

## Lake Water Quality in Maine's Changing Landscape (65)

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Topic Area: Land use and water interactions

Approach or Method: 2, 3, 5 and 6

Maine is a water and lake rich state. Nearly 1 million acres of the state are covered by 5,782 lakes larger than 1 acre in surface area ([1]; [2]). Maine lakes range up to 74,890 acres (Moosehead Lake) in surface area and 316 feet in depth ([1]). Maine's lake ecosystems include valuable cold-water fisheries such as land-locked salmon, lake trout, and arctic char, all of which are native to Maine, but vulnerable to cultural eutrophication and fish introductions. Recent water quality assessments underscore the significance of changing land use as a threat to lake ecosystems in Maine.

“The major threat to maintaining the present lake water quality is changing land use. The greatest change has been the transition from mostly forested land to numerous small residential developments ([2], p. 18).”

As in other lake-rich states, lakes have consistently played a prominent role in the spatial distribution and intensity of seasonal residential development in Maine. Recent increases in seasonal development and conversion of seasonal to year-round homes have sparked concerns regarding the management of lakeshore development and the impacts of such development on water quality and other lake services.

This research focuses on the interactions between land-use and lake water quality and strives to provide scientific research to support practical management decisions. Two types of modeling are combined to address lake water quality in Maine's changing landscape. First, an economic model of land conversion to residential use is estimated using statewide data on the conversion of undeveloped lands. Second, we develop a group of models to examine variation in nitrogen, phosphorous, and water clarity as a function of residential development, among other factors. Marrying the two, we are able to simulate future residential development patterns based on the results of the economic model and, in turn, simulate the future water quality of Maine lakes.

The economic model is a spatially-explicit, econometric model of the conversion of undeveloped land to residential use. Conversion is expected to reflect the relative returns to land in alternative uses, such that residential development is more likely to occur in areas where the return to the

land in residential use exceeds its return in an undeveloped use. Because of the landscape characteristics of Maine, the spatial variation in returns to forestland and returns to lands in residential use are paramount to the development of the model. The economic model developed here builds on other spatially-explicit models of land use change (see [3]). Land-cover information from 2 points in time (1991 and 2004) is used to describe conversion to residential use. Various binary discrete choice models are considered, and the model is estimated using statewide data.

The models of water quality draw from ongoing research at the University of Maine and elsewhere on drivers of variation observed nutrient and water clarity levels. This dynamic, instead of static, view of nutrients and water clarity correlated to the changing residential developmental along lakes is an exciting new research topic in Maine.

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