

# Assessing the Effectiveness of Land Conservation in the North Quabbin Region of Massachusetts: 1993 to 2003



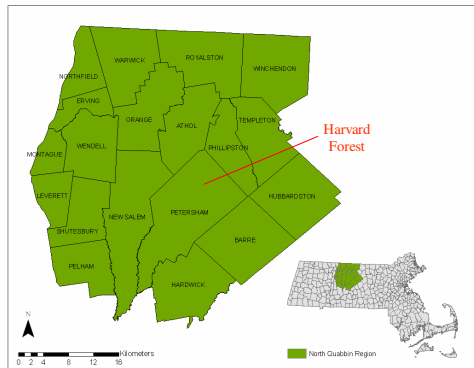
Nicholas Malizia *nmalizia@clarku.edu*



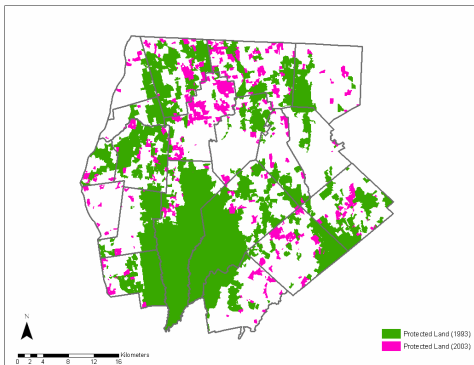
## Abstract

Through the efforts of numerous land conservation agencies and programs, the North Quabbin Region (NQR) of Central Massachusetts has become one of southern New England's largest protected bioreserves. This study develops a methodology to assess the effectiveness of lands acquired for conservation in the region between 1993 and 2003 in contributing to the protection of a diverse ecological and cultural landscape. The methodology uses an index to assess the value of the protected areas in terms of their land cover characteristics, as well as other landscape factors such as the size of the area and proximity to already protected lands. Geographic Information System (GIS) technology was used to assign weights to, and then combine, layers containing spatial information of the different index components. A number of weighting schemes were used and different indices were developed to identify areas of conservation priority based on a variety of ecological and cultural concerns. According to the relative operating characteristic (ROC), the resulting indices showed that in all cases the lands protected between 1993 and 2003 scored better than random. This illustrates that parcels protected during this time were concentrated on areas of relatively high ecological or cultural value. To date, this methodology has been used to assess the value of already protected lands; however, it can also be used as a tool to prioritize lands for future conservation actions.

## North Quabbin Region (NQR) Study Area

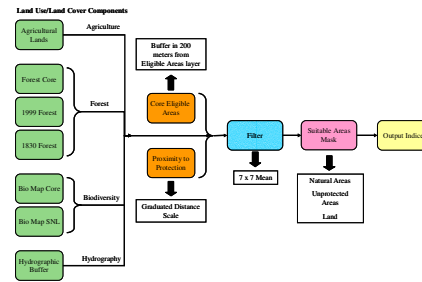


## Protection Status in the NQR: 1993 and 2003



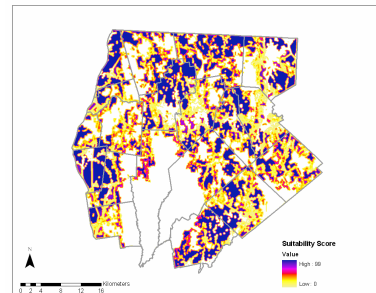
Conservation groups have invested millions of dollars to protect lands in the North Quabbin Region. In 1993, 37% of the NQR was protected. The green lands in the image above locate the lands that were in protection as of 1993. By 2003, 43% of the NQR landscape was protected. The pink lands in the image above locate lands that were protected between 1993 and 2003.

## Index Development



To assess the conservation lands, indices were created that weighted the value of protection according to maps delineating land cover characteristics, proximity to protection, and location in eligible core areas. These suitability variables represented by the criteria map layers were scaled from 0, the least suitable according to the represented criteria, to 100, the most suitable. The contributing layers were then multiplied by some fraction to weight their influence in the final index. The resulting weighted maps were then added together to yield the suitability indices.

