Habitat Use by Juvenile Chinook Salmon in the Willamette River Basin

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A field study and habitat modeling effort were conducted to: (1) evaluate the performance of the habitat model; and (2) to describe habitat use patterns for juvenile Chinook salmon in the Willamette River. The habitat model uses an underlying hydraulic model and habitat criteria provided by the Science for the Willamette Instream Flow Team (SWIFT). The field study was conducted during April–July in 2020 and 2021. Data were collected in a total of 634 habitat cells (approximately 2-m^2 apiece) in the mainstem Willamette River (rkm 167–281), in the lower Santiam River (rkm 6–27), and in the lower McKenzie River (rkm 41 and rkm 33) and included parameters that described habitat conditions (Figure 1) and fish presence. Habitat cells included sites located in the main channel (373 cells; 59%), side channels (228 cells; 36%), and alcoves (33 cells; 5 percent). Snorkelers observed juvenile Chinook salmon in 42% of the cells in the main channel, 38% of the cells in the side channel, and in 6% of cells in alcoves.

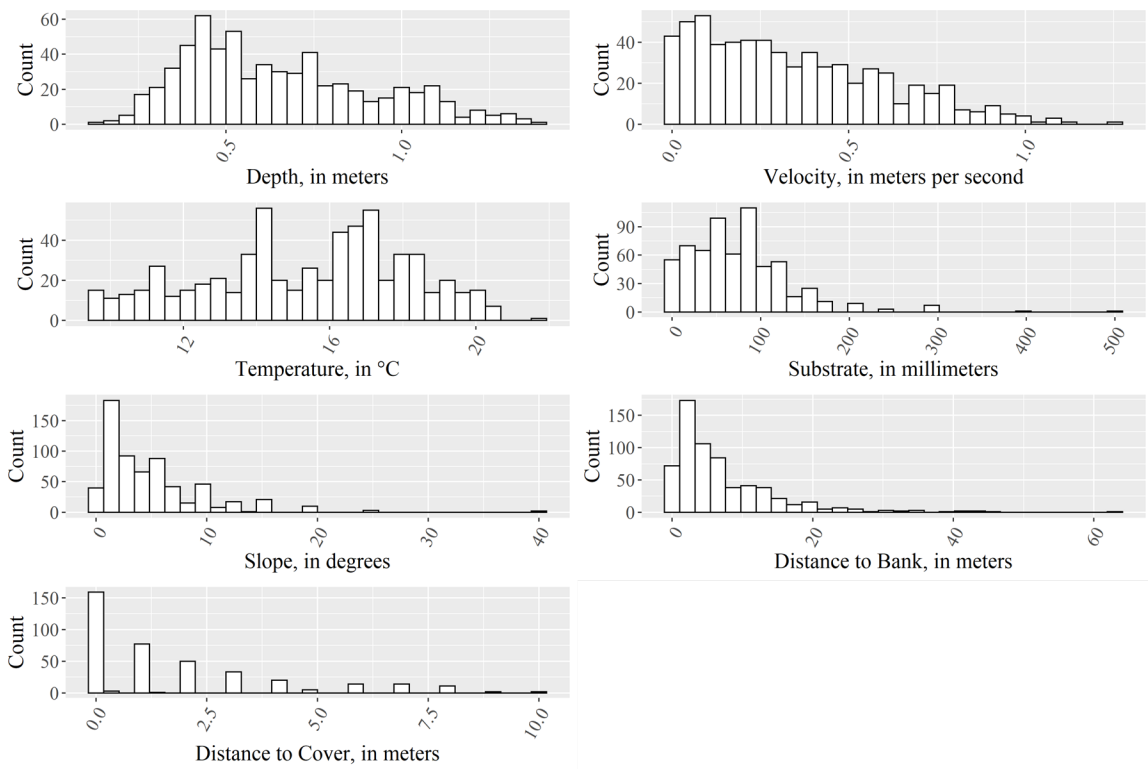

Figure 1.—Histograms showing data distributions for seven variables describing fish habitat that were collected in the Willamette River basin during April–July in 2020 and 2021.

Results from the study showed that habitat preference for juvenile Chinook salmon underwent a seasonal shift from April to July. Juvenile Chinook salmon transitioned into habitat with higher water velocity as the season progressed (Figure 2). This transition resulted in fish using habitats during June and July that were substantially different than habitat defined by SWIFT (Figure 2). We also found that juvenile Chinook salmon were rarely observed in water depths less than 0.25 m, whereas SWIFT criteria included water depths to a minimum of 0.05 m. For April, 92% of the cells where Chinook salmon were present had depth and velocities that fell within SWIFT criteria. However, in June and July a substantial percent (34% and 73%, respectively) of the cells where juvenile Chinook salmon were observed fell outside of the SWIFT criteria. Finally, depth preference remained largely unchanged throughout the study period so the hydrodynamic model criteria should primarily be modified to account for seasonal changes in water velocity preferences. These findings should prove useful for increasing the predictive accuracy of the hydrodynamic model for juvenile Chinook salmon rearing habitat.

