly fishing, the angler uses a very limber rod, equipped with a specialized form of reel, to alternately cast and retrieve his hook and line. The hook is disguised with an artificial lure which resembles the insects and small fishes upon which the he use of lines that are specially constructed to maintain casting momentum. The fly is connected to the line by a leader which is tapered to ensure that the lure will be properly presented when it meets the water. Rods, reels, lines, and flies may be matched in an almost endless variety of combinations, according to the fisherman's assessment of such factors as wind condition, footing, overhead and water obstacles, species behavior, and his own preferences and abilities.

COMMERCIAL SALMON FISHING

Commercial salmon fishing in British Columbia is based on three methods: trolling, gillnetting, and seining. Each method is characterized by a particular kind of vessel, gear, and technique. There is variation, also, in the capabilities and limitations of each method.

Trolling

In principle, commercial trolling is identical to the method used by sport fishermen. Commercial vessels, however, are much larger than the usual sport fishing boat, and are equipped differently. Some commercial trollers are over fifty feet in length. They are easily distinguished, even at a distance, by two tall poles which rise high above the mast, and two more which lie back from the bow. When the boat is fishing, these poles are dropped out and downward, carrying stainless steel lines. Reeled on power-driven spools known as "gurdies", the lines are stretched downward at a very steep angle for thirty fathoms or more by lead "cannonballs" which weigh up to 20 kilograms. Each line carries from three to seven spoons, attached by clear plastic leaders at intervals of twelve to fifteen feet. The catch is cleaned, de-headed, and glazed as soon as it is brought aboard. The larger fish are preferred, partly because they require less labour for a given weight of fish.

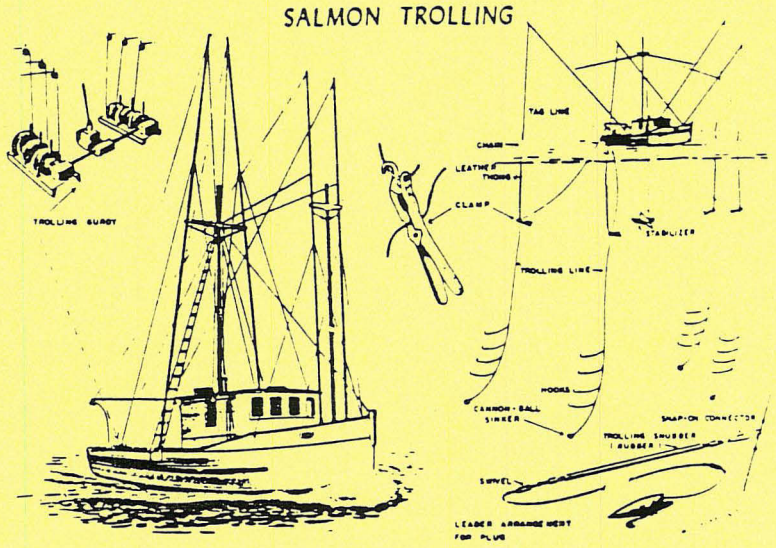

Figure 12: Pacific Coast Salmon Troller

Trollers have become bigger and their equipment has grown much more sophisticated in recent years. The bigger vessels are able to fish in heavier weather than their smaller predecessors and competitors. Moreover, modern trollers, equipped with freezer equipment, can stay out much longer than the older vessels which rely on ice alone to keep their fish fresh. Electronic equipment is used, not only in navigating, but in locating and staying on top of the fish. Once a school of salmon has been found, it is unlikely to evade the newer troll vessels.

Troll vessels fish during the daylight hours, when the lures are most visible to their quarry. When fishing, they operate at very slow speeds, and are seldom seen near the mainland. Traditionally, the commercial trolling season for chinook and coho extended from April through October. Openings for troll fisheries now are becoming more complex, and are varied from area to area.

The strength of the troll fleet is its ability to supply the market for high-quality fresh and frozen salmon. Troll-caught fish are taken on the ocean feeding grounds, in the silver-bright condition. If we had no trollers, the market for these fish would go to other suppliers.

Trollers have traditionally concentrated on taking very large chinook salmon. Their selectivity is achieved by using lures that attract this species; by fishing at depths and in areas frequented by chinook; and by returning under-size fish or representatives of unwanted species. This latter practice has been criticized by seiners and gillnetters, who claim that the fish set free are too badly damaged to survive. Most trollers now use barbless hooks, which cause less harm.

In recent years, many trollers have been taking coho, sockeye, and pink salmon, as well as chinook. Although these species bring a lower price per pound, they provide a very substantial supplement to the daily catch. The 1983 total troll catch is reported, by species, in Table 1 (taken from British Columbia Catch Statistics - 1983).

TABLE 1: 1985 TROLL CATCH BY SPECIES, IN TONNES

Chinook	4 211
Sockeye	3 373
Coho	6 710
Pink	7 692
Chum	1 666
Steelhead	18
Total	23 670

Gillnetting

Commercial gillnets work on the same principle as those employed in traditional Native fisheries. The net is hung like a curtain across the path of migrating salmon. Fish of the desired size pass their heads through the net mesh but are unable to get the rest of their bodies past the obstruction. They are caught by the gills as they struggle to back out.

By regulation, commercial gillnets must be between 135 and 375 metres (about 75 to 200 fathoms) in length and no more than 60 meshes deep. The older, linen nets could not be made too big and heavy without running considerable risk of breakage when loaded. The nylon filaments currently in use are much stronger and can therefore be made larger. Nets are available in a range of mesh sizes. This permits the operator to fish selectively, since salmon below a desired size range are able to pass through the net while those above the size range are prevented from entering it. Nets also come in a variety of shades, because different areas and times of year require certain colours to make the mesh least visible to fish.

The net is suspended vertically in the water by a "cork-line" that is held at the surface by floats, commonly known as "corks." The bottom of the net is attached to a series of weights by the "lead-line." A flag attached to a float marks the end of the net.

Gillnet vessels are usually 30 to 40 feet in length, and are manned by one or two men. Modern gillnetters are capable of somewhat greater speeds than their predecessors. Cruising speed is important in the current era of very short openings, because it bout 15 knots. With a wet net and a load of fish, the weight goes up and cruising speed is reduced. A loaded gillnetter tends to plow if opened up.

Most of today's gillnet boats are equipped with a power-driven drum which is used to pay out and retrieve the net over the stern. While the powered drum is, of course, a labour-saving device, it has also helped to reduce the time required to set and retrieve the net. Time is at a premium in an opening that may last for only a few hours.

High-speed gillnet vessels have a shallow draft, and are therefore very "cranky" when at rest in a beam sea. To counteract this problem, they are often equipped with stabilizer poles, one each side of the deckhouse. When lowered to permit operation of the stabilizing plates, these poles may appear at first glance to resemble trolling gear. They are, however, shorter than trolling poles.

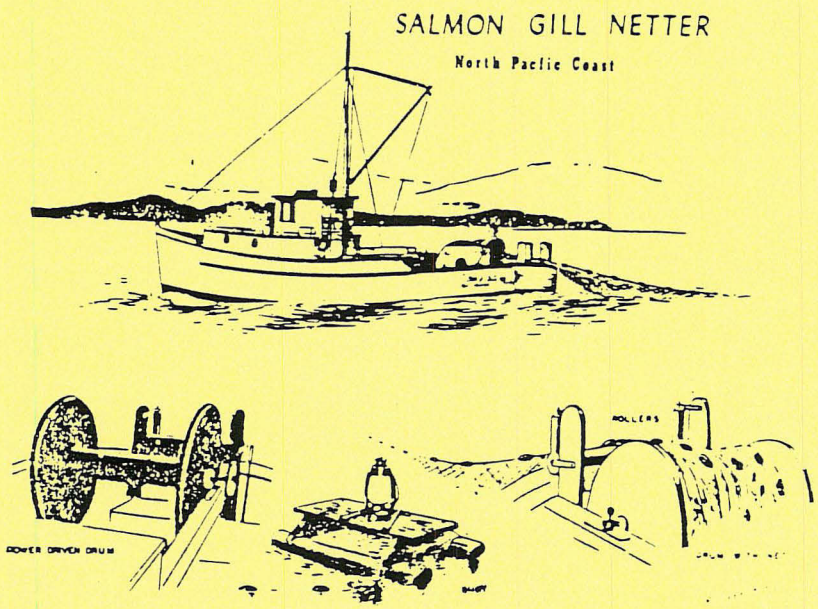

Figure 13: Typical Gillnet Operation

In a salmon gillnet operation, the net is first attached to an identification buoy, which is thrown overboard. The net is then paid off the drum, and the boat and net are allowed to drift with the current or tide. When the operator judges that enough fish have been caught, he reverses the drum to retrieve his net. The fish are shaken loose from the net as it passes over rollers mounted on the stern of the vessel.

