Estimates of Wenatchee Steelhead Redds in 2018

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Abstract

This report contains estimates of total steelhead redds in the Wenatchee, after accounting for observer bias.

Contents

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1   Introduction

Redd counts are an established method to provide an index of adult spawners (Gallagher et al. 2007). In the Wenatchee and Methow subbasins, index reaches are surveyed weekly during the steelhead spawning season (Mar 12, 2018 - Jun 11, 2018) and non-index reaches are surveyed once during the peak spawning period. The goal of this work is to:

- Predict observer net error, using the model described in Murdoch et al. (2018).
- Use estimates of observer net error rates and the mean survey interval to estimate the number of redds in each index reach, using a Gaussian area under the curve (GAUC) technique described in Millar et al. (2012).
- Estimate the total number of redds in the non-index reaches by adjusting the observed counts with the estimated net error.

2   Methods

2.1   Net Error Model

The model for observer net error (observed redd counts / true number of redds) is fully described in Murdoch et al. (2018). It uses covariates of the log of observer experience, mean discharge, the observed redd density and mean thalweg CV as a proxy for channel complexity. After normalizing these covariates, the model coefficients are shown in Table 1.

Table 1: Net error model covariates and coefficients.

Covariate	Estimate	Std. Error	t value	Pr($>$|t|)
(Intercept)	0.682	0.039	17.529	0.000
Obs. Redd Density	0.277	0.053	5.218	0.000
Mean Thalweg CV	-0.169	0.043	-3.937	0.000
Mean Discharge	0.116	0.048	2.426	0.020
Log Surveyor Exp.	0.115	0.042	2.760	0.009

2.2   Data

Redd counts were conducted on a nearly weekly basis for index reaches, and once during the peak spawning period for non-index reaches. The covariates in the observer error model of Murdoch et al. (2018) were collected during each survey. They were compared with the covariates contained in the model data set, as well as the estimates of net error (Figure 1).

Those covariates in the observer error model were collected during each survey in 2018, and predictions of net error were made for each survey. From these survey specific estimates of net error, a mean and standard error of net error was calculated for each reach. The standard deviation was calculated by taking the square root of the sum of the squared standard errors for all predictions within a reach.

2.3   Estimating Redds

Estimates of total redds were made for each index reach with a minimum of 2 redds and at least 3 weeks with at least one new redd found using the GAUC model described in Millar et al. (2012) and Murdoch et al. (2018). The GAUC model was developed with spawner counts in mind. As it is usually infeasible to mark every individual spawner, only total spawner counts can be used, and an estimate of average stream life must be utilized to translate total spawner days to total unique spawners. However, in adapting this for redd surveys, we note that individual redds can be marked, and therefore the GAUC model can be fit to new redds only. The equivalent of stream life thus the difference between survey numbers which can be fixed at 1.

