Potential Sockeye Salmon Spawning Sites within the John Prince Research Forest:

based on a 3% slope gradient

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Abstract

This project was developed to predict areas of Sockeye Salmon spawning habitat within the John Prince Research Forest (JPRF). Model Builder was used to create a model that would generate the slope of both streams and rivers within the research forest, as well at to extract segments of streams and rivers with a slope gradient <3% which is based on critical environmental parameters for spawning Sockeye. Spawning Salmon are highly sensitive to varying environmental conditions and will not spawn if the environmental conditions are not adequate.

Introduction

Sockeye Salmon have specific environmental parameters in which they are able to spawn in. These Parameters include temperature, bed material, stream gradient and water chemistry (DFO, accessed October 21, 2007; Brunett et al, 2007). These parameters are outlined by the NCSU, which states the following guidelines for Sockeye spawning habitat: need water temperatures to be 10°c; a maximum stream gradient of 3%; and bed material must be clean (meaning not silky) and particle sizes can range from Sockeye Salmon are extremely sensitive to changes in these environmental parameters therefore to maintain productive spawning habitat actions must be taken to ensure that these sites are sustained for future generations of Sockeye.

A low sediment load is required during the salmon spawning seasons. A high-velocity stream flow is capable of carrying more sediment and will often have high levels of suspended solids. Any sediment transported by the water is subject to deposition as velocity decreases. Deposition of sediment on spawning beds can hamper salmon reproduction. Salmon eggs require a well-oxygenated environment during the embryonic stage. Eggs are laid in permeable gravel beds with many open spaces that allow continuous water flow to bathe the eggs with cool oxygenated water. When sediment is deposited, the open spaces can become clogged and the circulation of water may be reduced. Embryos can suffocate from a lack of oxygen and may be poisoned by their own metabolic waste (NCSU, 2007). Brunett et al (2007) incorporated GIS modeling techniques for the Coastal Landscape Analysis and Modeling Study (CLAMS) in order to examine the distribution of potential salmon habitat based on current and future landscape characteristics along the Oregon coast. The habitat modeling was done to determine the potential areas of high quality rearing habitat for juvenile Coho and Steelhead salmon stalks, based on stream flow, valley constraints and stream gradient (Brunett et al, 2007). Brunett et al (2007) found that changes to landscape characteristics influence stream habitat and in turn greatly impact salmonid populations. By applying GIS model builder to Sockeye habitat in the John Prince Research Forest (JPRF) theoretical parameters can be used to assess where potential areas of spawning habitat are within the JPRF. The objective of this project was to generate a model which will use stream gradient to help determine areas of essential fish habitat (EFH) pertaining to Sockeye Salmon spawning sites. It must be addressed that further environmental parameters are needed that were not available at the time of this project. These parameters are addressed in the concluding remarks of this project.

Study Area and Data Source

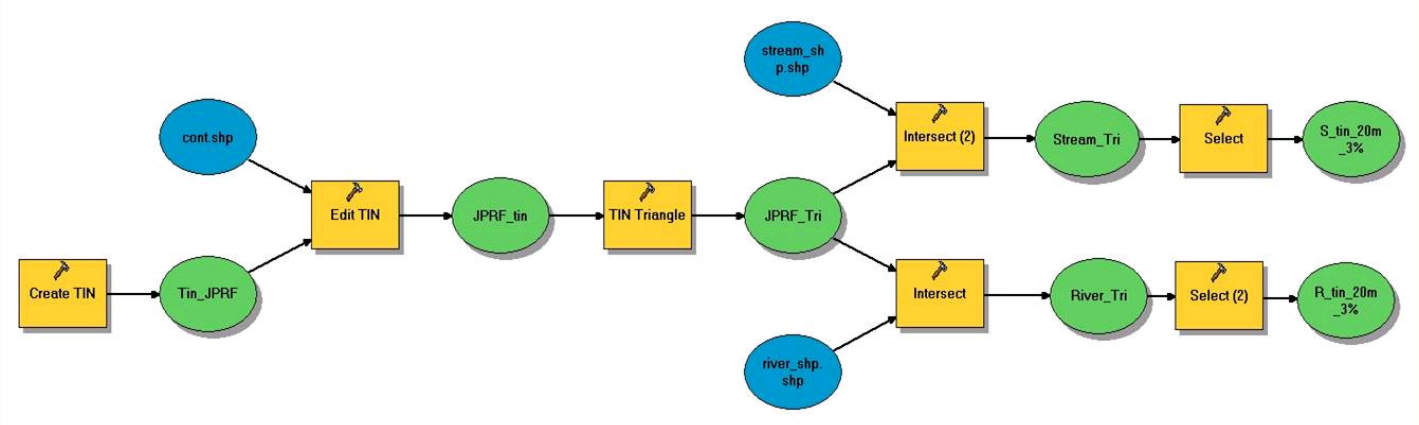
- The study area is the John Prince Research Forest (JPRF) in North Central BC, 50 km north of Fort St. James, B.C.
- Data used for this project included: streams; rivers; lakes; study boundary; and trim data.
- The data used for this project was available from the UNBC GIS lab as well as from the JPRF website at http://researchforest.unbc.ca/jprf/jprf.htm

Data Manipulation

- Converted all layers from ARC files to shape files
- Created a Tin Triangle from the Trim Data
- Intersected the Streams layer with the Tin Triangle in order to extract stream gradient
- Intersected the Rivers layer with the Tin Triangle in order to extract gradient of the rivers
- Extracted streams with gradient of <3%
- Extracted rivers with gradient of <3%