The best fishing time for gillnetters is at night, when the net is least visible to fish. Fish which regularly move into shallow water at dusk and return to deeper locations for the day are particularly vulnerable to gillnets. The first set of the day is commonly made just before dawn, and the second at dusk. The first set of the night is usually the most productive, and some gillnetters will leave their nets in the water for an additional, late night (or early morning!) set. Gillnet fishermen in areas such as the Fraser River and Johnstone Straits will also fish during the day to take full advantage of a short opening.

A gillnet operation is susceptible to a number of hazards. Perhaps the most common problem is entanglement -- with floating or submerged logs and other debris, with the shore, with the vessel itself, and with the nets of adjacent fishermen. Debris is a typical occurrence in rivers and estuaries, although it can also be found in the ocean. Problems with the shore and with reefs occur most often when the net gets out of control as a result of unfavourable winds and tides. In shallow water, the mesh sometimes sags down and becomes tangled up with the lead line as the latter bounces along the bottom. The leadline and

mesh can also become tangled with the corkline if the net is improperly wound on the drum while being removed from the water. Difficulties such as these are of particular concern to fishery managers, because a gillnet will continue to fish as long as it is in the water. Nets, or sections of net, that are cut loose and abandoned are a continuing hazard to fish, as well as to navigation.

Gillnetters operating very close to a processing plant might deliver their catch several times daily, almost as soon as it is taken. Most, however, are unloaded only once each day. The catch is iced or covered with an insulating ice blanket to prevent it from spoiling before delivery.

Although they contribute significantly to the harvest of all salmon species, gillnets are dominant only in certain fisheries. As a rule of thumb, they are likely to be more efficient than seines when the intended catch is dispersed over a relatively wide area rather than concentrated in schools. With salmon, they find their best use inside the larger rivers or off the mouths of Coastal systems. In such locations, some species of migrating salmon tend to travel individually or in relatively small, loose-knit aggregations. Gillnets are the most productive gear on the Fraser River, and sockeye are the species most often taken. The gillnet catch tends to outweigh the seine harvest by several hundred tons in chum salmon, but is lower in chinook.

TABLE 2: 1985 GILLNET CATCH BY SPECIES, IN TONNES

Chinook	525
Sockeye	13 461
Coho	857
Pink	4 012
Chum	6 211
Steelhead	153
Total	25 219

Some vessels, known as "combination boats," are rigged for both troll and gillnet fishing. Combination boats are readily recognized by the presence of trolling poles and a gillnet drum on the same vessel. They are permitted to gillnet with trolling gear aboard, but not the other way around -- in other words, it is illegal for them to troll with a hung gillnet on board or while gillnetting.

Seining

Unlike the gillnet, which waits passively for fish to become entangled in the mesh, the commercial seine net is used to encircle and trap the quarry.

Commercial salmon seiners employ what is referred to as a "purse seine." In addition to a cork-line and lead-line, the purse seine is equipped with rings, spaced about twelve feet apart along the bottom edge. A line (appropriately known as a "purse line") runs through the rings. When the purse line is drawn in, it pulls the bottom of the net together so that fish are unable to escape by swimming downwards.

When not in use, the purse seine is carried, either on a "table" or on a drum, near the stern of the vessel. To put the net into service, the crew first lowers one end into the water. Several methods may be used to hold the outer end of the net in position:

- The early seiners used an unpowered skiff. The skiff operator keeps the end of the net in one spot while the remainder of the net is paid out.

- Because they are safer in heavy seas, powered skiffs are allowed in Area 20.

- In Johnstone Strait and other suitable coastal locations, the outer end of the net may be attached to an object on the shore. This alternative requires a sharp drop-off at or very near the beach.

- Modern seiners attach a "running line" to the outer end of the net. When this is paid out at the correct speed, it prevents the net from trailing in a straight line behind the vessel.

The vessel travels in a wide circle, paying out the rest of the net as it goes. Once the net is in position, the ends are drawn together and the purse-line is tightened as rapidly as possible to minimize the number of escaping fish. The net is then hauled aboard until the catch is massed in a small portion of net (the "bunt") held against the side of the vessel.

On some seiners, a large, mechanically-lifted dipnet (the "brailer") scoops the fish from the water and transfers them to the hold. The more modern craft have a hydraulic-powered ramp which is lowered into the water over the stern. The entire bag is brought onto the ramp and then lifted by it to the deck.

As with gillnetters, the catch must be iced to control spoilage before it is delivered to a plant or collector vessel.

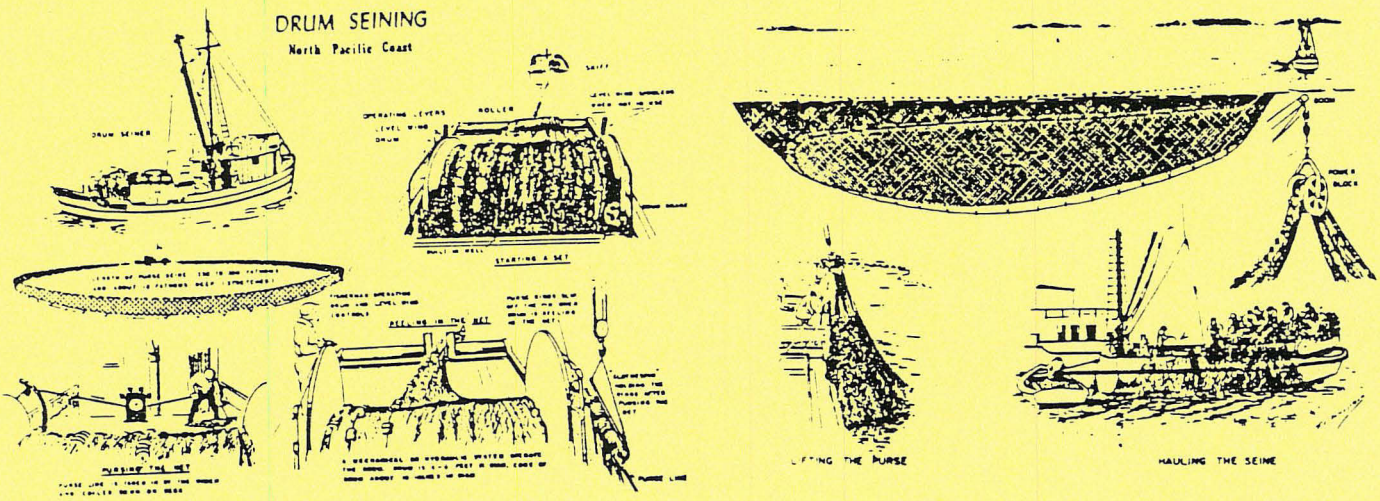

Figure 14: Purse Seine

Seine boats have increased in size over the years, and are now commonly 60 to 70 feet in length. They carry a crew of five or more. Some of the older vessels are known as "table seiners" because the net is carried on the aft deck, which acts as a sort of table. On these vessels, a power block attached to a boom is used to recover the net. With the exception of some very large boats and the US tuna fleet, table seiners have virtually disappeared from BC waters. There are no drum seiners in Alaska, because vessels in that State must be equipped with power blocks.

