

STUDIES OF JUVENILE SALMONIDS IN
BROWNLEE RESERVOIR (SUMMARY)

by

Joseph T. Durkin

and

Donn L. Park

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SUMMARY

Studies of the distribution and movement of young salmonids in Brownlee Reservoir, in relation to the environment, commenced in the spring of 1962 and have continued to the present date.

Sampling activities included the use of Lake Merwin-type floating traps; purse seines; surface, mid-water, and bottom trawls; gill nets; and fyke nets. Additional catch information was provided by recruitment studies in the Snake River and Eagle Creek, supplemented by data from the skimmer facilities operated by the Idaho Power Company. Information on the timing of the 1962 Snake River recruitment was provided by the Idaho Department of Fish and Game. Records of bypass catches and marking in Eagle Creek were supplied by the Oregon Game Commission.

Key stocks under study include progeny of chinook salmon runs in the Snake River, Eagle Creek, and the Weiser River. Movement of these juveniles through the reservoir can be projected by examining peaks of abundance at time of entry into the reservoir and at time of exit at the skimmer facilities (lower end of the reservoir).

Individual sub-populations were distinguished by size differences, fin clips, and jaw & thread tags. The latter marks provided precise information on migration rates and distribution. Length frequencies of the respective sub-populations usually provided an accurate means of identifying the various stocks in the reservoir, but during certain times of the year there was an overlap of length frequency distributions of the various stocks. When this occurred, an arbitrary apportionment was made of numbers captured from each stock. This was based on the distribution of fin-clipped fish within the respective size ranges of each group.

Studies of the sea-going rainbow (steelhead) trout were complicated by the presence of both native and hatchery stocks of resident trout. The entire group was treated under the category of rainbow-steelhead, and only a limited assessment of their movements was made.

Longitudinal and vertical distributions of fish in the reservoir were related to various environmental factors, especially temperature and oxygen. The extent of reservoir drawdown and timing of the fillup period were also critically examined for their effects of fish passage.

The following summarizes our records of the principal salmonid stocks entering Brownlee Reservoir and their eventual progression through the reservoir as related to environmental conditions:

Weiser River Spring-run Chinook Progeny

This stock enters the reservoir at age group I from the first week of April until the second week of June. A second group, falling within the general size category of Weiser River migrants, has been observed from the third week of June until the fourth week of July. The origin of this migration is subject to question, however, because of the presence of fin-clipped fish from other stocks, namely Eagle Creek.

The initial migration peaks in the Snake River around the first or second week in May and is observed shortly thereafter at the upper end of the reservoir. Migrants from the Weiser River have been definitely identified (fin clips) at the skimmer facility (lower reservoir) from the last of April until the first of July, with peaks during the third and fourth weeks of May. This indicates an approximate elapsed time of 2 weeks between peaks of entry and peaks at the skimmer.

Arrivals at the skimmer net constituted approximately 10 percent of the Snake River sample catch in 1962 and 2.3 percent of the estimated recruitment in 1963, indicating a higher success of migration in 1962 than in 1963. Of significance here is the fact that there was a substantial drawdown (45 feet) in 1962 and fillup was gradual and not completed until early June. Drawdown in 1963 was nominal (21 feet), and fillup was rapidly completed in mid-April. A sharp contrast between the temperatures of river and reservoir water in the spring of 1963 may also have affected the movement of fish from the upper reservoir.

Residualism among Weiser River progeny is apparently rare in the reservoir. Only one marked fish of this stock has been recovered in the year following entry. This fish was tagged in June 1962 at the upper reservoir and was recovered in May 1963 some 13 miles down the reservoir.

Eagle Creek Spring-run Chinook Progeny

These fish initially enter the reservoir (Powder River arm) as 0-age migrants in the fall, generally with the first substantial runoff in October or November. This run continues until freezeup in December and appears to be the main outmigration from this stream. Fish from the fall migration first appear at the skimmer in mid-January and are in evidence until the first week of July.

A second, smaller outmigration, comprised primarily of age-group-I fish, commences in early February and continues until late June. These fish make their initial appearance at the skimmer in late March and are in evidence until the last of June.

Fall recruits appear to remain at the head of Powder River arm for several months before commencing migration out of the arm. Migration times

from entry in the reservoir to recovery at the skimmer ranged from 60 to 138 days. By contrast, the spring recruits take considerably less time. Tag recoveries from this group indicate migration times of from 11 to 52 days.

Skimmer catches in 1962 and 1963 indicated two peaks of Eagle Creek progeny--one from mid- to late March and a second in mid-May. In 1964 there was a peak in late January and a second, smaller peak in late March. Substantial sections of the skimmer net were removed in late February 1964.

There was no evidence of Eagle Creek progeny in the reservoir after the first week of July. However, a maximum period of residence lasting almost 9 months is indicated. For the most part, this stock is in the reservoir during favorable temperature and oxygen conditions.

In 1963, a number of marked Eagle Creek fish were recovered at the head of Brownlee Reservoir, and some were even recovered in the Snake River about 3.5 miles above the reservoir. This obvious upreservoir movement is believed to be related to the drawdown and filling schedules previously noted. In 1962 and 1964, when drawdown was substantial and when fillup was not completed until early June, Eagle Creek progeny were not found in upper Brownlee Reservoir.

A maximum of 7.7 percent of the recruitment from Eagle Creek was taken at the skimmer. This is based on 9,235 fin clips at Eagle Creek bypass traps (October 1961) and recovery of 710 of these marks at the skimmer in 1962.

