

SUMMARY--BROWNLEE RESERVOIR REPORTS

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The investigation of the effect of a large impoundment, Brownlee Reservoir, on the passage of salmonids was initiated in 1962. Research activities were pursued in five major areas: (1) limnology, (2) adult passage, (3) juvenile recruitment, (4) juvenile passage, and (5) juvenile escapement.

In terms of the limnology, the temperatures and the oxygen concentrations appear to be the most critical factors affecting the distribution and survival of migrant fish. Temperatures in August and September have reached 81° F., and oxygen concentrations have ranged from 0 to 4 parts per million in the limited area of suitable salmon habitat (temperatures of 70° F. and less). Environmental conditions in the fall, winter, and spring appear optimal for fish survival.

The reservoir is stratified each year, but the formation of the thermocline is influenced by the operation of the reservoir; a significant drawdown with slow filling delays stratification. Air temperature and the volume and temperature of inflowing water from the Snake River appear to be of secondary importance to stratification.

Spilling operations at Brownlee Dam influenced the current patterns within the reservoir. At a maximum drawdown of 87 feet, measurable current patterns were detectable throughout the reservoir, but during fill-up the velocities and directional patterns became erratic. Significant spills in April and June 1964 increased the current and changed the directional pattern of water flow in the upper reservoir.

Carbon dioxide, silicate, and sulfate levels, in addition to hydrogen ion concentration, appear to be within acceptable limits for fish survival.

Brownlee Reservoir has a buffering effect on the Snake River below the dam; in the fall, downstream temperatures are higher and oxygen concentrations lower for a longer period of time than in the river above the reservoir. A reverse effect occurs in the spring.

The peak of the adult spring-run chinook salmon migration occurs at Brownlee Dam in May, when environmental conditions are suitable for passage. These fish spawn in Eagle Creek of the Powder River system and in tributaries to the Snake River, principally the Weiser River. Eagle Creek is about 20 miles above the dam, whereas the Weiser River is about 12 miles upstream from the reservoir.

The adult fall-run chinook migration peaks in late September, and at least a portion of these fish enter the reservoir when high temperatures and low oxygen concentrations may prevail. However, tagging experiments indicate that these migrants pass successfully through the reservoir and complete their spawning in the Snake River in the vicinity of Swan Falls.

From sonic tracking experiments, it was learned that adult fish released in the reservoir were initially disoriented, but as evidenced by arrival on spawning grounds, they eventually resumed upstream migration.

Juvenile migration into Brownlee Reservoir from the Snake River occurs in the spring, but from Eagle Creek it is principally in the fall with smaller numbers migrating in the spring. Migration from the Snake River peaks in May and consists mainly of fall-run chinook progeny. The migration from Eagle Creek begins with increased flows in the fall and peaks in October or November. After thawing, a second migration begins in late winter and continues through the spring until flows are drastically reduced by irrigation water diversion.

Progeny from spring-run chinook salmon from the Weiser River enter the reservoir as 1-year-old fish and enter an environment increasing in temperature and decreasing in oxygen concentration. In 1962, 10 percent of the recruitment estimate passed through the reservoir to the skimmer net near the dam, whereas in 1963, only 2.3 percent completed this migration. The difference in success of passage in the two years may have been related to conditions in the reservoir. In 1962 there was a 45-foot reservoir drawdown followed by a gradual fill-up. By contrast, there was only a 21-foot drawdown in 1963 and fill-up was rapid. Also, in 1963, a sharp contrast between reservoir and river water (shear line) in the upper reservoir may have affected downstream movement. Few fish from the Weiser River remain in the reservoir for more than one year.

Spring-run chinook progeny from Eagle Creek enter the reservoir as 0-age group fish in the fall and as age-group-1 fish in the spring. The fall migrants appear to remain in the upper Powder River for several months before migrating downreservoir to the skimmer net. Migration rates of this group, determined from tag recoveries, range between 11 and 52 days to the skimmer net. The spring migration enters the reservoir in early February and continues until late June. They make their appearance at the skimmer in late March and continue until late June.

In 1963, marked Eagle Creek fish were recovered at the head of Brownlee Reservoir. This upstream movement may be related to drawdown and filling schedules, since Eagle Creek progeny were not observed upreservoir in 1962 and 1964, when substantial drawdowns occurred and fill-up was not complete until early June.

Fall-run salmon progeny enter the reservoir as 0-age fish and appear at the skimmer from May until mid-July. In 1962, peak numbers occurred at the skimmer from mid- to late May, but in 1963, they did not appear in quantity until late June and early July. This suggests that the early fill-up in 1963 may have hampered the migration. Sharp temperature differences in the upper reservoir between the river and reservoir water masses in 1963 may also have delayed migration.

A considerable number of fall-run progeny remained in the reservoir after termination of the skimmer net operation in the early summer and appeared at the net again in January of the following year as age-group-1 fish. These fish ranged in size from 160 to 240 mm. and appeared in excellent condition. Apparently a suitable niche for survival existed somewhere in the reservoir during the critical summer period.

Only a minute fraction of fall-chinook progeny were taken at the skimmer net. In 1962, 1,645 of an estimated recruitment of 529,000 (1961-brood-year fish) reached the skimmer, and in 1963, 4,381 fish of the same brood were captured at the skimmer. Thus, only 1.1 percent of the estimated recruitment from the 1961 brood was accounted for in the skimmer catches in 1962 and 1963.

The movement of hatchery chinook and coho juveniles through the reservoir in 1964 appeared fairly rapid from preliminary analysis. Favorable passage conditions may have been created by the substantial reservoir drawdown with slow fill-up, high volumes of inflow from the Snake River, and subsequent spilling operations.

Relatively few rainbow-steelhead trout appeared at the skimmer (less than one-tenth of the skimmer catch) during the 1962-64 period. In view of the number of adults passed over Brownlee Dam in recent years, this species appears to be in jeopardy unless large numbers are migrating downstream through the turbines and spill.

Escapement from the reservoir occurs through the turbines and through the spillway when operated. About 12 percent (47,400) of the total fingerling recruitment estimate of 1962-brood fall-run chinook progeny from the Snake River escaped the reservoir in 1963 and 1964. In 1964, about 54 percent of the hatchery-reared chinook fingerling, released in the Snake River during early spring, passed the sampling sites below Brownlee Dam, peaking in May. About 43 percent of hatchery-reared coho released in the Snake River escaped from the reservoir in May and June 1964. Peak escapement of spring-run chinook progeny from Eagle Creek occurred in March, April, and May, 1964, with about 49 percent of the recruitment estimate passing out of the reservoir.

An estimated 21,550 trout migrants left the reservoir between August 1963 and June 1964, about 31 percent of which were considered resident rather than seaward migrants.

Escapement from the reservoir appears to vary from year to year (10 to 54 percent) depending on reservoir conditions. The best escapement occurred in 1964, when a substantial drawdown and a slow fill-up occurred, accompanied by high inflows from the Snake River.