Table seiners have been replaced by drum seiners -- so called because the net is carried and retrieved by a very large power drum mounted near the stern. The drum makes it possible to set and retrieve a net at a speed much greater than could be achieved by the older equipment. Speed is an important feature, partly because fewer fish are able to escape the encircling net, and partly because more sets can be made with a given time period. From a drum seiner, the net can be set, hauled in, emptied, and made ready for the next operation in as little as 20 minutes.

The maximum number of fish taken in each set depends partly on the species. With pinks, the maximum catch is probably about 9000 pieces. For sockeye and other larger species, 4000 pieces would be a very good set. Average catches per set, of course, are much lower than this.

TABLE 3: 1985 SEINE CATCH, BY SPECIES, IN TONNES

Chinook	733
Sockeye	14 735
Coho	1 410
Pink	25 996
Chum	15 769
Steelhead	33
Total	58 676

Seine fishing is much more efficient than gillnetting where there are dense concentrations of fish. If we wish to make a very fast catch of schooled fish, for example, a seiner will do the job much more rapidly than will a number of gillnet vessels. On the other side of the coin, gillnets are less likely than seine gear to over-fish a migrating stock. Their catch capability is significantly lower, because large number of fish are able to under or around the net.

Of the three commercial fishing methods, seining is the least selective. Any fish within the encircling net is likely to be taken, and once the purse has been drawn tight, there is no chance of escape. The fisherman may choose to target on schools of a particular species. But if a school contains a proportion of different species, these will be taken as "incidental catch." Even the smaller fish, which might pass through the mesh, suffer scale damage.

The non-selectivity of seine gear is useful when we want to sample a run. This gear is the most likely to yield a representative sample, since all ages, and both sexes have an equal change of being included in the catch.

In a seine operation , the net will often be set in such a way that the circle is curved inwards against the direction in which fish are travelling. In this way, the fish are caught within the encircling net, rather than diverted around it. You can often judge the way a run is moving by the way in which seine nets are being set. Seines are typically most effective on a flood tide, because inward-migrating salmon prefer not to swim against an ebb tide.

Interruptions to the operation can result from mechanical failures or from problems with the net. Wind and tide sometimes cause the net to drift before the vessel has "made the turn" preparatory to completing its encirclement. Certain tide combinations can also cause the net to roll up into an incredible tangle which might take the crew an entire day to unravel. Contact with obstacles such as reefs, rocks, and the shore can prevent the net from being pursed up, and might even result in the vessel running aground. Seiners generally fish in daylight, because the skipper and crew must be able to see what they are doing. An experienced crew on a small seiner, however, is able to fish at night if the rewards justify the risk.

Ocean Transport

One of the major concerns of any fishing industry is to return the product to shore in the best possible condition. In the early days, most BC fishing boats were small. Powered by oar and sail, they were obliged to deliver their catch to the processors on a daily basis to minimize spoilage. Since there were very definite limits to the distance a boat could travel in a single day, canneries were built close to the fishing grounds, at numerous locations along the coast.

The advent of the internal combustion engine made it possible for boats to travel further from the cannery. In addition, vessels became larger and capable of carrying ice which could be used to keep the catch chilled until it could be delivered to the plant. Vessels carrying ice could travel further and stay out

longer than ever before. Even today, some seiners and a few gillnetters are equipped to chill and transport their own catch.

The next major development was the appearance of the packer -- essentially, a small freighter equipped to collect and temporarily preserve the catch from a number of fishboats. Packers service fishermen up and down the coast, saving the fisherman valuable travel time between the fishery and the processing plant. The early packers lacked proper facilities for icing a large cargo. Over the years, however, ice became much easier to produce and obtain. By the 1950's packers capable of carrying 50,000 to 100,000 pounds of fish were common.

Packer technology took a large step forwarfd in the late 1950's, with the discovery that fish stored in iced sea water keep their quality better than those preserved in ice alone. Iced seawater offers three main advantages, as follows.

1. The holding temperature can be lowered several degress below that of melting ice water without freezing the fish.

2. Fish suspended in iced sea water are not subject to crushing.

3. Loading the catch into and out of the tanks is simpler and less labour-intensive than packing the fish in ice.

About fifty percent of today's packers (aptly termed, "champagne boats") are now fitted with equipment which keeps the brine bubbling and the fish in even better condition.

Although both serve the same function, a distinction is commonly made between collectors and packers. Collectors are small (37 to 50 feet in length), so that they can get easily into tight spots and and alongside gillnetters. Packers are usually bigger (50 to 130 feet in length), and can handle fish from collectors, large seiners, and the occasional gillnet vessel.

Some fisheries are serviced by land-based or barge camps. The catch delivered to these camps is kept in ice until it can be picked up by a packer. Fishermen are credited for their catch, and are able to buy groceries, fuel, and other necessities from the camp.

Fishing as a Business

In popular mythology, the fisherman is a hardy, independent soul who operates and repairs a boat that has been in his family for generations. His catch is brought home and sold to local housewives and perhaps to some kind of fish market. His living is made, by a combination of skill, hard work, and good luck, from a resource that is free for the taking and accessible to all. His greatest struggles are with nature, notably the sea and the weather.

The myths are still not too far from reality in some respects. Today's fishermen very often is a hardy, independent person who is skipper, deckhand,

engineer, mechanic, and general jack-of-all-trades. Skill, hard work, knowledge of the sea, and good luck still count for much.

However, the myth is misleading in three critical respects.

1. Only a few fishermen operate without borrowed capital. Even in the early days of the industry, when boats were powered by oar and sail, many fishermen were unable to raise the purchase price of a vessel. Since then, of course, vessels have become bigger, more mechanized, and much more expensive. Moreover, since the catch is not paid for until it has been caught, most fishermen require financing to support themselves and their crew during the early part of the fishing season. Like most businessmen, today's fishermen typically utilizes credit to maintain his cash flow.

2. Only a very small proportion of the catch is sold directly to householders and the local trade. The overwhelming bulk of the fish taken by the commercial fleet is purchased by processing companines who, in turn, compete on the national and international markets.

3. The ocean provides something far less than a limitless supply of fish. For many decades, there have not been enough fish to keep everyone in business. For almost two decades, it has been estimated that less than half of the existing salmon fleet could take all of the available catch. The situation is even worse in years of weak salmon runs.

Escalating costs of operation, the pressures of financing and cash flow, the vargaries of the international fish market, and intense competition for the available resources are everyday facts of life with which the typical fisherman has to live. To cover his costs (for fuel, maintenance, labour, and so on) he must modernize his vessel -- often at the price of borrowing heavily in an inflationary money market. To make his payments and stay in business, he has to catch at least a minimum number of fish. If the market is depressed, prices will be low and he has to catch even more fish to stay afloat. And since fish are in limited supply, he may not be allowed to increase his catch. Thus, although it is true that some fishermen do have very substantial earnings (particularly in the good years), it is equally true that a number are forced out of business every season. When prices are down or fishing is closed because of small runs, bankruptcies increase.

To ensure their supply of fish, the processing companies offer the fisherman a range of attractive services. In the early days, these services began with credit -- towards a grub stake and the purchase of a boat. As the industry became more sophisticated, some companies began to buy fishing vessels and then leased them to fishermen. They also provided a fleet of packers and collector vessels, and they maintained fishing camps so that fishermen need not return as frequently to shore. The other services which provided by the companies are:

- radio networks which supply up-to-date fishing and weather information;
- net lofts, which supply new nets and maintain those already in use;
- assistance in making mechanical repairs.

The fisherman who avails himself of these services has the backing of a large enterprise with years of experience in the industry. He is guaranteed a minimum price for his catch, and in most cases can expect a bonus above the minimum. In return, he agrees to sell his fish to the company.

