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The Present State of the  
Columbia River Salmon Resources

by

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## THE PRESENT STATE OF THE COLUMBIA RIVER SALMON RESOURCES

By WILLIS H. RICH

THE SALMON of the Columbia River have supported an intensive fishery for over seventy years but are now showing unmistakable signs of depletion, and various factors are contributing to the rapid progress of this condition. Five species of fish enter into the commercial fishery on the Columbia River itself. These are (1) the Chinook salmon (*Oncorhynchus tshawytscha*), (2) the blueback salmon (*O. nerka*), (3) the silver salmon (*O. kisutch*), (4) the chum salmon (*O. keta*) and (5) the steelhead trout (*Salmo gairdneri*). The Chinook is of far greater importance than all other species together and constitutes by weight approximately three-quarters of the total catch. In addition to the catch made in the river a large number of Columbia River salmon are taken in the ocean, especially by trolling, but to a small extent by purse seines. This oceanic catch is almost exclusively composed of Chinooks and silver salmon.

The annual commercial value of the pack of salmon on the Columbia River has averaged about four and a half million dollars over the past thirty years. Thousands of people are directly dependent upon this industry for all or part of their income and other thousands benefit indirectly. It constitutes one of the major resources of the Pacific Northwest.

Unfortunately there are no satisfactory statistics on the catch of Columbia River salmon. There are no records at all of the sort necessary to measure the fishing effort and only within the last few years have catch data been taken by the states of Oregon and Washington in such form that they can be combined to give reliable figures of the total catch. For past years a rough approximation of the catch is given by the pack figures published by the Pacific Fisherman and, more recently, by the United States Bureau of Fisheries (Fiedler). These are the best available data covering a long period; yet these are unreliable in a number of ways, of which the following may be mentioned: (1) The pack figures only give the packs of canned and mild cured salmon and do not include those sold fresh or processed in other ways. (2) There are included fish brought in from other streams, and Columbia River fish shipped elsewhere are excluded. (3) During various periods there has not been an accurate segregation of pack by species; Chinooks have been listed as of "chum grade" and steelheads have presumably been packed as Chinooks.

In spite of the imperfection of the data it is reasonably certain that they give a fairly good picture of the trend in the annual catch during the history of the fishery. Craig (1938) has given these data in their most acceptable and readily available form. (See also Oregon State Planning Board, 1938.) With certain corrections and modifications and supplemented by similar figures for 1937 and 1938, compiled from the Pacific Fisherman Yearbook for 1939, these data are presented in table 1. Here the figures are in the form of the average annual catch in pounds for each five-year period beginning with the years 1866 to 1870. There was no segregation by species previous to 1889, but an estimate has been made of the catch of Chinooks previous to this year on the assumption that the percentage of Chinooks in the total pack (which was the only record) was the same as for the period 1889 to 1910—approximately 80 per cent. A similar estimate was not made for the other species, because each represents such a small percentage of the total that such estimates would be exceedingly unreliable.

From this table it is apparent that the catch of Chinooks has consistently declined during the past twenty years and that during this period the average catch has been lower than for any other period except one (that ending with

TABLE 1  
AVERAGE ANNUAL POUNDAGE OF COLUMBIA RIVER SALMON FOR FIVE-YEAR PERIODS, 1866 TO 1938, IN THOUSANDS OF POUNDS

Period	Chinooks	Bluebacks	Silvers	Chums	Steelhead
1866-1870.....	3,264	.....	.....	.....	.....
1875.....	14,348	.....	.....	.....	.....
1880.....	25,024	.....	.....	.....	.....
1885.....	31,493	.....	.....	.....	.....
1890.....	20,998	.....	.....	.....	.....
1895.....	24,248	2371	2986 <sup>b</sup>	844 <sup>c</sup>	3662
1900.....	23,257	1819	3330	988 <sup>d</sup>	2104
1905.....	28,941 <sup>a</sup>	784	1374 <sup>b</sup>	1138 <sup>a</sup>	604 <sup>a</sup>
1910.....	23,282	723	2934	2154	624
1915.....	26,982	899	3472	3010	1899
1920.....	30,437	809	4519	3476	1980
1925.....	22,014	1198	6237	2077	2393
1930.....	20,326	725	5995	3975	2885
1935.....	18,192	299	4279	1158	1781
1936-1938.....	16,540	708	4044	2241	1720

Data from Craig, 1938, and Pacific Fisherman Yearbooks for 1938 and 1939. Up to and including 1888, the poundage of Chinooks has been estimated on the basis of 80 per cent of the total poundage as estimated from the figures of total pack given in Pacific Fisherman Yearbooks.

