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The Role of Sediments and Aquatic Plants in the Nutrient Budget of Spirit Lake at Mount St. Helens, WA

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INTRODUCTION

The 1980 eruption of Mount St. Helens caused the bathymetry of Spirit Lake to change drastically, resulting in an increase in surface area and a decrease in average depth. Subsequently, Spirit Lake is experiencing an increase in productivity. This analysis examines concentrations of carbon, nitrogen and phosphorus obtained from sediment samples collected over the summer of 2010, as well as aquatic plant height data, in order to identify sources of the lake's increasing productivity. The results of these analyses will be used as part of a larger nutrient cycling model examining changes in the lake over time.

OBJECTIVES

To calculate nutrient concentrations in immediate areas surrounding determined watershed entry points in order to identify major source areas of nutrient input. To create surfaces of sediment Carbon, Nitrogen, Phosphorus and plant height to determine total nutrients in the lake sediment as well as photic zone.

METHODS

Nutrient concentration results and GPS sediment sampling location data were added to ArcMap and joined. Incising zonal statistics was added as a layer as XY data. Kriging Interpolations were done for Carbon, Nitrogen and Phosphorus concentrations for the lake in total. A bathymetric point shapefile was obtained from PSU and was interpolated using IDW. Field calculator was used to calculate concentrations in meters from the given the elevation attribute.

Figure 1. Zonal statistics for carbon concentrations in parts per million for each 200 meter buffer zone for all calculated drainage basins.

Figure 2. These entry points which nutrients can be attributed to the surrounding drainage basin areas. Zonal statistics were run to determine C, N, P values within each buffer per drainage basin. This analysis tells us how much C, N, and P are being contributed to the lake by each basin in the surrounding watershed.

METHODS CONT'D.

To determine mean plant height, a point shapefile containing canopy heights was manipulated to eliminate any values over 2 meters to eliminate inaccuracies caused by logs still lodged in the lake floor from the eruption. Next, an IDW interpolation was performed on the plant height attribute. Using the bathymetry layer reclassified into photic (≤10 m deep) and sub-photic (≥10 m deep) zones, zonal statistics were run to determine total lake area per zone as well as average plant heights per zone.

RESULTS

The outputs of these analyses will be used to determine total C, N and P due to plant biomass as well as total C, N and P in the lake sediment by volume. These results will be used in conjunction with land cover data per drainage basin in order to identify sources of high nutrient input in the surrounding areas.

Figure 3. Kriging interpolation of sediment carbon concentrations derived from sediment sampling data.

Figure 4. Zonal statistics for carbon concentrations in parts per million for each 200 meter buffer zone for all calculated drainage basins.

Figure 5. Mean phosphorus concentrations per buffer zone obtained from zonal statistics output.

Figure 6. Bathymetry of lake classified in 5 meter increments.

Figure 7. Zonal statistics for plant heights in photic and sub-photic zones. These plant heights were interpolated to determine total plant nutrients in each zone as well as total nutrient concentrations in lake sediment.

Figure 8. Kriging interpolation of nitrogen concentrations in parts per million for each 200 meter buffer zone for all calculated drainage basins.

Figure 9. Kriging interpolation of sediment carbon concentrations derived from sediment sampling data.

Figure 10. Zonal statistics for nitrogen concentrations in parts per million for each 200 meter buffer zone for all calculated drainage basins.

Figure 11. Mean nitrogen concentrations per buffer zone obtained from zonal statistics output.

Figure 12. These entry points which nutrients can be attributed to the surrounding drainage basin areas. Zonal statistics were run to determine C, N, P values within each buffer per drainage basin. This analysis tells us how much C, N, and P are being contributed to the lake by each basin in the surrounding watershed.

Figure 13. Kriging interpolation of nitrogen concentrations in parts per million for each 200 meter buffer zone for all calculated drainage basins.