Distinct from companies offering such services are the cash buyers. These individuals travel from fishery to fishery, buying directly from the fleet and selling again to the highest bidder. Their business is strictly cash-and-carry; although they pay a higher price than the packing companies, they accept no responsibilities other than immediate payment. The fisherman who regularly sells his catch to cash buyers is strictly on his own.

Industry Organization

Over the years, fishermen, their crews, and shore workers have created a number of labour organizations to represent them in dealing with the processing plants. Prominent among these are the United Fishermen and Allied Workers' Union and the Native Brotherhood of BC. Historically, labour organizations in the fishing industry have taken a keen interest in issues involving resource conservation and utilization. On the other side of the ledger, they do have the power to practically shut down the industry should negotiations fail.

Several fishermen's cooperatives have also emerged. These enterprises typically process and/or market the catch delivered by their members. Ownership is commonly purchased by members from their share of the cooperative's income.

Also representing fishermen are several vessel owner's associations. Typically, these organizations do not become involved in labour relations. Their primary objectives are to identify common problems and to formulate solutions. They will often represent their members at public hearings or through direct lobbying in Ottawa.

Fish processors, in turn, are represented by the Fisheries Association of BC. This association negotiates prices for fish as well as wage agreements for paid employees. It also exerts influence in matters of fisheries jurisdiction and management.

The history of the packing industry is a topic of considerable complexity. When vessels became larger, faster, and capable of preserving their catch for longer periods, many canneries at remote Coastal locations became redundant. Operational logistics, such as the supply of labour and materials, favoured plants located in major communities such as Vancouver and Prince Rupert. At the same time, competition between companies in an uncertain world market eliminated many. Over the years, dozens of plants have been shut down, and others purchased by the surviving companies. Today, a medium-sized packing company

typically services some fifty seine vessels and perhaps 150 gillnetters. Fish processing in BC is dominated by fewer than ten firms. One company alone (BC Packers) absorbs 40 to 50 percent of the catch.

The Fleet

At the end of November, 1986, the Pacific commercial salmon fleet consisted of 1084 troll vessels, 737 gillnetters, and 546 seiners.

Some of these vessels operate for only a few weeks annually, and none is used at anywhere near its full capacity. This situation is by no means new. Over the last several decades, it has prompted the participation of fishermen, processing companies, and government in several very serious attempts to solve the problem of excess fleet capability.

One such attempt is a licencing program which restricts the number and size of vessels permitted to participate in salmon fishing. In the short-term, licencing may not have been as effective as its originators hoped. The early licencing program permitted vessel owners to combine the tonnage of several small boats in order to licence a larger craft. As soon as licencing restrictions were introduced, any boat carrying a licence became valuable for its licence alone -- no matter what its size, age, or condition. A great many boats that had been long tied up or beached were discovered, licenced, and once more officially retired, their tonnage being combined to licence larger craft. Combining of licences is no longer permitted, and in the end, the number of vessels has dropped drastically. However, since many of the remaining boats are much larger and more efficient than their predecessors, the catch capability of the fleet may not have been materially reduced.

The Department's second response to excess fleet capability has taken the form of buy-back programs. In a buy-back program, the government purchases vessels from owners who wish to retire their boats from the industry. In theory, this should make it easier for those fishermen who wish to seek a living elsewhere. It should have the added advantage of reducing the size and catch capability of the fleet. Again, however, several unexpected effects occurred. Firstly, vessels that were retired from one fishery sometimes found their way back into non-licenced fisheries. A salmon vessel, for example, might at one time be bought by the government, sold at auction, and then turn up in the herring fishery. When restricted entry licencing was eventually applied to herring the same vessel could acquire a new licence and remain in service. The second major difficulty with buy-back programs is that the vessels being retired are typically the smaller, older, and least efficient vessels. Since the larger, faster, and better-equipped vessels remain in service, the reduction in fleet catch capability may not be sufficient to ease fishing pressure on the available stocks.

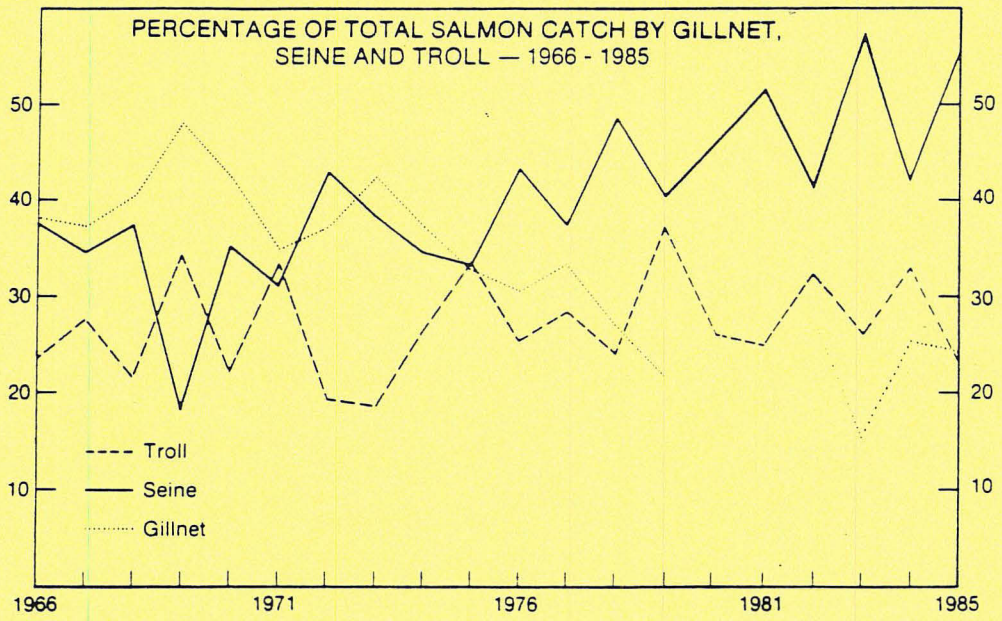

Figure 15: Percentage of Salmon Catch, by Gear, for 1966 - 1985

FURTHER REFERENCES

Useful references include the following.

1. Indian Fishing Early Methods of the Northwest Coast, by Hilary Stewart, J.J. Douglas Ltd. Vancouver, 1977.

   Contains numerous excellent illustrations, as well as detailed descriptions of Native gear, its construction, and its use.

2. Bright Waters, Bright Fish, by Roderick Haig-Brown, Douglas & McIntyre. Vancouver, 1980.

   Written by one of the world's most respected proponents of sport fishing, this book provides a lucid examination of the sport fisherman's values, traditions, standards, ethics and responsibilities to the resource.

3. The Fishermen's Sourcebook, by Bill Wisner, MacMillan Publishing Co., Inc., 1983.

   This excellent reference offers an exhaustive review of the major sport fishing gear, techniques, and applications.

4. Principles for Handling Salmon on Freezer Vessels, by C. Ann Davies, Department of Fisheries and Oceans, 1980

5. Turning the Tide A New Policy for Canada's Pacific Fisheries, by P.H. Pearse, Commissioner, 1982.

GLOSSARY OF COMMON FISHING TERMS

The following definitions reflect common usage only, and may not be suitable for technical, scientific, or legal communication. More precise definitions are given for some of these terms in the relevant Regulations.

