Biodiversity Indicator Tool (BIT)

Product Summary

September 6, 2016

Introduction

In April 2007, the OPRHP received a grant from the NY State Biodiversity Research Institute to develop a Geographic Information Systems (GIS)-based model to help OPRHP address the two common threats to biodiversity – habitat fragmentation and adjacent land use pressures. The model was designed as a tool to rank areas adjacent to State Park lands based upon the potential of those areas to support high biodiversity. Therefore, the model could help guide OPRHP decisions with respect to augmenting State Park land important for species and ecological community viability, maintaining or increasing ecological connectivity between natural areas within the landscape, and buffering State Park land from adjacent land use impacts (Figure 1).

Much has changed since 2007: new data have been acquired, landscapes throughout the state have been altered, and Park boundaries have changed. Therefore an updated tool reflecting current data and information was needed for land surrounding State Parks, but also for our partners throughout the state. A contractor worked in collaboration with a Connectivity Model Team to develop a tool – referred to as the Biodiversity Indicator Tool (BIT) – that can identify high priority areas for open space protection statewide. The Connectivity Model Team was made up of biodiversity, GIS, and planning specialists from NYS ITS, OPRHP and NYNHP. The contractor also consulted with users of the previous version of the tool, OPRHP Planners and Real Property staff, as well as Executive staff to guide the development of this tool.

The primary goal of the tool is unchanged, namely, to inform OPRHP decision-making related to planning and biodiversity conservation. However, this updated and expanded tool has statewide coverage and is therefore not limited to areas in the vicinity of State Park lands. The Biodiversity Indicator Tool can therefore support decision making in four key arenas at different geographic scales:

1) The tool provides information about potentially high biodiversity locations *within* State Parks and Sites;

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2) BIT also provides priority ranking of areas for biodiversity protection on lands *adjacent* to OPRHP lands;

3) The tool can help identify opportunities for maintaining or increasing connectivity *between* State Park lands and natural areas within the landscape; and

4) Finally, the tool can be used to identify opportunities for open space protection *statewide.*