<sup>a</sup> Average of four years. There are no pack data for 1901.

<sup>b</sup> Average of four years. There are no data for 1891 or 1901.

<sup>c</sup> Figures for 1893 and 1895 only.

<sup>d</sup> Figures for 1899 and 1900 only.

1890) since the period ending with 1875. The catch of bluebacks has declined even more markedly, but much of this decline apparently took place rather suddenly about 1900. The trend of the catch of silvers and chums was upward from 1890 to about 1920. Since then, the catches of these species has fluctuated considerably and it is difficult to see any marked change. What change there is, however, appears to be in the direction of reduced catches. The catch of steelhead has remained fairly constant so far as the general trend is concerned. The most important species are the Chinook and bluebacks and it is apparent that these are the very ones that show most clearly a reduced abundance.

There are two main reasons for this depletion. First is the reduction in the area for spawning and rearing of the young fish that has come about through the advance of settlement and civilization along the tributaries where the salmon once spawned unhindered. This advance has meant, and still means, the erection of dams and other obstructions to the ascent of the spawning adults, the construction of irrigation ditches into which the young fish pass on their seaward migration, the imposition of other hazards to the seaward migrants, and the reduction of water flow in the natural stream channels, which effectively makes the areas available for the rearing of young salmon smaller and therefore less productive. This reduction in spawning and rearing area has been constant over a number of decades and has recently been accelerated by the initiation of a program by the federal government for the construction of numerous great dams that may well result in the extermination of a large part of the remaining runs of both Chinooks and bluebacks. Just what proportion of the original spawning and rearing areas remains is not known, but the survey now under way by the United States Bureau of Fisheries will eventually provide this important information.

But in addition to this, these fish have for many years been subjected to a

very intensive fishery and without much protection other than what is afforded by artificial propagation. There is one closed period that covers the months of March and April, another the period from August 25 to September 10, and there are weekly closed periods of 24 hours during the open season from May 1 to August 25. This weekly closed period is practically useless so far as the escapement of fish through the commercial fishing area is concerned because the fish require from two to three weeks to cover this part of the river. Closure for one day a week, therefore, only benefits the fishermen above any given point. It extends, slightly, the productive fishing area, but without materially increasing the ultimate escapement at the upper limit of the commercial fishing region.

The two seasonal closed periods likewise do nothing for the runs of bluebacks, which are at present confined to the period between May 1 and August 25. They do, however, protect in some degree the runs of Chinook salmon that enter the river during March and April and during the August-September closed period. Since the Chinooks composing these protected runs may, by chance, enter the river either a little before or a little after the period covered by the parent run, the effect of this protection has been to hold up the catch during the time just preceding and following the closed periods. This effect is not so apparent preceding the spring closed period, because comparatively few Chinooks enter the Columbia during February and March, anyway.

The intensity with which the fishery within the river is carried on has been well brought out by a study made last year for the United States Bureau of Reclamation (Calkins, Durand, and Rich, 1939). On the basis of actual counts of fish passing Bonneville Dam and of estimates of the numbers taken in the commercial fishery, it was determined that during 1938 the ratio of catch to escapement for the bluebacks was over 3 to 1. For the Chinooks this ratio varied from approximately 3.5 to 1 during May to over 6 to 1 in June and July, but fell in August to about 1.5 to 1. Furthermore, for the Chinooks the fishing intensity was so great during June and July that, while the catch in the lower river was quite steadily increasing, there was no significant change in the number of fish passing the Bonneville Dam until late in July. The intensity is indicated also by the fact that, for most of the weeks during these two months, the catch in the lower river steadily declined from Monday until Saturday at such a rate that the catch at the end of the week was often less than half what it had been at the beginning of the week.

But this intensive fishery within the river is only part of the story. The troll fishery for salmon that extends from southeastern Alaska to Monterey Bay makes heavy inroads on the Columbia River Chinooks during their life in the ocean. It is impossible to determine with the data at present available the exact extent of this drain on the resource; but it can be shown to be a large element.

Experiments have been conducted by various agencies in which Chinooks captured in the troll fishery were tagged and released and data were later obtained concerning the place of recapture. These have shown that a large percentage of the fish captured by troll north of the Columbia River as far as southeastern Alaska were bound for the Columbia. Unfortunately there are no equivalent data on the troll fishery to the south of the Columbia River and it is not known how extensively, if at all, this draws upon the Columbia runs.