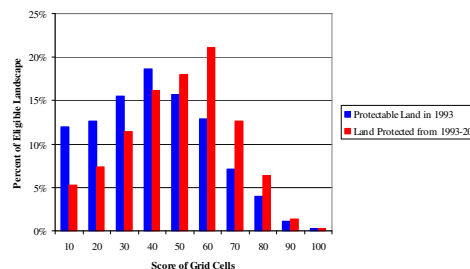
## Example Index



This is one of the indices developed using this methodology. The biodiversity land cover component, proximity to protection, and eligible core area layers were all given equal weighting to assess the areas protected between 1993 and 2003.

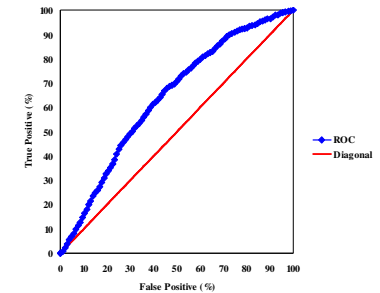
## Protected v. Protectable

Effectiveness of NQR Protection According to BioMap Index



The value of the lands protected between 1993 and 2003 are compared to the total lands eligible for protection during the time period according to the example index shown above. The trend shows that the protected lands scored higher than the rest of the eligible landscape and are thereby better suited for protection.

## Assessment Using ROC



The ROC is used as an indication of how well the protected areas lie on the high scoring cells of the suitability index. To calculate the ROC, grid cells in the suitability image are grouped into 100 classes based on their values. The top scoring 1% of the grid cells are in group one; the next 1% are in group two and so on. If protection is effective, it would first occur in the highest scoring cells and then the lower scoring cells. To determine the ROC, the entire suitability image is eventually protected according to this process; each group is protected according to its order and then added to the other antecedent groups. If a grid cell is predicted to be protected by the process and is, then it is classified as a true-positive. If it was not protected yet predicted to be so it is classified as a false-positive. The amount of true-positives predicted by the suitability map is compared to the amount of false-positives for each step in the process using a curve. The blue line in the figure above represents this curve. The area under the curve is the ROC value. Protection that perfectly follows the scores of the suitability map would have an ROC of one. If acquired lands are of little or no value the ROC would have a value of zero. A random allocation of protected lands would yield an ROC of .5. The red diagonal in the figure above delineates this scenario. The above diagram shows the ROC for the example biodiversity index, which scored .638 indicating protection was slightly better than random.

Area	Contributing Layers					ROC Value
	Proximity	Agriculture	Forest	BioMap	Hydrography	
60%	20%	20%	—	—	—	64.4
33%	33%	33%	—	—	—	64.8
20%	20%	60%	—	—	—	62.3
20%	60%	—	—	—	—	60.9
60%	20%	—	20%	—	—	65.1
33%	33%	—	33%	—	—	65.8
20%	20%	—	60%	—	—	65.0
20%	60%	—	20%	—	—	61.8
60%	20%	—	—	20%	—	64.4
33%	33%	—	—	33%	—	64.5
20%	20%	—	—	60%	—	63.1
20%	60%	—	—	20%	—	62.0
60%	20%	—	—	—	20%	64.7
33%	33%	—	—	—	33%	65.0
20%	20%	—	—	—	60%	63.0
20%	60%	—	—	—	20%	61.3

This table outlines all the combinations of layers and weightings that were used to create the indices. The ROC values for the protected areas according to each suitability index are also provided to compare how well the protection performed according to each of the suitability indices. While the values suggest that the protection was better than a random allocation of the same area of conservation, the value is too low to be considered a good representation of the most valuable eligible lands. These low values may result because some of the lands with the highest suitability were not actually available for acquisition during this time period, even though they were deemed eligible for protection in this study.

## Next Steps

Work on this project will continue through the school year. Eventually, we will present this information to local land trusts so they can use this information to guide their future acquisitions.

## Acknowledgements

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