Use of Topographic Indices to Predict Potential Brook Trout *(Salvelinus fontinalis)* Habitat in Lakes on the Canadian Shield

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Brook trout (*Salvelinus fontinalis*) are closely linked to the hydrology of the watersheds they inhabit. Groundwater inputs in the form of surface or sub-surface flow at lake and stream margins are important features of spawning (Curry and Devito 1996; Blanchfield and Ridgway 1997) and young-of-year (YOY) habitat (Curry *et al*. 1997; Biro 1998). Landscape features such as topography can be used in a geographical information system (GIS) to map these areas of potential saturation and water accumulation with the use of a topographic index (TI). The $\ln(a/\tan\beta)$ is a widely used TI in hydrology derived from the soil saturation component of Beven and Kirkby's (1979) TOPMODEL, where a is the up-slope area contributing water to a given cell and β is the slope of that cell.

A TI was developed for Algonquin Park, Ontario, to identify potential brook trout habitat and associated sub-catchments that sustain them. A field survey of 21 lakes in the Park with self-sustaining populations of brook trout was also undertaken to determine the distribution of hydrological features used by YOY brook trout. Large values of the topographic index (representing high inputs of groundwater) derived in a GIS environment were found to correspond closely to field locations of potential brook trout habitat in lakes. Only 11% of cells (from a total of over 13500) from the 21 lakes surveyed have TI values large enough to be considered potential brook trout YOY habitat. YOY use of these seepage and stream habitats was seasonal with few being used in both spring and summer. This is possibly associated with their strong ($P<0.01$) preference for colder, shallower, and narrower habitats typical of small groundwater dominated streams. The number of potential seepage and stream habitats increases asymptotically with lake surface area ($R^2=0.74$). The asymptote of the relationship occurs at a lake surface area of 200 ha.

Provincially, 93% of all brook trout lakes have a surface area of less than 200 ha. It appears that lakes greater than 200 ha have a lower density seepage and stream habitat per kilometre of shoreline despite the significant increase of catchment area with increased lake surface area ($R^2=0.85$). The limited number of nursery habitats in larger lakes may be attributed to the increasing complexity of drainage networks (i.e. higher order streams) in larger catchments. Thus larger lakes have proportionally the same amount of habitat; however the number of YOY access points to that habitat decreases in larger lakes.

Over 50% of the potential lake shore habitats found in the field were not present on the Ontario map system. However, preliminary results show that YOY brook trout show patterns in their use of different TI values at different times of the year and in different habitats. Knowledge of the spatial patterns of brook trout groundwater habitat use is therefore required to protect these areas from anthropogenic sources of disturbance. This large scale GIS and TI approach offers a means of predicting the location of potential habitat sites based on their physical characteristics.

References

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