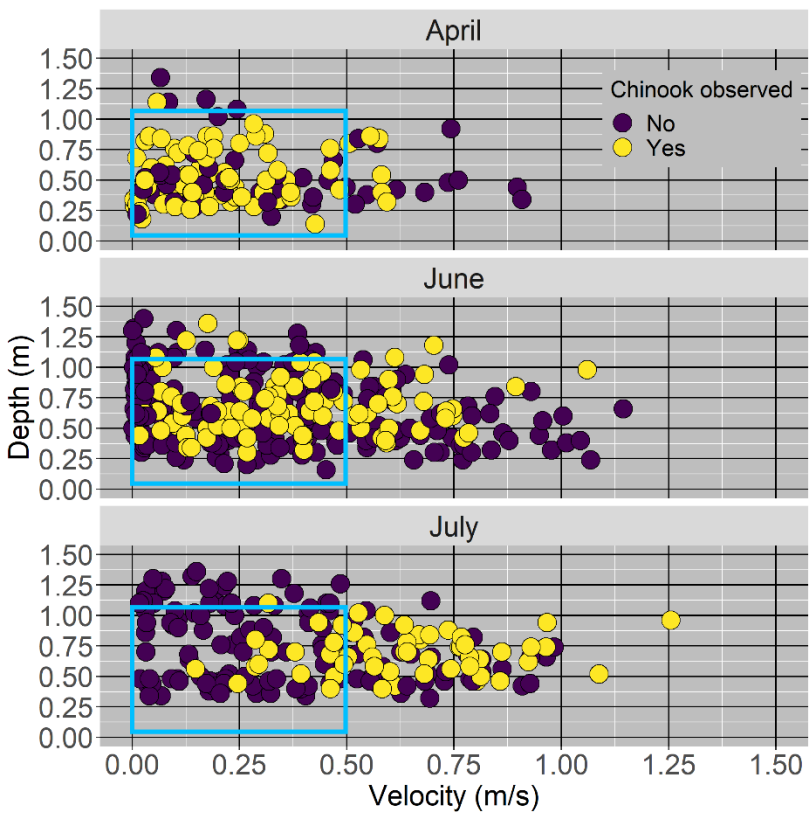

Figure 2.—Water velocity and depth measurements for habitat cells where juvenile Chinook salmon were observed (yellow) and not observed (purple) during sampling in April, June and July of 2020 and 2021. The blue overlay box outlines water velocity and depth values predicted as suitable habitat by the hydrodynamic model.

We developed resource selection functions to describe the probability of juvenile Chinook salmon presence in Willamette River basin habitats based on water velocity and water depth for

April, June and July (Figure 3). These functions illustrate the shift to areas of increased water velocity from April to July and provide updated criteria for use as inputs into the hydrodynamic model. Results from the field study and modeling efforts provide new insights into habitat use by juvenile Chinook salmon based on data that was explicitly collected in the Willamette River basin.

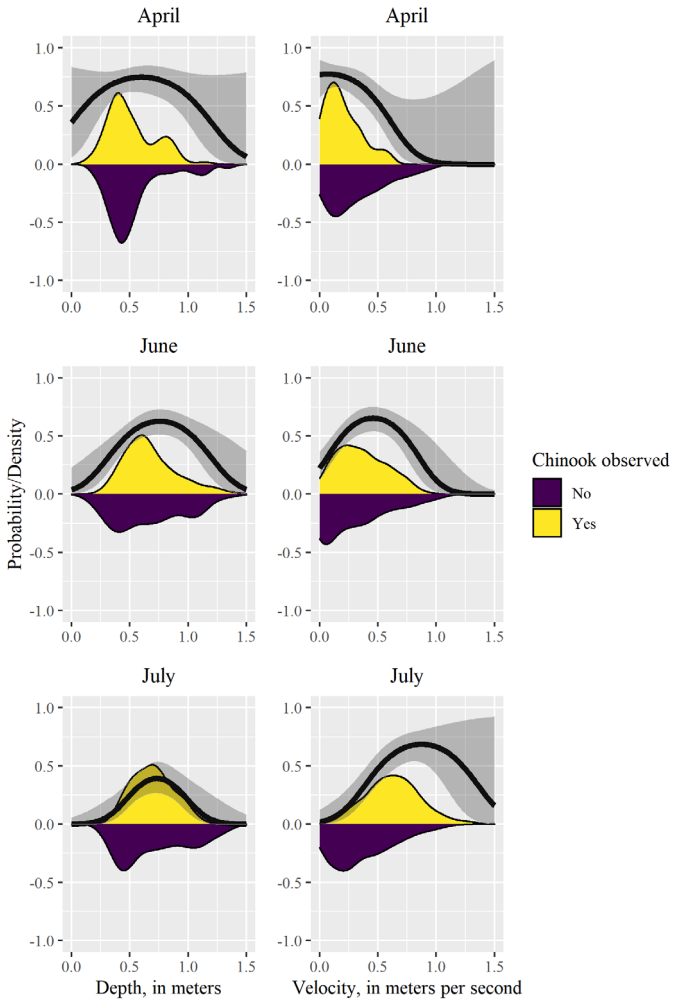

Figure 3.—Monthly resource selection functions (black bold line) for juvenile Chinook salmon presence probability in Willamette River habitat based on water depth and water velocity. Uncertainty in the resource selection function estimates is shown as the grey band. Also included are kernel density plots showing the distribution of data collected each month in habitat cells where juvenile Chinook salmon were observed (yellow) and not observed (purple).