For non-index reaches, which were surveyed only once during peak spawning, the estimate of total redds
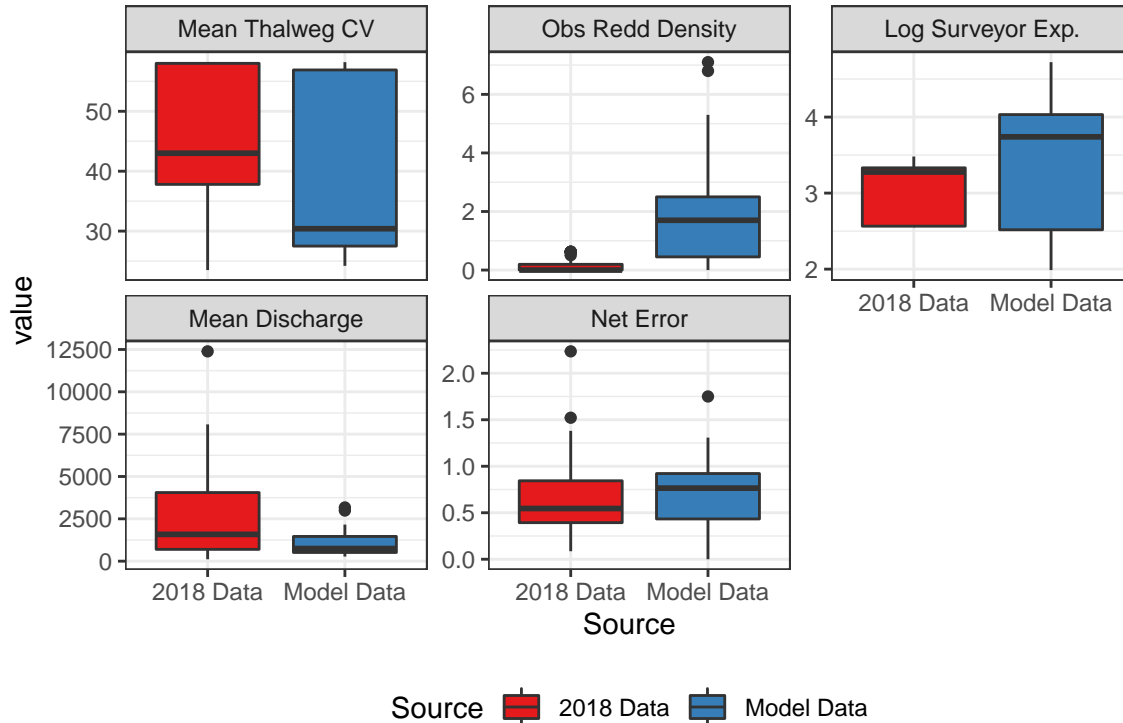
Figure 1: Net error covariate values from the original study the predicted reaches in this report.

was calculated by dividing the observed redds by the estimate of net error associated with that survey. This assumes that no redds were washed out before the non-index survey, and that no new redds appeared after that survey. As the number of redds observed in the non-index reaches ranged from 0 to 0, any violoation of this assumption should not affect the overall estimates very much. Any index reaches that did not meet the thresholds described above were treated as non-index reaches, and the total observed redds in those reaches were divided by the mean estimate of net error for each reach.

3 Results

3.1 Redd estimates

The estimated net error, observed redds and estimates of redds are shown in Table 2. Plots of the new redds and the GAUC fit to those data are shown in Figure 2.

Table 2: Estimates of mean net error and redds for each reach.

River	Reach	Type	Net Error	Net Error CV	Observed Redds	Estimated Redds	Redds CV
Chiwawa	C1	Index	1	0	0	0	-
Nason	N1	Index	1	0	0	0	-
Peshastin	P1	Index	1	0	1	1	0
Wenatchee	W1	Non-Index	1	0	0	0	-
Wenatchee	W2	Non-Index	1	0	0	0	-
Wenatchee	W2	Index	0.736	0.238	0	0	-
Wenatchee	W3	Non-Index	1	0	0	0	-
Wenatchee	W4	Non-Index	1	0	0	0	-
Wenatchee	W5	Non-Index	1	0	0	0	-
Wenatchee	W6	Non-Index	0.925	0.223	0	0	-
Wenatchee	W6	Index	0.784	0.232	2	3	0.197
Wenatchee	W8	Index	0.484	0.301	1	2	0.31
Wenatchee	W9	Non-Index	1.055	0.225	0	0	-
Wenatchee	W9	Index	0.779	0.2	8	10	0.454
Wenatchee	W10	Non-Index	0.558	0.301	0	0	-
Wenatchee	W10	Index	0.472	0.357	16	34	0.449
Total	-	-	-	-	28	50	0.319