This updated model will be a valuable tool in assisting OPRHP and others in decisions related to land conservation based on biodiversity protection and enhancement. Because the results of this project were developed using a scientifically-based methodology, they provide a credible basis for comparison of various proposals for open space conservation. This model serves to incorporate biodiversity information into the mix of criteria used for open space acquisition and other protection measures. It is an important tool for predicting areas of high potential biodiversity that will act as buffers or connections designed to protect and enhance habitats crucial to the viability of both listed and common species as well as ecological communities.
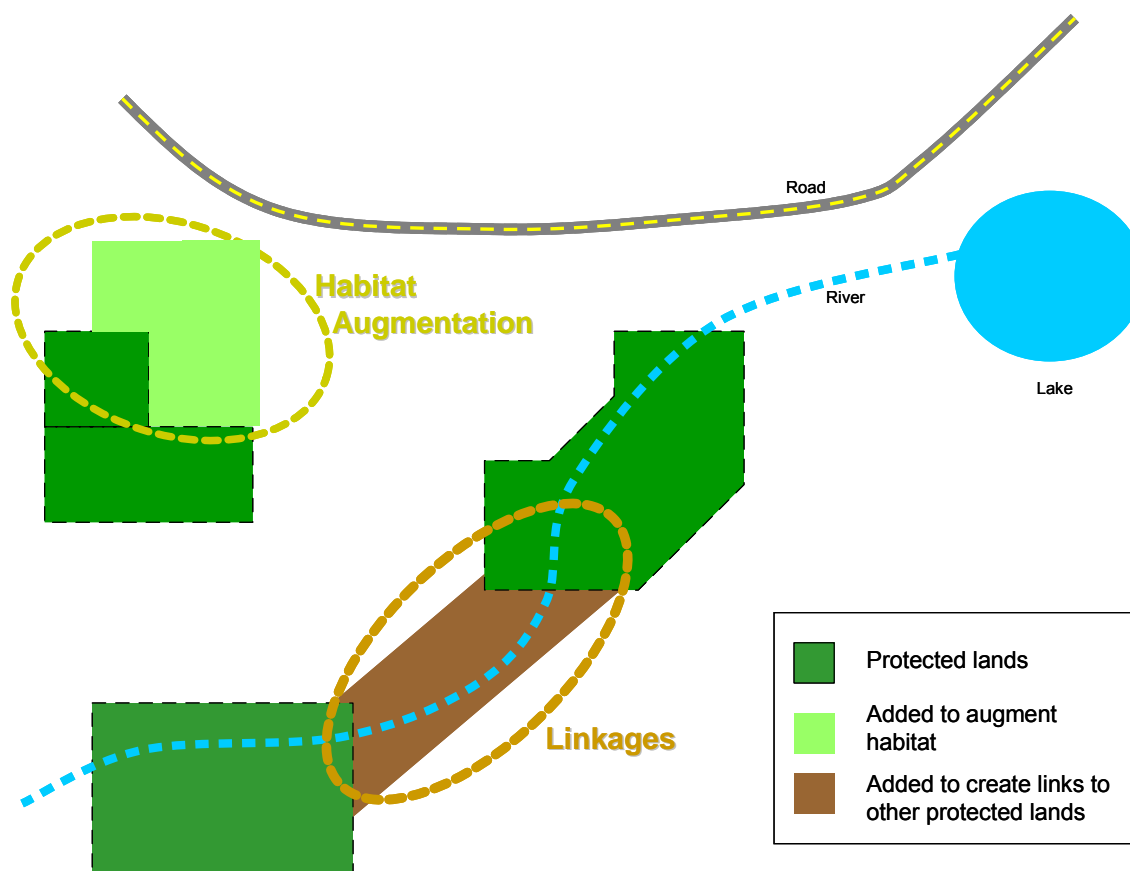
Figure 1 – Schematic representation of how acquired lands can increase "connectivity," either by augmenting habitat near existing protected lands, or by creating new links between protected areas.

Description of the GIS Model

The underlying biodiversity indicator model and associated GIS mapping tools were built from a set of readily available natural resource data sources available in geospatial format. Data sources included the richness of rare or threatened animals and plants; the presence of significant natural communities; the richness of common vertebrate species; the presence and size of contiguous blocks of core forest; the presence of other natural lands, such as grasslands; the presence of wetlands; proximity to streams and water bodies; and proximity to areas of high environmental stress caused by anthropogenic features and activities.

Individual data layers were compiled, processed, and normalized to a common scale of zero for a regular grid of 30 × 30 meter cells covering the entire state. The values of the individual data layers at each unique cell across the state were then added to yield the final value for that cell. Each output cell has a value equal to the sum of the input data layers at that location (Figure 2). Resulting cell values are essentially the biodiversity score for each location. Higher scores indicate that more biodiversity features from the input data layers were present; lower scores indicate fewer co-occurring features. Thus, high values of the indicator point to locations where animals, plants and biological communities are more likely to occur and thrive.