In southeastern Alaska such tagging experiments were conducted by the United States Bureau of Fisheries in 1926 and 1927. Out of a total of 470 Chinooks tagged there were 38 returns; 22 (58 per cent) were taken in the Columbia River (Fisheries Service Bull., 1928). The Biological Board of Canada carried on an excellent series of experiments for a number of years

that covered the entire outer coast of British Columbia. In the north, around the Queen Charlotte Islands, 2117 Chinooks were tagged and 277 were captured, of which 27 per cent were taken in the Columbia River. Along the outer coast of Vancouver Island 3485 were tagged and 421 recaptured, of which 56.5 per cent had gone to the Columbia (Pritchard, 1934). There have been no similar determinations of the proportions of Columbia River Chinooks in the extensive trolling operations conducted in the region of Swiftsure Bank off the coast of Washington, nor in those conducted off the mouth of the Columbia itself; but it may fairly be assumed, I believe, that the percentage of Columbia River fish in the catch on Swiftsure Bank is not less than has been shown for the fishery along the west coast of Vancouver Island and that practically all the Chinooks taken off the mouth of the Columbia derive from the runs to that river.

Satisfactory statistics on the catch of Chinooks by troll in Alaska are not available. The various reports on Alaska fisheries and fur-seal industries (Bower, 1936, 1937, and 1938) give annually the weight of Chinooks taken by troll, but an unknown part of this catch is made in inside waters where, probably, the percentage of Columbia River fish is different from what was determined by the tagging experiments. The average weight for the whole of Alaska for the three years 1935 to 1937 inclusive was approximately 700,000 pounds. On the basis of the available information on the percentage of Columbia River fish taken in southeastern Alaska and northern British Columbia, it seems conservative to assume that at least 200,000 pounds of this catch may be attributed to the Columbia runs.

So far as I am aware, there are no published records of the poundage of Chinooks taken by troll in British Columbia. There is a rather large fishery there, however, and it is probable that the catch of Columbia River Chinooks considerably exceeds that made in Alaskan waters.

For the fishery along the Washington coast, especially in the region of Swiftsure Bank, Rounsefell and Kelez (1938) give the catch in terms of numbers of fish for the years 1927 to 1934. The average is nearly 200,000. The poundage is not given. Certainly half these fish can be considered to belong to the Columbia River runs.

Data on the troll catch off the mouth of the Columbia are given conveniently in a report on commercial fishing operations in the Columbia River by the Oregon State Planning Board (1938). Table 4 of that report gives the average annual catch for a ten-year period, 1928 to 1937 inclusive, as approximately 730,000 pounds, all of which may safely be ascribed to the Columbia River runs.

It is useless to attempt to put all these data into comparable form or to try to give more than a rough estimate of the number and poundage of Columbia River Chinook salmon that are taken in the troll fishery. It is certainly large, perhaps nearly 2,000,000 pounds, and since many of the fish are small the number caught may well reach 200,000 or more. It is greatly to be hoped that more satisfactory statistics will eventually be available.

This troll fishery has developed almost entirely since about 1915 and may well have had much to do with the reduced catches within the river itself that have been made since the five-year period ending with 1920. The catch of troll fish made off the mouth of the Columbia enters into the data given in table 1, so that, as this new fishery was developing, it was to be expected that the total catch would rise, as it did during the five-year period ending in 1920. After this initial rise, however, it was to be expected that the total take would fall as a result of the still further reduction of the breeding stock. This may well have been an important element in the conspicuously reduced productivity of recent years. In this connection it should be noted again that the number of

fish taken by troll is much greater than would be required to make up the same poundage if the fish were taken in the river. Many of the troll-caught fish are immature and would not spawn for one or more years (Rich, 1925). During this time they would naturally remain at sea, where they would increase several times in weight. Also there are persistent rumors that the trollers kill many fish that they do not land because the fish are smaller than the buyers will ordinarily accept.