ANGLING	Sport fishing with a hook and line.
BEACH SEINE	Seine net which is set so as to encircle an area of water bounded on one side by the shore.
BRAILER	In purse seining, the large, power-lifted dipnet by which fish are scooped from the seine and deposited on board.
BUCKTAIL	Wet fly, used by sport fishermen, which imitates the darting, erratic movement of the small fishes on which salmon feed.
BUNT	In a purse seining operation, the small portion of the net in which fish are collected just prior to their being brought aboard.
CANNONBALL	Very heavy sinker, used in sport and commercial trolling to ensure that the bait or lure remains at the selected depth.
CASH BUYERS	Commercial fish buyers who travel from fishery to fishery, purchasing fish directly from the fleet and selling it to the highest bidder.
CHAMPAGNE BOAT	Packer fitted with equipment which keeps the catch in bubbling iced seawater.
COLLECTOR	Small freighter, equipped to collect and temporarily preserve fish while transporting the catch from the fishery to a processing plant; commonly services gillnet vessels.
COMBINATION	A commercial vessel that is rigged to fish from either of two types of gear -- e.g., gillnet and troll.
CORKS	Floats, nowadays usually made of plastic or other man-made material, which are used to support the top of a gillnet or seine net in the water.
CORK-LINE	The line which connects the corks together.

DIPNET	1. A hand-held net used by food fishermen to catch and scoop salmon from a river. 2. A hand net used by sport fishermen to bring a hooked fish on board.
DOWNRIGGER	A large, hand-cranked spool, permanently mounted on the stern, equipped with a special line at the end of which is a sinker; used in sport fishing to control the depth of the bait or lure.
DRUM SEINER	Commercial purse seine vessel, equipped with a very large, powered drum on which the net is stored, paye* out, and retrieved.
DRY FLY	Artificial lure, resembling insect or small fish, which is used by anglers to attract fish at or just above the water surface.
GAFF	A large hook, fastened to the end of a pole and jerked upwards to impale the fish; used by food fishermen.
GILLNET	A form of entrapment net, in which fish are caught by the gills as they attempt to swim through the mesh.
GURDIES	Large spool on which fishing line is wound; operated by hand in sport fishing, and by power in commercial trolling.
JIGGING	Angling method in which the hook is alternately bounced and allowed to rest at or near the bottom.
LEAD-LINE	Line connecting the weights by which the bottom of a gillnet or seine net is held down in the water.
LEISTER SPEAR	Food fishing spear by which the fish is caught between two barbed prongs.
MOOCHING	Form of trolling, in which the bait or lure is alternately allowed to rest and then drawn rapidly forward.
PURSE-LINE	Line, installed through rings at the bottom of the net, which draws the bottom of a purse seine together, hereby preventing the downward escape of the catch.
PURSE SEINE	A net which is used to encircle fish, and is then drawn together by a line through rings along the bottom to prevent downward escape.
STRIP HERRING	Strips of herring, cut from the back of the fish and used by sport fishermen.

TABLE SEINER	Older type of purse seine vessel, equipped with a net "table" on the aft deck and a power block for retrieving the net.
TROLLING	Fishing method in which the bait or lure is drawn through the water by a boat.
WET FLY	Artificial lure, resembling food organism, which is used by anglers to attract fish below the water surface.

FIELD SERVICES STAFF DEVELOPMENT MANUAL

VOLUME 1: THE PACIFIC SALMON

BOOKLET 5: SALMON MANAGEMENT

Prepared for the Field Services Branch

Training and Career Development Office

Pacific Region

Department of Fisheries and Oceans

March, 1987

TABLE OF CONTENTS

ABOUT THIS BOOKLET

Imagine for a few moments a bright, sunny morning in a Coastal Sub-district during the first net opening of the salmon season. Spread over the waters of the nearby ocean, several hundred gillnetters and seine vessels are busy at the harvest for which they have waited all winter. A patrol vessel stands off to one side, and a smaller DFO boat passes among the fleet. The radio crackles with words of a seemingly foreign language. There are telephone calls to and from the District Office, the adjacent Sub-districts, and occasionally the Division Office. All day long vehicles come and go, there are hurried conferences, and decisions are announced. As the day slips by, the exhilaration of the early morning settles down to a more sober mood, and tempers occasionally flare. The air nevertheless remains vibrant with the knowledge that something vital and important is going on. Despite the tension, the inter-personal conflicts, and the long hours, a commercial salmon fishery is probably one of the most intensely exciting events most of us will ever witness in this part of the world.

Yet, if a salmon fishery is exciting, it can also be confusing to the point of appearing chaotic -- particularly to those of us who are new to salmon management or who participate from a peripheral position. For people who are not "in the know", it is difficult to connect the events taking place around them with last year's stream inspections, the subsequent paperwork, and the series of meetings that precede the season. In the absence of a more general frame of reference, it is very easy to feel overwhelmed by a sense of personal inadequacy in the face of chaos.

We hope that this booklet will be of benefit to new Fishery Officers, clerical staff, patrolmen, technicians, ship's crews, fishermen -- and indeed, to anyone who sometimes finds himself bewildered by the mysteries of a busy salmon season. The booklet presents a model which will help such persons make sense out of what they see going on around them.

Those who are familiar with salmon management will find that we have necessarily simplified a great many complex issues. Our account of salmon management is emphatically not intended to be a properly academic treatment of the subject.

The definition of salmon management itself requires a few words of explanation. Taking a broad view of things, it could be argued that the term should be applied to all those activities which support the salmon resource -- including, for example, enforcement, licencing, and habitat management. In this booklet, we have adopted a perspective which is more restricted, but which is also more consistent with current Departmental conventions. The subject, for our purposes here, is confined to the decision-making and planning processes directly involved in ensuring that the resource is managed wisely.

For those who might expect catch and escapement monitoring to be included in a treatment of salmon management, we would like to call attention to Booklet 6: Salmon Data Collection and Recording. The fieldwork involved in salmon management is excluded from Booklet 5, partly to permit a more uncluttered discussion and partly to control the length of the presentation.

Learning Objectives

Readers who would like a more formal account of what they can expect to learn from this booklet are encouraged to consider carefully the learning objectives listed below.

Persons who master the information presented in this booklet will be able to do the following things.

1. Identify the competing biological and non-biological values that are commonly considered in establishing the overall objective of salmon management.

2. Compare the advantages and disadvantages of the fixed escapement strategy.

3. Outline the relationship between fisheries objectives, strategies, tactics, and mechanics.

4. Identify the major phases in the annual salmon planning cycle.

5. Given historical catch, escapement, and age composition statistics, calculate the average ratio of return and the predicted return for a salmon stock.

6. Describe briefly how observations about over-wintering and other losses might influence the return prediction.

7. Describe in general terms the use of current-year catch and escapement data to make in-season amendments to a salmon management plan.

8. Explain briefly the rationale for the salmon planning review process.

SALMON MANAGEMENT OBJECTIVES, STRATEGIES, AND TACTICS

This section of the booklet is concerned with what many people might be inclined to dismiss as "mere" theory -- i.e., theory that appears to be completely ignored by those of us who are caught up each year in the excitement and turbulence of a "real world" salmon fishery. For the benefit of the men and women who remain contemptuous of theory, we would like to underline the observation that appearances are often deceiving. Theory is not idealism. Rather, it is a deliberate attempt to clarify and organize the objectives and assumptions which, consciously or unwittingly, underlie our decisions. Theory is thus a valuable tool for reducing confusion, conflict, and errors.

Rationale for Fishery Management

As a matter of contemporary public policy, the management of any renewable resource is commonly considered to be largely a matter of ensuring that utilization is limited to 'surplus' production -- i.e., production exceeding that required for the continuance of the resource.

The general goal of most resource management is typically stated in terms of maintaining the yield, or harvest, that can be taken on a sustained basis from a given environment. This goal is commonly applied to the management of forest, rangeland, and wildlife resources, as well as to fisheries.

In fisheries management, we assume that without government regulation fishermen would sooner or later deplete the resource. There are many examples of this happening, not only in other parts of the world, but throughout Canada. It does not seem realistic to expect that fishermen will voluntarily cooperate among themselves to conserve the resource.

Furthermore, without some form of government direction, fishermen seem incapable of conducting the harvest in an orderly manner. They over-fish some stocks while leaving others under-utilized. In the process, they bicker over fishing privileges, and come close to armed conflict over the use of a limited resource. While they may not exactly welcome government regulation, few fishermen would be willing to get along without it.