The output of the model is a 30 x 30-meter grid covering the state. For convenience, the resulting model values were rescored to an easily recognizable scale of 0 – 100, where 100 equals highest potential value of biodiversity. Therefore, in its entirety, the model is simply a linear mathematical combination of the geospatial data layers, and the output of the model is a single number. This number is the "biodiversity indicator."
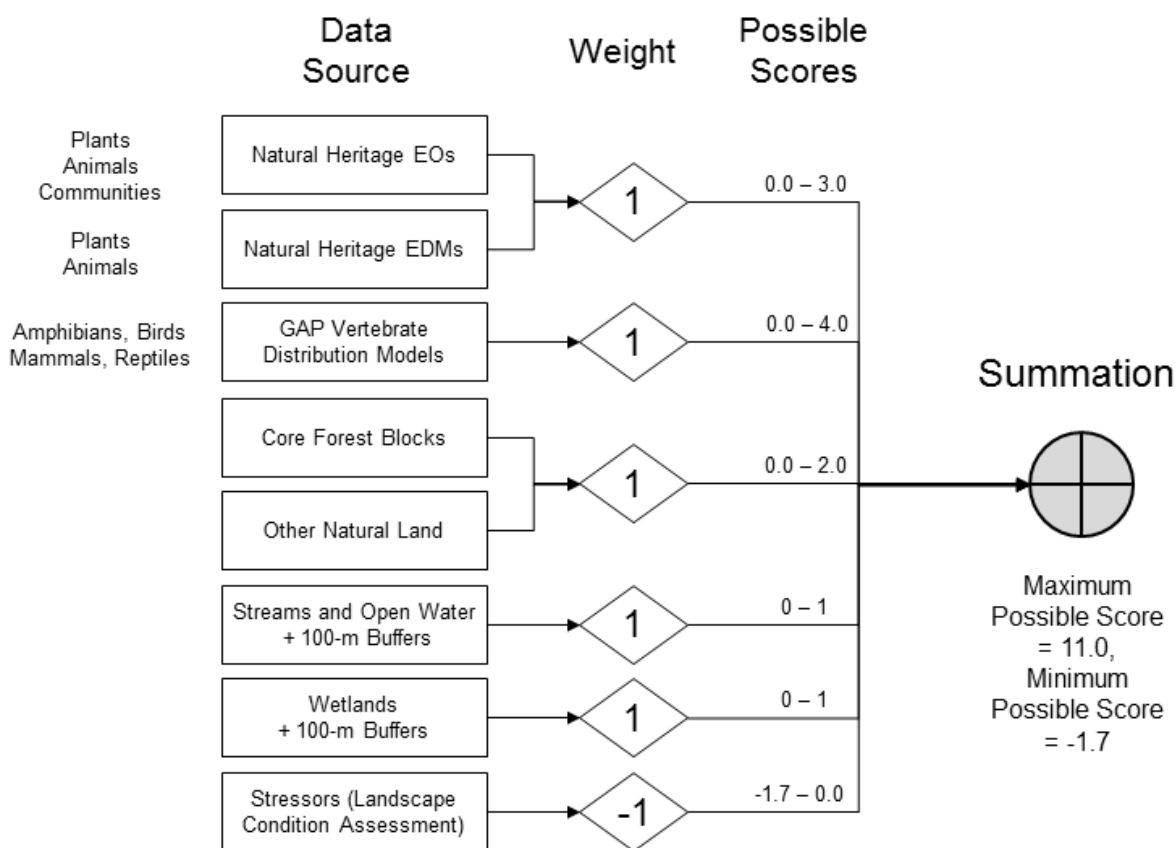
Figure 2 – Flow chart of the GIS modeling process. All input data layers are 30 x 30 meter rasters clipped to the boundaries of New York State plus 200 meters. Baseline raster values are 1.0 for the presence of a feature and 0.0 for the background, except for core forest, grassland, and landscape condition, which can exceed 1.0 in limited areas. A weighting factor is multiplied by each raster. In the baseline version of the model supplied to users, all weights are equal to 1. The weighted raster layers are added together to produce the model output. Although the maximum possible score is 11.0 that value score is generally not achieved anywhere. For simplicity of presentation, the resulting model output was rescaled to a range of 0 – 100; i.e. the maximum score from the output is equal to 100.

