Priority Conservation Mapping for Rare Plants

The New York Natural Heritage Program desires to produce a map of priority conservation areas within selected areas of the Hudson Valley to allow local municipalities to efficiently and effectively aid conservation efforts. Natural Heritage priority conservation sites are defined as those lands and waters that are essential to the continued persistence of the rare species and significant natural communities at the site, either because they provide habitat or because they support natural processes critical to their survival. In order to create a means where these priority areas may be easily updated, an automated mapping process to determine these sites is preferred.

With other similar projects to provide priority conservation maps, the maps typically included a standard buffer around the known population of the rare plant or animal (*e.g.*, the Massachusetts BioMap Project used a 100 meter circular buffer around all rare plant populations). While various studies (Table 1) report using a standard, justifiable buffer, this methodology may capture unsuitable developed lands or lands unnecessary for the species protection while leaving out areas that may be critical for that site's protection. An improved option includes buffering the population a pre-determined distance and then clipping out all unsuitable habitats. While this approach will reduce the amount of unsuitable land captured during a GIS analysis, it still may leave out lands outside of the pre-determined buffer that are deemed necessary for a species protection.

Table 1. Buffers recommended to abate specific threats

Aim	Action/Buffer	Citation
Stop trampling	Simply fence immediate population.	Maschinski, Frye, Rutman 1997
Minimize edge effects in forest interiors	15-50 meters	Spellerberg 1998
Protect Atlantic white cedar populations from development	Maintain a buffer of 91 meters between wetland and development.	Ehrenfeld, J. and J. Schneider 1991
Protect interior habitat from vegetational changes at forest edges	92 meter buffer	Matlack, G. 1994
Minimize change in lichen composition/diversity	Studied lichen composition/ diversity along forest edge and compared to areas up to 100 meters into forest. 50 meters needed to protect interior lichen diversity.	Esseen, P. and K. Renhorn 1998
Maintain forests interior	100 meter buffer	Mladenoff *et al.* 1994
Reduce effects of sunlight and wind penetration along forest edges	100 meter buffer	Maryland GreenPrint Program
Reduce edge effects caused by roads	200 meter buffer	Angold 1997
Minimize vegetation changes caused by roads	10-1000 meters depending on what threats you are trying to protect against	Forman and Alexander 1998
Maintain species diversity within wetland	A buffer of 1000-2000 meters recommended. A buffer of 120 meters as required by Canadian law is not sufficient.	Findlay, C. and J. Houlahan 1997
Minimize damage to vegetation from deer browse	Maintaining stand size of 200-400 sq. km of continuous forest and reduce deer densities down to 2 per sq. km.	Alverson, Waller, and Solheim 1988
Buffer riparian systems	Forested areas provided greater buffer protection than non-forested areas	Chesapeake Bay Program 2001

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As computer capabilities increase, it is becoming more and more possible to develop detailed algorithms to automatically generate these priority conservation area maps. These algorithms may take slope, geology, hydrology, and other elements present on the landscape and available in various GIS layers to develop polygons that should more accurately capture the lands necessary for proper protection of a particular species. In a mapping effort that is the first of its kind, the NY Natural Heritage Program will use GIS algorithms to generate conservation priority sites for select counties within the Hudson Valley.

First some background research is necessary to develop defendable buffers. At a minimum, fencing a rare plant population will provide protection from trampling (Maschinski *et al*. 1997). Beyond simple protection from trampling (*i.e*., fencing of the immediate population), the decisions for buffer selection becoming more difficult as the literature suggests buffers ranging from a few meters to two kilometers. Very few rare plant locations will allow for a two-kilometer buffer, and from a practical standpoint this seems unattainable.