To the general public, conservation and orderly harvesting of the resource are thus the two primary justifications for fishery management.

Scarcity as an Indicator of the Need for Management Action

How do we know when we're doing a good job Well, historically mankind has come at this in a negative way. As the fish start getting fewer, smaller, and harder to catch, it becomes apparent that an area has been over-fished. When this happens, fishermen must either work harder for longer hours or pull out to exploit more distant waters.

Crude as this approach is, it is still an indisputable indicator of the need for management action. Harvesting of the Pacific herring was curtailed in the late 1960's, for example, when it became apparent that the fish were no longer available. Even today, we have numerous examples in which local stocks of salmon have virtually disappeared within the last decade. No doubt we're working hard to improve our knowledge and management of these resources. This doesn't change the fact that stock depletion is still the final, last-ditch indicator of a management problem -- one that cannot be ignored or disputed.

In economic terms, the main objection to this indicator is that it occurs after the damage has been done. Utilization of an endangered resource often must be discontinued for some years before stocks recover. This causes disruptions in fishing activity -- disruptions that are costly and annoying to commercial, sport, and food fishermen alike. If protective measures do not work, the stock may be harvested to extinction, and the resource lost forever. Since these results are not acceptable, we need other sources of information with which to manage fisheries.

Long-term Population Monitoring

For many fish species, managers commonly attempt to keep track of changes in the age, sex, and size composition of stocks that are exposed to fishing pressure. Changes in these characteristics are used as indicators of the effects which harvesting or natural events might be having. If it appears that the number of mature fish is dropping below a level required to maintain reproductive levels, for instance, fishing might be restricted. Restrictive action may be particularly urgent if the number of juvenile fish is also declining.

Long-term population monitoring, although important, is not sufficient in the case of the Pacific salmon. Salmon are comparatively short-lived, and are extremely vulnerable to over-fishing during the spawning migration. If we were to rely solely on long-term population trends for salmon management, we would find stocks disappearing before effective action could be taken.

The Salmonid Life Cycle as a Basis for Stock Management

The key to the management of the Pacific salmon is found in the salmonid life cycle.

Suppose that, from the eggs deposited by a single pair of spawning salmon, four fish reach maturity -- two male and two female. If one of each sex were caught by fishermen, the remaining pair would be left to repeat the cycle. Provided all other factors were held constant, this process could go on indefinitely; from every return, we could allow fishermen to take one pair and leave the other to perpetuate our imaginary stock.

Although in the real world things are much more complicated than this model suggests, it remains the central concept adopted in the management of the Pacific salmon. From the total return, we subtract the number of spawning fish required to maintain the stock at a desired level. The remainder are treated as a surplus that may be taken by fishermen. This notion is often written as a formula, thus:

Total return - escapement = catch.

Yield (Catch) as a Salmon Management Objective

Suppose that you are responsible for the management of a particular salmon stock. Each year you attempt to hold back, from the fishermen, a spawning escapement that will sustain future returns at a desired level. Notice those two words, "desired level". In order to know how many spawning fish to withhold, you would have to decide how large a return you are aiming for. Should it be the largest return possible from this stock, or should it be some lesser number?

In fishery management, this question has been answered traditionally in terms of two key objectives, as described below. Both of these objectives have been subjected to much debate and have inherent flaws. An excellent overview is provided by P.A. Larkin in his article, "An Epitaph for the Concept of Maximum Sustained Yield" (see the List of Further References).

1. The Maximum Sustained Yield (MSY) is the largest average catch that can be taken continuously from a stock under existing environmental conditions. For species with a fluctuating recruitment, the maximum might be obtained by taking fewer fish in some years than in others. The terms, "Maximum Equilibrium Catch" (MEC) and "Sustainable Catch" are sometimes used to mean the same thing.

   The concept of MSY was probably the first management goal to be formally articulated for the Pacific salmon. It was widely accepted by salmon managers and, over time, by fishermen.

2. MSY is theoretically sound when applied to the maintenance of a single, isolated stock. In practice, however, the concept is difficult to use, since it fails to take into account a variety of competing biological, economic, and administrative values which challenge the desirability of taking the maximum sustained yield from stocks of Pacific salmon. MSY has been replaced by a more flexible objective known as the Optimum Sustained Yield (OSY)

   OSY has been defined formally as "a deliberate melding of biological, economic, social, and political values designed to produce the maximum benefit to society from stocks that are sought for human use, taking into account the effect of harvesting on dependent or associated species." The

key word in this definition is the term, "melding." Over the next few pages, we shall take a brief detour to consider the biological and non-biological values which are brought to bear in contemporary salmon management.

Additional Biological Concerns

So far, we have looked primarily at the question of preventing over-fishing -- or, from the other side of the coin, of maintaining the best possible yield. As you are no doubt aware, fishery management must be concerned also with a variety of other biological problems.

1. Take, for a start, the question of whether we should permit juvenile fish to be harvested. Harvesting juveniles will deprive a stock of reproductive potential. In addition, the utilization of juvenile fish yields a lower rate of production than does the harvest of mature specimens. Minimum size restrictions are intended to deal with this problem, on the assumption that the juvenile fish we wish to protect will, on the whole, be smaller than mature specimens.

2. Salmon are particularly vulnerable to fishing during spawning or on their way to the spawning grounds. During the spawning season, salmon tend to school and to follow known migration routes, often into shallower water. They are also less alert and less likely to avoid predators. Some of our regulations are necessary to protect fish at these times.

3. Some of the most perplexing problems occur in the management of what are often referred to as 'mixed stock fisheries'. A mixed stock fishery is based on a salmon run which contains either (a) fish of the same species from several spawning systems or (b) fish of different species which originated from the same stream. Thus, a mixed run may contain several species and stocks of salmon.

It is extremely difficult to protect weaker stocks when they occur in mixed fisheries. Suppose, for example, that a run consisting of two stocks -- Stock A and Stock B. Stock A returns at 3:1, which might allow two-thirds of the run to be harvested. Stock B returns at 4:1, and can withstand a 75 percent harvest rate. If we tried to maximize the harvest from Stock B, we would be over-fishing Stock A. Alternatively, if we restrict harvesting to a level that will not damage Stock A, then Stock B will be under-utilized.

The obvious solution would be to insist that each stock be fished after it has separated from the main run -- i.e., in or very near its spawning stream. (Incidentally, in case you should run across the term, fisheries of this kind are known as "terminal fisheries"). In this way, we would be able to monitor the escapement and control the harvest of individual stocks.

In practice, terminal fisheries are seldom used, largely because our fishing industry is equipped and accustomed to taking fish while they are in or near the

ocean, where most stocks are of better quality. Salmon taken in the Johnstone Straits interception fishery, for example, are more valuable and eagerly sought than the same fish taken several weeks later when they have entered the Fraser.

We generally want each salmon to grow until it approaches the point at which it begins to deteriorate on its way to the spawning ground. Mixed stocks make this difficult to achieve, because the rate of deterioration varies from one species to another. ishery will have begun to drop in quality.

The difficulties are equally severe in fisheries based on a mixture of cultured and natural stocks. Cultured stocks can be maintained with very few spawning fish, and can be exploited more heavily than natural stocks. If natural stocks are mixed in the same run, they will probably be harvested at the same rate as cultured fish, even though they require a stronger escapement. This is a frequent problem, to which we have not yet found a satisfactory solution.

Non-biological Factors Which Influence Salmon Management

1. You will often hear fishermen and fishery managers talking about gear conflicts. In effect, these are most readily apparent as conflicts between fishermen. Seine fishermen, for example, sometimes argue that gillnetters will break up schools of salmon, thus reducing their catch. They are also anxious to avoid the possibility that a drifting gillnetter might run afoul of a seine net tied to the beach or controlled by a running line. Gillnetters, for their part, are often fearful that seiners will take a disproportionate share of the available fish. For these, and other related reasons, gillnetters and seiners are usually separated, if possible, to minimize disruptive interactions between the two gear types.