GIS Process Steps for the Weighted Model

Dataset Name	Description	Scoring
Communities	NYNHP Significant natural communities, converted to raster format.	Presence/absence (0 or 1).
GAP_Amphibians	USGS GAP amphibian species distribution models, excluding NYNHP rare species. Sum = common amphibian richness.	Linear scaling to statewide maximum richness (0.0 – 1.0).
GAP_Birds	USGS GAP bird species distribution models, excluding NYNHP rare species. Sum = common bird richness.	Linear scaling to statewide maximum richness (0.0 – 1.0).
GAP_Mammals	USGS GAP mammal species distribution models, excluding NYNHP rare species. Sum = common mammal richness.	Linear scaling to statewide maximum richness (0.0 – 1.0).
GAP_Reptiles	USGS GAP reptile species distribution models, excluding NYNHP rare species. Sum = common reptile richness.	Linear scaling to statewide maximum richness (0.0 – 1.0).
EO_Animals	NYNHP Element occurrences, converted to raster format. Sum = rare animal species richness.	Linear scaling to richness at 99th percentile (0.0 – 1.0)
EO_Plants	NYNHP Element occurrences, converted to raster format. Sum = rare plant species richness.	Linear scaling to richness at 99th percentile (0.0 – 1.0)
EDM_Animals	NYNHP EDM, masked to exclude EOs. Sum = modeled rare animal species richness	Linear scaling to richness at 99th percentile (0.0 – 1.0)
EDM_Plants	NYNHP EDM, masked to exclude EOs. Sum = modeled rare plant species richness.	Linear scaling to richness at 99th percentile (0.0 – 1.0)
Forest_Core	CCAP 2010 Forest Fragmentation Class, intersected with NYS Simplified Streets buffer. Result = core forest blocks at least 45 meters from known roads.	Scored by block area: minimum value = 1.0, blocks of 500 acres (200 hectares) or larger = maximum value of 2.0, all other blocks receive a linearly scaled value from 1.0 – 2.0
Forest_NonCore	CCAP 2010 Forest Fragmentation Classes 1, 2, and 3, intersected with NYS Simplified Streets buffer. Result = non-core forest at least 15 meters from known roads Reclassified to value = 1.	Presence/absence (0 or 1)

Dataset Name	Description	Scoring
Grassland	CCAP 2010 Land Cover Class 8 (Grassland), aggregated by adjacency (ArcGIS Process = "Region Group"). Result = grassland blocks.	Scored by block area: minimum value = 1.0, blocks of 500 acres (200 hectares) or larger = maximum value of 2.0, all other blocks receive a linearly scaled value from 1.0 – 2.0
Shrubland	CCAP 2010 Land Cover Class 12 (Scrub/Shrub)	Presence/absence (0 or 1)
Water_100	National Hydrography Dataset (NHD) High Resolution flow lines, area features and water body features, and National Wetlands Inventory (NWI) ponds. Features converted to mosaic raster. Erase mask from CCAP Developed Land Cover Classes (2, 3, and 4) to exclude developed land.	Presence/absence (0 or 1)
Wetland_100	DEC regulated freshwater and tidal wetlands, and National Wetland Inventory estuarine and marine, freshwater emergent, and riverine wetland types, plus 100-m buffer. Features converted to mosaic raster. Erase mask from CCAP Developed Land Cover Classes (2, 3, and 4) to exclude developed land.	Presence/absence (0 or 1)
Landscape_Condition	Landscape Condition Assessment (NYNHP), 30 x 30 meter raster format.	Linear scaling of values to the 99th percentile of the statewide LCA distribution (0 – 1.69). Multiplied by -1 in the weighted model.

Background value (NoData) = zero for all rasters.

