Assessment of lake suitability to rainbow smelt invasion based on information from native range in Maine

Methods as described in Mercado-Silva, N., J.D. Olden, J.T. Maxted, T.R. Hrabik, M.J. Vander Zanden. 2006. Forecasting the spread of invasive rainbow smelt in the Laurentian Great Lakes region of North America. Conservation Biology 20: 1740-1749:

"Our objectives were to develop a model for rainbow smelt presence and absence based on their distribution in their native range in coastal regions of Maine (U.S.A.) and to apply model predictions in other geographic areas to forecast future invasion potential.

(…) Limnological data and rainbow smelt distribution data for Maine lakes were obtained from databases managed by the Public Educational Access to Environmental Information (PEARL) in Maine. We estimated that 354 Maine lakes are within the native range of rainbow smelt. (…) Lake morphometry and physical-chemistry variables were obtained for 819 lakes from data sets in PEARL (provided by the Maine State Department of Inland Fisheries and Wildlife, Maine Department of Environmental Protection, the Volunteer Lake Monitoring Project, Senator George J. Mitchell Center, U.S. Environmental Protection Agency, and the Acadia National Park Lake Monitoring project of the National Park Service) and from geographic information provided by Maine Department of Environmental Protection.

(…) We compiled information for Wisconsin inland lakes from various sources. Maximum lake depth, area, and Secchi-disk readings were obtained from an extensive lake data set at the WDNR (K. E. Webster, personal communication), pH information was obtained from the STORET database of the U.S. Environmental Protection Agency (STORET-EPA), and shoreline perimeter was calculated with a GIS (ESRI 2002) from data obtained from the WDNR. We obtained information for 5188 lakes in Wisconsin, but data availability was uneven among lakes (lake area = 5188 lakes, Secchi-disk readings = 3891, pH = 1190, maximum depth = 5142, shoreline perimeter = 1190).

(…) We used classification trees (Breiman et al. 1984; Salford Systems 2002) to model rainbow smelt presence and absence within their native range in Maine. This methodology uses a recursive partitioning algorithm to repeatedly partition the data set according to the explanatory variables into a nested series of mutually exclusive groups, each as homogeneous as possible with respect to the presence or absence of rainbow smelt (see De'ath & Fabricius 2000).

(…) For Wisconsin lakes, the model had a misclassification rate of 11%. The model correctly predicted presence and absence of smelt (sensitivity = 87.5%; specificity = 89%). The model identified 553 new lakes with the potential to be invaded by smelt. (…) In Wisconsin and Ontario, <5% of lakes capable of supporting smelt currently do, indicating vast potential for future spread in both areas."

References:

Breiman, L., J. H. Friedman, A. Olshen, and C. G. Stone. 1984. Classification and regression trees. Wadsworth International Group, Belmont, California.

De'ath, G., and K. E. Fabricius. 2000. Classification and regression trees: a powerful yet simple technique for ecological data analysis. Ecology 81:3178–3192.

Salford Systems. 2002. CART. California Statistical Software, San Diego.