

Estimates of Wenatchee Steelhead Spawners

Spawn Year 2023 Using Previous Estimates of Overwinter Survival

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Abstract

This report contains estimates of total steelhead spawners in the Wenatchee, as well as split out by spatial strata, using previous estimates of over-winter survival.

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Table 1: Data from the radio telemetry study, representing fish known to have escaped to the Wenatchee River.

Year	Origin	Initial Fish	Surviving Fish	Survival	SE
2015	Natural	25	24	0.96	0.04
2015	Hatchery	20	16	0.80	0.09
2016	Natural	12	9	0.75	0.12
2016	Hatchery	4	3	0.75	0.22
Total	Natural	37	33	0.89	0.05
Total	Hatchery	24	19	0.79	0.08

1 Introduction

This report provides an alternative estimate of steelhead spawners in the Wenatchee subbasin, based on results from a PIT-tag based patch-occupancy model that estimates escapement, and a radio telemetry study that estimated overwinter survival in the mainstem of the Wenatchee.

2 Methods

2.1 Overview

Estimates of escapement to the entire Wenatchee watershed and various tributaries within the Wenatchee were made using a branching patch-occupancy model (Waterhouse et al. 2020) based on PIT tag observations of fish tagged at Priest Rapids dam. All fish that escaped to the Wenatchee were assumed to experience overwinter survival in the mainstem, and then some fish move to the tributaries to spawn. Thus tributary escapements from the patch-occupancy model are equivalent to tributary spawners. The remaining spawners were assumed to have spawned in the mainstem (where redd counts would normally be conducted).

2.2 Data

2.2.1 Escapement

A random sample of steelhead were trapped at Priest Rapids dam and PIT tagged. The subsequent PIT tag detections were analyzed to estimate movement rates past various PIT tag arrays, while accounting for imperfect detection, using the the branching patch-occupancy model described in Waterhouse et al. (2020), and implemented with the DABOM R package. Movement rates were translated to escapement estimates by multiplying them by an estimate of total escapement past Priest Rapids dam, by origin. This was generated using a combination of dam counts, re-ascension rates, proportion of hatchery and natural origin fish trapped in the ladder.

In some years, counts of steelhead at Priest Rapids dam were deemed unreliable. In those situations, we used counts at the next upstream dam, Rock Island dam, and a separate estimate of the re-ascension rate at Rock Island (by origin). We then reconstructed the escapement past Priest by dividing the Rock Island escapement by the estimated movement rates of fish from Priest Rapids to Rock Island.

2.2.2 Overwinter survival

Estimates of overwinter survival in the Wenatchee subbasin come from a radio telemetry study, conducted over two years (2015 and 2016) in the Wenatchee (Fuchs et al. 2021). Steelhead in the study were both radio and PIT tagged, and zero mortality was observed in fish once they entered the tributaries of the Wenatchee. Tags were combined across both years of the study, since we are making the assumption that overwinter survival is consistent year to year.

Table 2: Known number of fish removed at dams or due to harvest, by origin.

Spawn Year	Removal Location	Agency	Source	Natural	Hatchery
2023	Dryden	WDFW-Wenatchee Research Office	Adult Trapping Surplus	0	0
2023	Dryden	WDFW-Wenatchee Research Office	Brood Collections	2	32
2023	Dryden	WDFW-Wenatchee Research Office	Harvest	0	0
2023	Tumwater	WDFW-Wenatchee Research Office	Adult Trapping Surplus	0	0
2023	Tumwater	WDFW-Wenatchee Research Office	Brood Collections	60	20
2023	Tumwater	WDFW-Wenatchee Research Office	Harvest	0	0

2.2.3 Known removals

Before applying overwinter survivals, we must account for any fish removed at Tumwater or Dryden for brookstock or surplus, as well as any deaths due to harvest (Table 2).

2.3 Analysis

This analysis depends on estimates of escapement from the PIT-tag based patch-occupancy model, by origin. We started with escapement to the entire Wenatchee subbasin (past site LWE), and then subtracted known removals. After this, we applied an overwinter survival estimate (by origin) to determine how many fish survived to spawn. We determined how many mainstem spawners by subtracting the total number of estimated tributary spawners from the total population level estimate of spawners.

Table 3: Inputs and estimates of total, tributary and mainstem spawners, by origin.

Parameter	Natural	Hatchery
PIT Estimate	434	400
PIT SE	55.3	52.7
Removed	62	52
Escapement	372	348
Overwinter Surv.	0.892	0.792
Overwinter SE	0.036	0.059
Total Spawners	332	276
Total Spawners SE	51.1	46.4
Trib Spawners	316	118
Trib Spawners SE	47.6	29.2
Mainstem Spawners	16	158
Mainstem Spawners SE	69.8	54.8

Table 4: Estimates (SE) of spawners by area and origin.

Area	Natural	Hatchery
Mainstem	16 (69.8)	158 (54.8)
Icicle	11 (8.9)	10 (9)
Peshastin	81 (23.5)	5 (6.9)
Mission	38 (16.9)	11 (10.1)
Chumstick	50 (19.4)	5 (6.7)
Chiwaukum	31 (16.7)	4 (7)
Chiwawa	64 (20.6)	57 (19.1)
Nason	42 (16.5)	26 (12.7)
Little Wenatchee	0 (0)	0 (0)
White River	0 (0)	0 (0)
Total	332 (51.1)	276 (46.4)

3 Results

3.1 Mainstem spawners

Estimates of total, tributary and mainstem spawners in the Wenatchee, by origin, are shown in Table 3.

3.2 Total spawners

Table 4 displays estimates of spawners in all areas within the Wenatchee, as well as the total by origin.

3.3 Comparison to Redd Counts

Redd counts were conducted this year, and the total number of steelhead redds observed on the mainstem Wenatchee was 13, while the estimate of total redds, after accounting for estimated observer error, was 15. That includes redds built by both hatchery and natural origin steelhead.

4 Discussion

In this analysis, we were able to estimate the number of spawners, by origin, through applying an empirical estimate of overwinter survival to total escapement estimates to the subbasin. While the estimate of natural origin spawners in the mainstem Wenatchee was very similar to redd-based estimates, the radio telemetry-based estimate of hatchery origin spawners was approximately ten times the redd-based estimate.

5 Acknowledgements

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6 References

- Fuchs, N. T., C. C. Caudill, A. R. Murdoch, and B. L. Truscott. 2021. Overwintering Distribution and Postspawn Survival of Steelhead in the Upper Columbia River Basin. *North American Journal of Fisheries Management* 41(3):757–774.
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