Snake River Fall-run Chinook Progeny

Fish of this population enter the reservoir as 0-age migrants, making their initial appearance in mid- and late April. Peaks have been noted in the river a short distance above the reservoir in the second and third weeks of May. Fish of this stock have appeared at the skimmer from early May until mid-July. In 1962, peak numbers arrived from mid- to late May, but in 1963, peak catches did not occur until late June and early July. Thus, again there is evidence that early fillup of the reservoir in 1963 may have seriously hampered migration. Sharp differences between the temperature of the river and the reservoir (river water colder) also may have delayed the fish. Peaks at the skimmer in 1962 occurred 1 to 2 weeks after peaks in the river, whereas in 1963 the peak at the skimmer did not show until 7 weeks after the peak in the river.

Progeny of the Snake River fall run were the only salmon migrants found in substantial numbers in Brownlee Reservoir after termination of the skimmer operation in early July. These fish again appeared at the skimmer as age group I early in January of the following year and continued their out-migration until June. The peak of this second-year movement occurred from late January through February. These fish ranged in size from 160 to 240 mm. and appeared in excellent condition.

Migration period	Chinook	Rainbow-steelhead
1962 fall	117,000	22,000
1963 spring	<u>16,500</u>	
Total:	133,500 ('61)	
1963 fall	24,000 ^{1/}	
1964 spring	<u>7,000</u> ^{2/}	2,800
Total:	31,000 ('62)	

1/ Includes 3,000 0-age fish taken in spring of 1963.

2/ Estimate to May 17, 1964.

The efficiency of the louver trap in the 1962-63 period was 10.2 percent, with selectivity toward larger fish. In 1963-64, the efficiency of the louver facility was improved. Average efficiency was 55.2 percent (range, 37-65 percent), and there was no evidence of selectivity on the basis of fish size.

Catches of Snake River fall-run progeny at the skimmer generally amounted to only a minute fraction (1 percent) of the estimated recruitment. For example, recruitment of the 1961 brood has been calculated at 529,000 fish of which 1,645^{1/} were reported at the skimmer in 1962. In the following year, 4,381 fish of the '61 brood were taken. Thus, the catch in the 2 years amounted to 6,026 fish or 1.1 percent of the estimated recruitment.

Gill net catches during mid- and late summer indicated that juveniles from the Snake River were restricted to a relatively narrow longitudinal band (0 to 70 feet depth) along the axis of the reservoir. During this period, only the epilimnal waters had sufficient oxygen (over 4 p.p.m.), but temperatures on the surface often exceeded 70° F. Growth during this period appeared to be retarded, but despite the rather severe environmental limitations, some fish obviously found a suitable niche in the reservoir and were in excellent condition by the time reservoir conditions improved in the fall.

Rainbow-steelhead Trout

These fish, both sea-migrants and resident (or hatchery) stocks, enter the reservoir in the spring, principally from the Snake River, its tributaries, and Eagle Creek. Relatively few appeared at the skimmer (less than one-tenth of the total skimmer catch) during the 1962-64 period. In 1962, rainbow-steelhead (1,460 fish) were taken at the skimmer from March through July, being most numerous in May. Catches at the skimmer in 1963 (1,200 fish) occurred from January through July, again peaking in May but showing a secondary peak in February.

Since it has not been possible to accurately separate native resident rainbows from their sea-going cousins, assessment of the total number of steelhead entering the reservoir was not attempted. Considering the number of adult migrant steelhead passed at Oxbow (1,000 to 2,000 fish) in recent years, it would appear from the catches of outgoing juveniles at the skimmer, that this species is definitely in jeopardy unless far greater numbers actually pass through the turbines and spill.

Tagging studies in upper Brownlee Reservoir in the spring of 1962 showed that most rainbow-steelhead were heading toward the dam, but few actually reached the skimmer. Of 406 fish tagged, 27 (6.3 percent) were recovered and only 5 of these fish were taken at the skimmer. Four of these recoveries at the skimmer were made in the following winter and spring, whereas the fifth fish was recovered approximately 1 month after release in the upper reservoir.

^{1/} Graban, James R. Evaluation of Fish Facilities, Brownlee and Oxbow Dams. May 1964.

Hatchery Plants (Chinook and Coho), 1964

Limited analysis of the movements of these fish suggests that they achieved a fairly rapid passage through the reservoir. Some fish passed completely through the reservoir in about 1 week. Reservoir levels ranged from minus 42 to minus 88 feet during the spring migration period. The low reservoir level--coupled with a relatively high inflow and substantial spills--undoubtedly created conditions highly favorable for passage.

INTERPRETATION

1. Progeny of spring chinook runs from Eagle Creek and the Weiser River appear to have been far more successful in reaching the skimmer facility than progeny from the Snake River fall run.
2. The extent of reservoir drawdown and the timing of the fillup period may well be key factors relating to the success of juvenile migrations through the reservoir. A drawdown of 40 feet or more coupled with a late fillup (June) has produced the more favorable conditions for passage.
3. Other factors relating to success of passage are the age & size of migrants and timing of the migration periods of the respective contributing stocks. Large migrants appear to fare better than the small ones, and early arrivals (January-May) at the lower end of the reservoir achieve a more successful passage than the late arrivals (June-July).
4. Catches at the skimmer net have provided a basis for assessing arrival time of the various populations at the lower end of the reservoir, and to some degree, they have given indication of the success of passage. Since the skimmer was essentially a surface collector, catches during June and July--when surface water temperatures are rising--may not accurately reflect trends of abundance at the lower end of the reservoir. In any event, the record has shown that the skimmer catches constitute only a small part of the total recruitment. Accurate assessment of success of fish passage must include not only the catches at the skimmer but the escapement through the turbines and spill at Brownlee Dam.