Land-use Impacts on Water Quality and Salish Sucker Distribution in the Fraser Valley

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Abstract

Salish sucker is SARA listed species found in the Fraser Valley. Its Recovery Strategy identifies critical habitat, but none of it is legally protected yet. In our study we examine the spatial relations between land use, water quality and the occurrence of Salish sucker in order to be able to better identify critical habitat and the impact of land uses on that habitat.

Background and Relevance

Current freshwater ecosystem management practices lack predictive capacity for identifying the essential habitat characteristics required for persistence of both rare and common species. The study area in the lower Fraser Valley is home to two endangered freshwater fishes, Salish Sucker (*Catostomus sp.*) and Nooksack Dace (*Rhinichthys sp.*), and used as spawning and overwintering habitat for Coho (*Oncorhynchus kisutch)*, and resident Cutthroat Trout (*Oncorhynchus clarkii*), as well as resident rainbow trout, steelhead, chinook, and lamprey. Water quality, specifically hypoxia, has been identified as a major threat to the recovery of Salish sucker (Fisheries and Oceans Canada, 2012), and likely also limits the abundance of salmonids. In our research we examine the land use impacts on water quality and fish distribution, specifically the Salish sucker.

Study Site

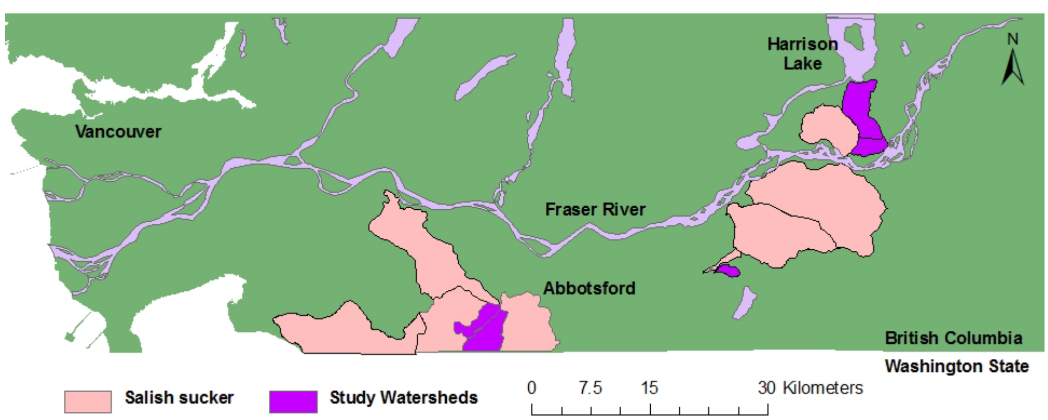

Figure 1: Map of the Fraser Valley highlighting the study areas

Methods and Data

Field studies over two summers in five streams in the Fraser Valley (Figure 1) sampled water quality and for Salish Sucker occupancy, and the adjacent land uses were noted. Water quality data collected included dissolved oxygen (DO), temperature, conductivity and depth. Salish Sucker occupancy was collected using 24 hours sets using Feddes traps set 150m apart in each stream. Fish species and abundance, and Salish sucker measurements (length, weight and tag ID) were recorded.

In order to assess the relative impact of different land-uses on water quality we used an exploratory spatial analysis technique--grouping analysis--to help us identify fundamental site differences. Four grouping analyses were conducted using the buffered summer water quality layer as the input feature and grouped into three categories (low, medium and high). Each water quality parameter, (DO, temperature, and conductivity), was used as an analysis field individually and then the fourth grouping analysis combined the three water quality measurements and was grouped into four categories. No spatial constraints were set, so a K Means algorithm was used for grouping. This minimizes the differences among the features in a group, over all three groups.

Intensive land-uses result in hypoxic water conditions, which is the most important factor driving Salish sucker presence at a site. Using the program 'unmarked' in R, we used occupancy probabilities, derived from the sampling data, to determine the spatial relation between fish presence and the water quality parameters.

Results

The results of the grouping analysis showed a clear relation between land use and water quality. 89% of the sites classified as forest were grouped into good dissolved oxygen, temperature and conductivity compared to only 21% of agriculture sites, 18% industrial and no urban sites. Of importance, 33% of the agriculture sites and 46% of the industrial sites had dissolved oxygen measurements below 2mg/L, which is considered hypoxic and barely able to sustain aquatic life. The results of the occupancy probability analysis showed clear relations between Salish sucker presence and water quality parameters. However, the relations changed over the summer as the site conditions changed, which clearly demonstrates the need for a multi-temporal study. The most parsimonious model found that the probability of detection in the spring was negatively related to dissolved oxygen and positivity related to temperature; while the probability of occupancy is negatively associated with percentage cover. Conversely, the summer model determined that the probability of detection was positively related to dissolved oxygen; occupancy was negatively related to percentage cover and percentage reed canary grass. Between the two seasons the probability of site occupancy decreased from 0.70 in the spring to 0.48 in the summer, suggesting that there is less suitable habitat available for the Salish sucker in the summer months perhaps due to declining water quality.

Conclusions

Through our analyses we identified a relationship between degraded water quality and intensive land-use. We also identified that Salish sucker presence is a function of dissolved oxygen. Our results show that multi-temporal and large spatial scales are important for identifying seasonal habitat usage and land-use impacts.

References

Fisheries and Oceans Canada. 2012. *Recovery strategy for the Salish Sucker (Catostomus sp .) in Canada*. Species at Risk Act Recovery Strategy Series, Fisheries and Oceans Canada, Vancouver. viii + 64 pp.