2. A good deal of public attention has been directed towards the international implications of salmon fishing. Alaskan fishermen are the first to harvest salmon returning to more southern waters. Until recently, southeast Alaska typically got about 80 percent of its chinook catch by intercepting fish destined for British Columbia, Washington, and Oregon. American fishermen in the Strait of Juan de Fuca also catch a large percentage of sockeye, pink, and other salmon travelling towards the Fraser River. Conversely, BC fishermen north of the Queen Charlotte Islands capture pink salmon returning to Alaska, and over fifty percent of the chinook and coho taken off the west coast of Vancouver Island are bound for Oregon and Washington.

3. Conflicts, of course, are not confined to the industrial sector. The Department is subject to competing pressures from commercial, food, and sport fishermen, all of whom insist that what they regard as a fair share of the resource be reserved for them. The Department is often asked to ensure, not only enough fish for reproduction and sustained yield, but also:

   a. that commercial fishing vessels leave enough for other fishermen closer to the spawning systems;

b. that sportsmen have something to catch and do not interfere with commercial operations;
c. that food fishermen, some of whom are many miles inland, also have enough fish to satisfy their requirements.

4. Fishermen tend to mass on fisheries which are predicted to have the most production. If this were allowed, some stocks would be over-fished while others remain under-exploited. The idea is to disperse the fleet, so that everyone gets a fair chance and the fish are harvested in an orderly manner. Openings in an under-utilized area often have to be advanced to draw fishermen from other areas that are in danger of being over-fished.

5. The industry's storage and processing capacity also must be taken into consideration. Cold storage facilities allow processing to be delayed for a somewhat longer period than was possible in the early days of the industry. Nevertheless, even our present facilities can be over-loaded if an exceptionally heavy run is harvested rapidly.

6. The Department's management capability also must be considered in the development of a harvesting plan. Some Sub-districts do not have sufficient manpower to control the fisheries within their jurisdiction. As a consequence, it is often necessary to move staff from fishery to fishery within each District.

Alternative Management Strategies

Three main strategies may be used to achieve fisheries objectives, whether these be expressed in terms of MSY or OSY. Each strategy differs from the others in implementation, yield, cost, and contribution to biological knowledge.

1. A "fixed escapement" strategy requires the establishment of a constant escapement target, referred to as the optimum escapement. This is the escapement which, on the average, over time will yield the maximum catch -- defined as the total returning run minus the escapement requirement.

   In comparison with the other two strategies, this approach gives the highest yield. However, it also produces the highest fluctuation in catches, because of the variability in survival rates.

   This strategy has a second disadvantage: if a fixed escapement target is consistently achieved, we have no way of knowing that it is, indeed, the best escapement; it provides no new knowledge. To apply this strategy with confidence, we would have to know that the optimum escapement has been determined by many years of experimentation with different escapements.

2. A "fixed catch" strategy involves the establishment of a stable catch, referred to as a "quota" or "total allowable catch."

The major advantage of this approach is that it yields a constant catch. However, it also tends to give the lowest catch, because the harvest must be set at a low level to ensure adequate escapements. It likewise results in the highest variability in escapement.

The fixed catch strategy should not be confused with the catch ceilings currently being applied to troll-caught chinook. Chinook catch ceilings specify only the maximum number of fish that may be taken within a given period; they do not indicate the number of fish that will be available for harvest.

3. A "fixed harvest rate" strategy requires that a constant portion of the run be removed as catch. The catch is less variable than with the fixed escapement approach, but more variable than when the catch is fixed. At least some fishing is allowed each and every year, regardless of run size. If the fixed rate is set below that determined in the MSY method, the population will stabilize at an optimum escapement level.

Of the three strategies outlined above, the first is most strongly associated with salmon management. This approach has been applied successfully, for example, by the Pacific Salmon Fisheries Commission and to the management of Skeena, Nass, and Smith Inlet sockeye.

It must be remembered, however, that in practice the escapement objectives for many stocks should be regarded as interim targets, since optimum escapements are extremely difficult to determine. When a target escapement has been achieved and evaluated for several cycles, it can be adjusted upwards. This process results in a controlled program of stock re-building, and eventually indicates the level at which the optimum escapement should be set.

Tactics

Tactics support the fixed escapement strategy by controlling the catch. Four main factors are manipulated:

- duration of fishing;
- area of fishing;
- number of participants in the fishery;
- type of gear that may be used.

Mechanics

By mechanics, we mean the employment and enforcement of tactics -- e.g., control over the number of days that fishing is permitted in a given area by a set number of vessels. Mechanics are provided through legislative authority. Violation of that authority is a criminal offense.

Summary

Figure 1 summarizes the relationship between fisheries objectives, strategies, tactics, and mechanics. In current practice, the broad objective of Optimum Sustained Yield involves a "melding" of biological and non-biological values to produce the maximus supported by tactics which control the catch through the manipulation of fishing times, areas, gear, and pressure. Legislative authority is applied, through enforcement action, to ensure that salmon management tactics are respected by fishermen.

MECHANICS	TACTIC	STRATEGY	OBJECTIVE
Use the Enforcement of tactics	Fishing duration Area fished Number of vessels Gear type	Fixed Escapement (Optimum)	Optimum or Maximum Sustained Yield

Figure 1: Relationship Between Salmon Management Objectives, Strategies, Tactics, and Mechanics

AN OVERVIEW OF THE SALMON MANAGEMENT PROCESS

From the foregoing discussion, it is clear that salmon management involves a good deal more than the regulatory activities which are so prominent during the fishing season. In fact, salmon management consists of a very complex series of planning, directing and controlling activities, conducted at key points throughout the year.

Example of a Typical Salmon Management Plan

The following example, taken from a salmon net fishery in Area 23, demonstrates generally how the system works.