Results

Statewide Biodiversity Indicator Tool

Figure 3 shows the statewide distribution of scores for the landscape-scale biodiversity model. Areas of high biodiversity are shown in red shades, while green areas represent low biodiversity areas, typically either urban development or agriculture. Lake surfaces, such as in the Finger Lakes, also have low scores because this is a terrestrial model.
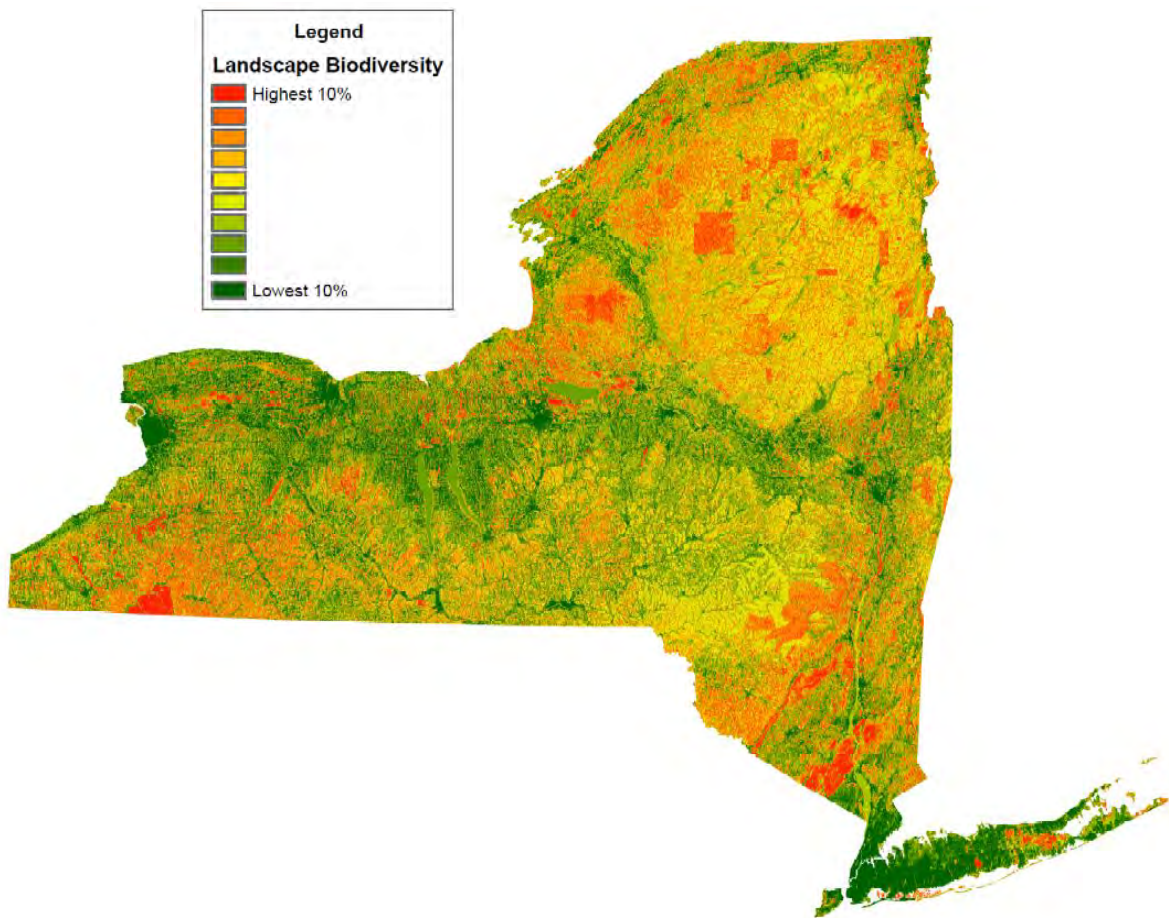

Figure 3 - Statewide distribution of scores for the Biodiversity Indicator Tool. The classification is quantile, divided into 10 classes. Hence, there are sharp lines between classes, leading to some anomalous patches on the distribution, in the Adirondack region for example.