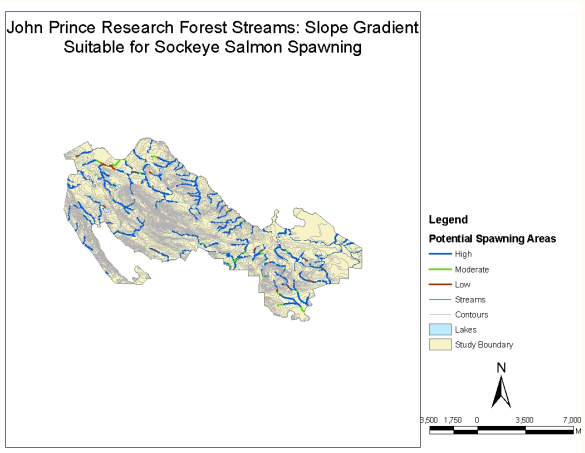
Methods / Procedure

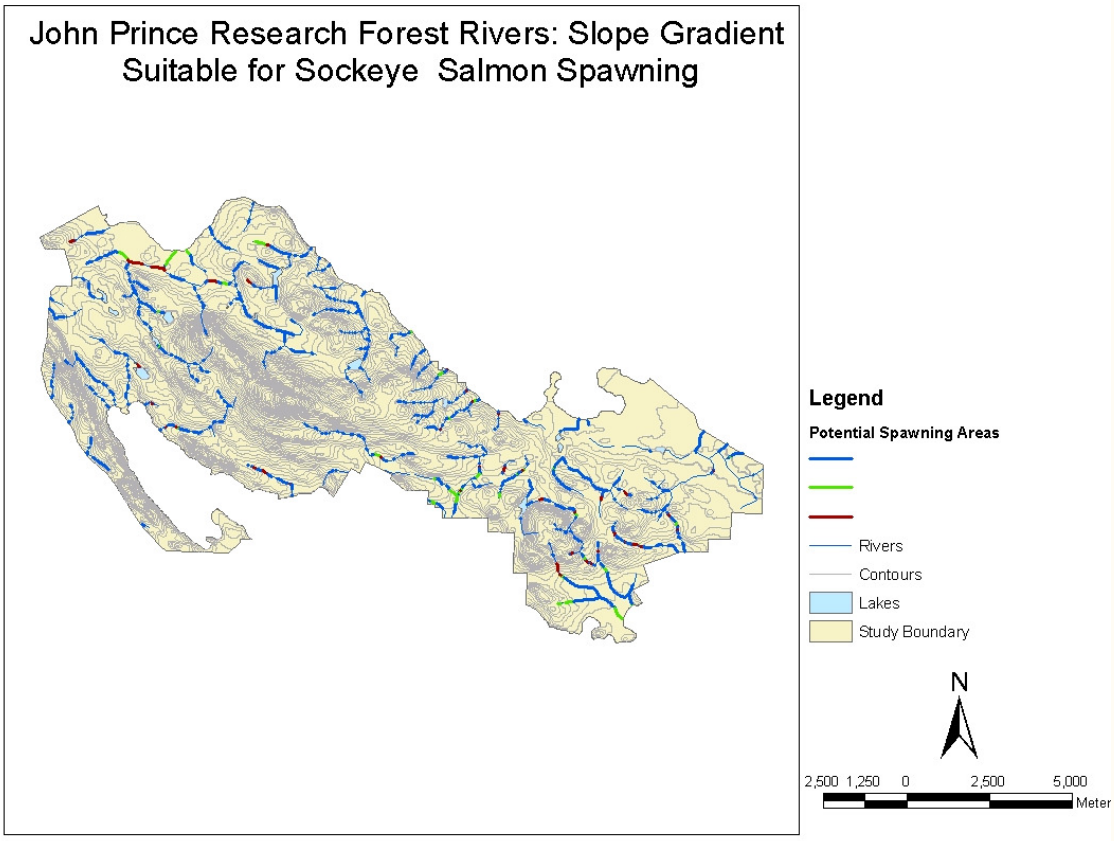
- Model builder was used to build a mode (seen below) that created: a TIN of the JPRF from the contours of the JPRF (trim data); the TIN was edited using an editing tool which converted the TIN into a TIN triangle in order to extract the gradient of hill slopes within the JPRF; the TIN triangle was then intersected with both the Streams and Rivers shape files to created two shape file one containing the gradient of streams and the other with the gradient of rivers within the JPRF; finally the select tool was used to create two new layers with gradients of <3% for both streams and Rivers.



Results

- Potential Spawning sites based on <3% stream gradient for Sockeye Salmon are indicated by blue, green and red lines in both the JPRF Streams and Rivers: slope gradient suitable for Sockeye Salmon spawning. Blue being high indicated highest potential for spawning based on lowest stream gradients and lowest energy exertion for the spawning Sockeye. Green are areas of moderated potential based on moderate stream gradient and moderate energy exertion within potential spawning areas. Red indicates areas of lowest spawning potential based on the highest stream gradient and highest energy exertion by the salmon.





Conclusions / Discussion

- In conclusion modeling spawning habitat for sockeye based on slope is possible; however, more environmental parameters are needed than were available for this project. Further parameters that would be needed to more accurately model Sockeye Salmon spawning sites would include, but are not limited to: water temperatures; water depth; bed material particle sizes; and water turbidity. In order to determine how effective this method of predicting Sockeye Salmon spawning sites is the results generated would need to be compared to actual field surveys pertaining known areas of Sockeye spawning in the JPRF.

References

- all materials, idea referenced in this project
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