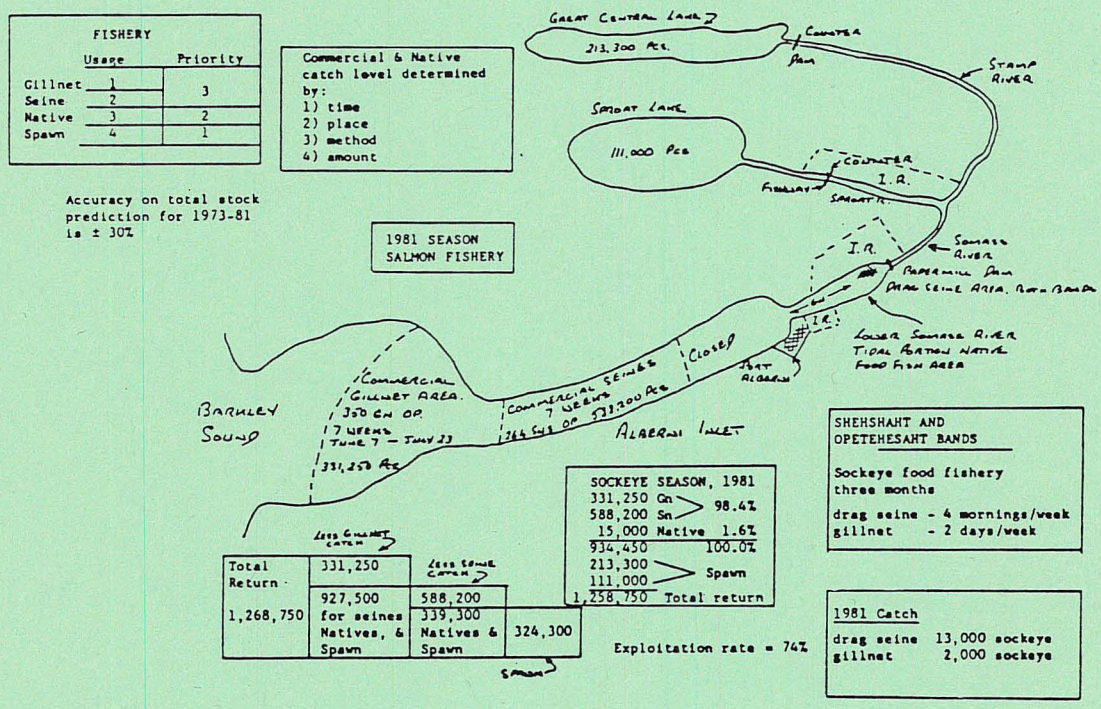

Figure 2: Geography of the Barkley Sound Sockeye and Chinook Fishery

Barkley Sound and Alberni Inlet form the migration corridor for a large sockeye population which utilizes Great Central Lake. A somewhat smaller stock returns to Sproat Lake, and both systems are used also by a sizable chinook population. The area commonly attracts a fleet of about 350 gillnet vessels and 250 seiners. Food fishermen employ gillnets in tidal waters near the mouth of the lower Somass River and drag seines just below the site of a papermill. The management plant is designed to: (a) attain a pre-determined level of escapement to both spawning systems; and (b) ensure that sufficient fish are left from the commercial fishery to satisfy the needs of food fishermen.

Suppose that in a given year the Somass River return is predicted to be approximately 1,250,000 fish, of which 325,000 are required for spawning escapement. Given this expectation, and considering the probable size of the fleet, the plan might call for an opening of two days a week for seven weeks. Fish quality is maintained by fishing as far as possible from the spawning system, but close enough to ensure that only target stocks are taken. To minimize the incidental catch of juvenile chinook, the outside waters heavily used by this species are closed to seine fishing. Gear conflict is controlled by confining seines to the waters of Alberni Inlet and restricting gillnets to Barkley Sound. Net length and mesh size also are restricted by regulation. Food fishing is permitted by drag seine on four mornings weekly, and by gillnet for two mornings a week for three months.

The Salmon Management Cycle

A salmon management plan is an extended statement which specifies the tactics (openings, gear restrictions, and so on) that are necessary to achieve the optimum escapements for the stocks within a given area. The plan must be adjusted each year in response to variations in salmon abundance, fishing pressure, and so forth. As illustrated in Figure 3, salmon management therefore operates in annual cycles, beginning with the formulation and preparation of an annual management plan -- based on a pre-season estimate of the return. In-season monitoring of the catch and escapement is used to adjust and amend the plan where necessary. Once the season is over, a comprehensive analysis of all available information is made in an effort to identify improvements for the following year. Return expectations for the next season are then prepared, and the cycle is completed with the formulation of a new plan.

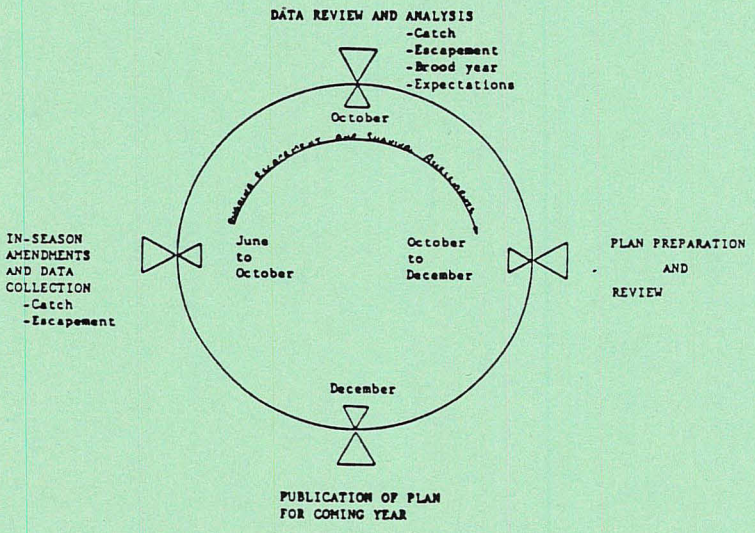

Figure 3: The Salmon Management Cycle

Try to keep Figure 3 in mind throughout the remainder of this booklet; although severely over-simplified, it will help you to keep the forest in sight when the trees become too thick!

Development of Commercial Fishing Plans

There might once have been a time when it was possible for a fishery manager to sit down by himself and formulate his plans for the coming season. If those days ever existed, they have long since vanished. Today, a great many individuals, both within and outside the Department, contribute to the development of harvesting plans for all major fisheries. Current-day planning processes ensure that all available expertise, not only within the Department but among user groups and other resource management agencies, is brought to bear on the preparation of salmon management plans.

The following outline demonstrates the steps involved. Note that procedures vary tremendously, between Divisions, between Districts within each Division, and even between Sub-districts within the same District.

1. During early October, the Sub-District Fishery Officer reviews past fisheries, brood year information, anticipated fleet capacity, and the management resources available in his area. On the basis of this information, and with assistance from the Management Biologist, he prepares a fishing plan. Salmonid Enhancement production data are considered at this point.

2. By October 15, these plans are sent to the District Office. Each plan is reviewed by the District Supervisor and Divisional Biologist. Amendments are made as necessary to facilitate stock management on a District-wide basis. For example, conflicts in opening times, fleet usage, and manpower availability are considered. This process normally occurs at a meeting of all District personnel involved in stock management, including the Management Biologist.

3. On November 1, the District Plans are submitted to the Division. The Areas Manager reviews the District plans with the Senior Management Biologist, and consolidates them in a Division Plan. Amendments may be made at this point to ensure consistency throughout the Division and to ensure the availability of management resources.

4. On November 15, the Divisional Plans are submitted to the Chief, Resource Allocation for consolidation in the Regional plan. Both domestic and international concerns are addressed at this level.

Public involvement, such as that arranged through salmon advisory committees, can complicate the process considerably. Formal variations to the process are as follows.

1. The Pacific Salmon Fisheries Commission makes recommendations about fishing plans in general and on the conduct of intercepting fisheries which affect Canadian and American fishermen. The PSFC may have up to four members from Canada and another four from the U.S. It has three Panels: (a) a Northern Panel to deal with salmon from rivers between Cape Caution and Cape Suckling; (b) a Southern Panel to consider salmon from southern rivers; and (c) a Fraser River Panel to provide advice on sockeye and pink fisheries involving Fraser River stocks. The latter panel has a strong day-to-day administrative role during the fishing season.

2. Plans for the Johnstone Strait mixed-stock fishery are developed with unusually high involvement by the District and Management Biology Units. In addition, the Johnstone Strait/Gulf/Fraser River Chum Advisory Committee plays a major role in formulating plans to harvest migrating chum. Chum harvest plans are not developed or announced until this committee meets in early September. The fishery normally occurs in September, October, and November.

3. Plans for Skeena River stocks are developed jointly by the Fishery Officer, District Supervisors, and Management Biologist. Plans are formally presented to the Skeena River Advisory Committee for comment prior to publication in the Commercial Fishing Guide.

4. A number of other advisory groups provide in-season advice on the conduct of various fisheries. The recommendations of these groups are considered during the planning process.

Development of Recreational Fishing Plans

Planning for the sport fishery differs from that adopted for commercial fisheries. The sport fishery requires one or two years to respond to major policy changes, although minor alterations can usually be implemented in a single year. Planning requires input from Sub-district Officers, Management Biologists, and the Sport Fish Advisory Board.

1. By September 1, Fishery Officers provide recommendations for change to the District Supervisor. Management Biologists provide contributions as required.

2. By September 15, the District Supervisor submits a District Sport Fishing Plan to the Division. The Sport Fish Management Biologist provides input at this stage.

3. By September 30, the Division Chief and Senior Biologist review and consolidate the plan. The Division recommends regulation changes to the Sport Fish Coordinator in the Regional Office. Region reviews the recommendations and adds any amendments needed to bring the plan into line with Regional policy. The total plan is then returned to the Districts for review.