Watershed Scale Tool

The results of the Biodiversity Indicator Tool were combined with the hydrologic unit boundary layer at the sub-watershed level (12-digit Hydrologic Unit Code, or "HUC12") for New York State (Figure 4.) Each sub-watershed was scored with the mean value of the BIT model scores for that area. The resulting Watershed Biodiversity layer can be used as a coarse scale view of the biodiversity (1:250,000 – 1:3,000,000).
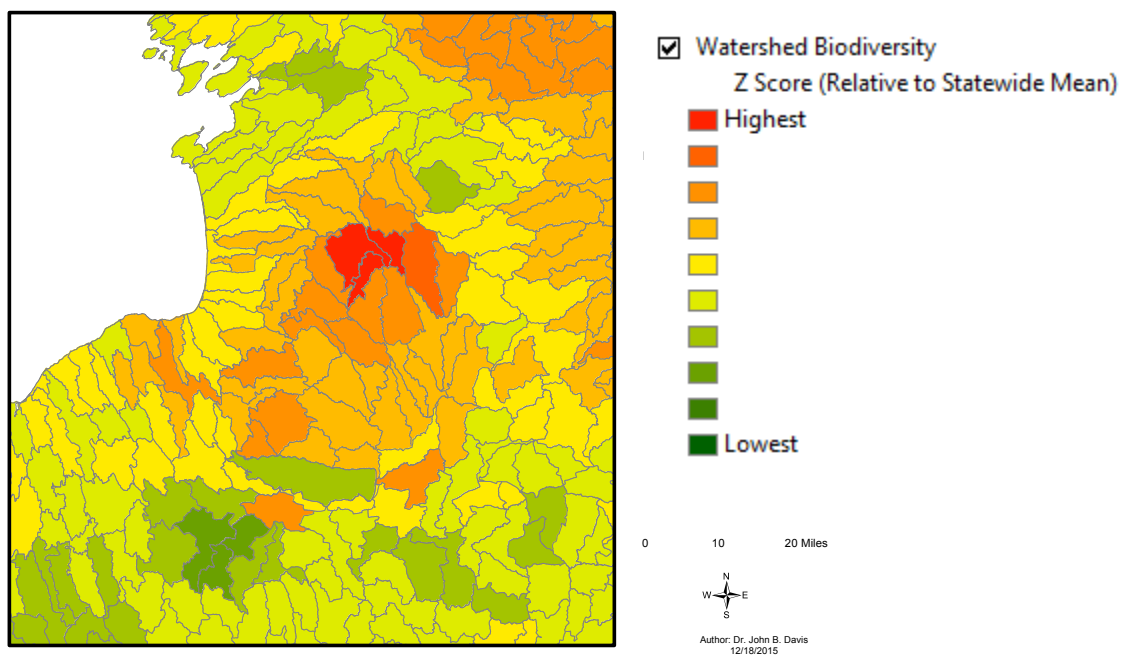

Figure 4 - Example of the scoring of HUC-12 sub-watersheds relative to the statewide mean value of the BIT model. Red colors indicate sub-watersheds with higher biodiversity-scores, and green colors indicate lower biodiversity scores. The example is from Tug Hill Area east of Lake Ontario.

Constraints and Limitations

The BIT is intended to be used as a geospatial tool to aid in biodiversity conservation in New York State. NYS OPRHP is providing this tool as is; this does not represent endorsement or lack of endorsement of any particular location.

The Biodiversity Indicator Tool elasticities a general indication of areas that may have high value for biodiversity, based on the geospatial data incorporated into the model. The tool is a predictive model and not a substitute for field work or detailed ecological knowledge of existing conditions on the ground.

While this tool has significant and wide ranging applications, there are many factors that can affect its validity such as the differences in resolution of the data, size of geographic area being analyzed and precision of the answer required for the question. The tool is intended to help aid and inform the preliminary investigation of large areas of the landscape, and should generally not be used as scales greater than (zoomed closer than) 1:10,000.

Inappropriate uses of the Biodiversity Indicator Tool include, but are not limited to, the following:

- As a replacement for local knowledge or assessments on the ground,
- Establishing exact boundaries for regulation or acquisition,
- Establishing definite occurrence or nonoccurrence of any feature for an exact geographic area,
- Determining abundance, health, or condition of landscapes, natural communities, habitats, species and connections,
- Establishing a measure of accuracy of any other data by comparison with these data,
- Altering the data in any way and redistributing them as an OPRHP data product, or
- Using the data without acquiring and reviewing the metadata.

Acknowledgements

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