The way in which the Chinook salmon runs have held up under excessive exploitation and a constant reduction in the available spawning area is remarkable. I mentioned above that about the only protection given to the Columbia River salmon has been that afforded by artificial propagation. Biologists in general are skeptical of the claims made for artificial propagation, and rightly so because these claims have often been extravagant and the proof is entirely inadequate. Indeed, many conservationists feel that the complacent confidence felt by fishermen, laymen, and administrators in the ability of artificial propagation to counterbalance any inroads that man may make upon the supply of a propagated species is a serious stumbling block in the way of the development of proper conservation programs. But it is to be noted that there is probably no salmon run of consequence that is so intensively propagated by artificial methods as is that of the Chinook salmon on the Columbia River. Even though satisfactory proof of the value of artificial propagation is lacking, it seems quite possible that there is a causal relationship that we do not understand between the intensive artificial propagation and the resistance to exploitation that the species has shown. This is a matter that, in my opinion, should have an important place in the study of salmon problems generally, and particularly in the study of those of the Columbia River. The possibilities of developing methods of artificial propagation that will produce satisfactory returns in terms of fish of commercial size is too great to be passed over lightly or with prejudice. But to be satisfactory the returns must be sufficiently in excess of those to be expected from natural propagation to warrant the expenditures incurred in operating the hatcheries.

We come, then, finally to this general picture of the present state of the salmon resources of the Columbia River. So far as our data show, the steelhead, silvers, and chums are nearly, if not quite, holding their own. The blueback runs were greatly reduced as long ago as 1900, since which time there has been no marked change in the size of the catch. This depletion of the bluebacks was probably due chiefly to the reduced spawning area available. The Chinook salmon catch has held up remarkably in spite of a fishery that is evidently being conducted with terrific and increasing intensity, but the record since 1920 is one of constantly decreasing catches. Reduction of breeding areas, which at present is accelerated, and an oceanic troll fishery that annually takes large numbers of both mature and immature fish, contribute to the environmental pressure against the species. Regulation of the fishery within the river protects only the runs of April and early May and those of late August and early September. In the face of this evidence the conclusion seems inevitable that the abundance of the Columbia River Chinook salmon will continue its present rapid decrease unless the species is given more adequate protection, either through regulation of the fisheries both in the ocean and in the river, or through enlarged and improved programs of artificial propagation.

The Columbia River salmon resources are, intrinsically at least, nearly if not quite as valuable as were those of the Fraser River before the destruction of the great sockeye salmon runs that appeared there quadrennially until the disaster of 1913. In the face of tremendous odds the Chinook salmon still survive in the Columbia although markedly depleted. The several opposed forces

are diverse in character and it may be that they will eventually prevail; they will certainly do so unless concerted and intelligent effort is made to overcome them, and even that may not be enough. At present there is confusion and great need for an integrated conservation program. Since international cooperation is essential, it would seem that the federal governments of the United States and Canada should act together. There is already a functioning organization that could properly be entrusted with this responsibility—the International Pacific Salmon Commission, which was established by treaty for the purpose of rehabilitating the sockeye runs to the Fraser River. It is my suggestion that the proper steps be taken to provide that body with authority and funds adequate to extend its work to include the preservation of the Chinook salmon runs of the Columbia River.

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LIST OF CONTRIBUTIONS  
from the  
DEPARTMENT OF RESEARCH  
of the  
FISH COMMISSION OF THE STATE OF OREGON

(These are offered in exchange for similar publications  
dealing with fishery research.)

1. Local populations and migration in relation to the conservation of Pacific salmon in the western states and Alaska. By Willis H. Rich. (Reprinted from "the Migration and Conservation of Salmon", Publication No. 8 of the American Association for the Advancement of Science. 1939.)
2. Symposium on "Dams and the Problem of Migratory Fishes" including the following papers:
  - a. Fishery problems raised by the development of water resources. By Willis H. Rich, Fish Commission of Oregon.
  - b. The passage of fish at Bonneville Dam. By Harlan B. Holmes, U. S. Bureau of Fisheries.
  - c. Fish problems connected with Grand Coulee Dam. By Wilbert M. Chapman, Washington Department of Fisheries.
  - d. Preliminary report on an investigation to determine possible methods of salvaging the Sacramento River salmon and steelhead trout at Shasta Dam. By Harry A. Hanson, U. S. Bureau of Reclamation.
  - e. A summary of the present status of dams versus migratory fishes on the Pacific coast with especial reference to problems in California. By Alan C. Taft, California Division of Fish and Game.(Special number of the Stanford Ichthyological Bulletin. 1940. Published in cooperation with the Fish Commission of Oregon.)
3. The present state of the Columbia River salmon resources. By Willis H. Rich. (Reprinted from Proceedings of the Sixth Pacific Science Congress, University of California Press, Berkeley, California, 1941.)