4 Discussion

Most of the covariates collected in 2018 were within the range of those in the model data set from Murdoch et al. (2018), leading to estimates of net error in a very similar range to the model dataset (Figure 1). However, most reaches did not meet the minimum thresholds of number of observed redds or number of weeks with at least one new redd observed, so we only used the GAUC method in only 2 reaches.
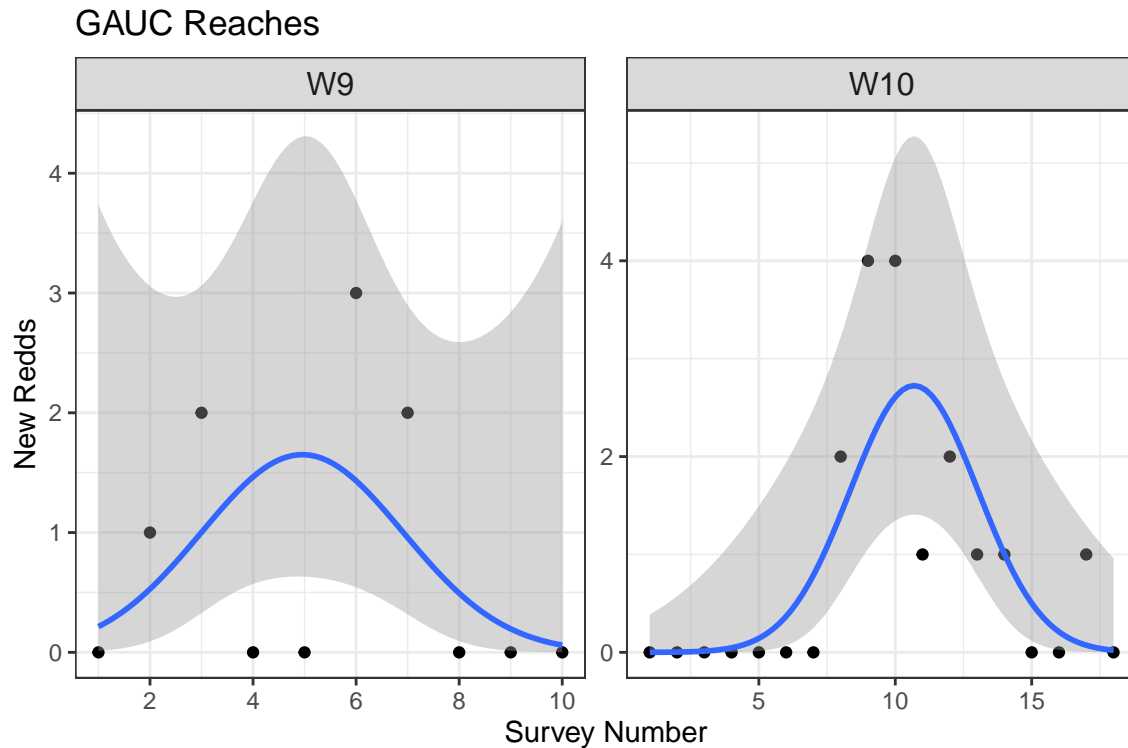
5 Acknowledgements

Figure 2: Plots of observed redd counts (black dots) through time for each qualifying index reach, and the fitted curve from the GAUC model (blue line) with associated uncertainty (gray).

6   References

Gallagher, S., P. Hahn, and D. Johnson. 2007. Salmonid field protocols handbook: Techniques for assessing status and trends in salmon and trout populations. Pages 197–234 *in* D. Johnson, editor. American Fisheries Society, Bethesda, Maryland.

Millar, R., S. McKechnie, and C. Jordan. 2012. Simple estimators of salmonid escapement and its variance using a new area-under-the-curve method. Canadian Journal of Fisheries and Aquatic Sciences 69(6):1002–1015.

Murdoch, A. R., C. J. Herring, C. H. Frady, K. See, and C. E. Jordan. 2018. Estimating observer error and steelhead redd abundance using a modified gaussian area-under-the-curve framework. Canadian Journal of Fisheries and Aquatic Sciences (999):1–10.

6.0.1 Colophon

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