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Ability of Salmonids to Ascend High Fishways¹

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ABSTRACT

The ability and persistence of salmonids in ascending pool-and-overfall fishways was measured in experimental "endless" fishway structures in which fishways of any height could be simulated. Six chinook salmon (*Oncorhynchus tshawytscha*), four sockeye salmon (*O. nerka*), and four steelhead trout (*Salmo gairdneri*) were permitted to ascend 1,000 feet in the experimental fishways. One sockeye salmon was allowed to ascend an endless fishway for over 5 days, climbing 6,648 feet, a vertical ascent of more than a mile, before the test was discontinued. Rate of ascent of all fish tested increased following an initial period of experience in the fishway. The level of blood lactate in the exercised fish showed no evidence of fatigue. Practical significance of the data in relation to fishway design is discussed.

INTRODUCTION

The large-scale development of water resources on the Columbia River system, with construction of numerous large dams on the main river and tributary streams, poses many special problems for agencies responsible for providing safe passage for migrant anadromous fish. One of these problems is the design of fishways for adult migrants at high dams. Experience on the Columbia River has been confined to fishways requiring a total vertical ascent of less than 100 feet. McNary Dam, the highest dam with fishways on the Columbia, requires an ascent of 92 feet. Pelton Dam on the Deschutes River, a tributary of the Columbia, has fishways requiring a total ascent of 188 feet, although this height is attained gradually over a distance of almost 3 miles. Several dams now proposed, however, would require that fish ascend much greater heights. The question arises as to whether the pool-and-overfall fishways now conventional on the Columbia River would be practical with dams 300, 400, or 500 feet high, or whether the migrating fish would tire after a few hours and

fail to complete passage through such fishways.

Another concern is the possibility that migrating fish might become fatigued because the effects of ascending fishways at many dams accumulated. In the Columbia River adult migrants may have to ascend as many as 10 major dams before reaching their spawning areas. Whether or not a total ascent of as much as 1,000 feet in pool-and-overfall fishways would fatigue fish to the degree that they might be unable to reach spawning areas or to reproduce successfully has been a matter of apprehensive speculation.

In an attempt to provide at least partial answers to these and other questions related to the behavior and performance of migrating fish in pool-and-overfall fishways, a series of tests was made in specially designed experimental structures in which fishways of great height could be simulated.

MATERIALS AND METHODS

The experiments were conducted in the Fisheries-Engineering Research Laboratory at Bonneville Dam on the Columbia River using a pair of "endless" fishways. These experimental fishways were pool-and-overfall types constructed so that each made a complete circuit (Figure 1), with the highest pool con-

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