In determining the appropriate buffer size, an initial threats analysis is needed. Within the Hudson Valley, and throughout most of New York, the greatest threats to biodiversity are loss of habitat, invasive species, and overexploitation. In fact, these are the same threats reported throughout the United States and beyond. Stein *et al*. (2000) report that 81% of globally imperiled or federally listed rare plants are threatened by habitat degradation/loss. The percent of listed rare plants affected by other threats are invasive species (57%), overexploitation (10%), pollution (7%), and disease (1%) (Stein *et al*. 2000). As these are the greatest threats, each will be addressed below to determine an appropriate buffer size.

<u>Habitat degradation / loss</u>

By far, habitat degradation and loss is the greatest threat to biodiversity (Stein *et al*. 2000, U.S. PIRG and Sierra Club 1997). Within the Hudson Valley, habitat degradation and loss includes the drainage or filling of wetlands, intense clear-cutting, conversion to agricultural lands, land development for commercial or residential purposes, loss of natural processes (*e.g.*, dam creation, fire suppression, shoreline hardening), mining, and reservoir creation. Many studies report a buffer at or near 100 meters to protect plants from development activities (Ehrenfeld and Schneider 1991, Matlack 1994, Esseen and Renhorn 1998, Mladenoff *et al.* 1994, Maryland GreenPrint Program). A buffer of 200 meters is desired between the targeted habitat and any road (Angold 1997). Protection of the landscape alone is not enough to guarantee a species long-term survival. Many species need some sort of management activity that may include impeding succession, adding fire to the landscape, managing wildlife, and soil disturbances. The conservation priority maps will attempt to protect the landscape necessary for these natural processes to occur, but active on-the-ground efforts are needed to carry the management forward.

<u>Invasive species</u>

Invasive species affect a significantly higher proportion of globally imperiled or federally listed plant species (57%) than animal species (39%) (Stein *et al*. 2000). Still, both groups are greatly affected by invasive species and this is a threat we may mitigate against through the use of habitat protection, particularly within more pristine areas. Roadways provide corridors that are frequently used by invasive species (Spellerberg 1998, Tyser & Worley 1992). Forman and Alexander (1998) suggest a minimum of a 200-meter buffer from a roadway to protect against the impact of invasive species. Many invasive species need some sort of initial soil disturbances to gain a foothold within the landscape (Richardson *et al.* 1994, D'Antonio 1993) and it is hoped larger landscapes would be subject to less disturbance than smaller sites. Protection of the landscape will not eliminate the threat of all invasive species, but it should greatly reduce their impact. On the ground management may still be needed to control some invasive species.

<u>Overexploitation</u>

Protection from overexploitation and collection cannot be addressed through the protection of additional land areas. Instead, educational outreach to stress the importance of enjoying rare species in their native habitats is encouraged. In addition, poachers should be prosecuted to the fullest extent possible to deter future exploitation. If these laws currently do not provide enough deterrence, then lawmakers may wish to consider revisions. Another form of overexploitation of the vegetation is occurring due to the high abundance of white-tailed deer. Alverson *et al*. (1988) suggest a deer densities 2/sq. km. to minimize the damage to vegetation from deer browse. Currently, the deer density within much of the Hudson Valley is 5 to 15 deer per sq. km with a few areas reporting over 20 deer/sq. km (QDMA 2003). This is another threat that cannot be addressed through land conservation, but will require a policy shift to reduce deer herds.

Pollution

Pollution has a far greater impact on animal species than it does on plant species (Stein *et al.* 2000). Very little is known about the uptake of pollutants and their effects on the vegetation. More studied are the effects of sedimentation, where increased sedimentation has led to increases in invasive plant species (Werner and Zedler 2002). Forman and Alexander (1998) suggest a 50 meter buffer to protect against salt, lead, etc. in aquatic systems and silt, sand, and nutrients from road dust. The distance increases to a minimum of 200 to mitigate against "hydrological effects." Since pollution has a minimal impact on rare plants, we assume the buffers selected for habitat degradation and invasive species will also provide protection from pollution.

Disease

Disease has very little effect on rare plant species, but it has a considerable impact on birds. Approximately 37% of imperiled birds are threatened by disease (Stein *et al.* 2000). Each year, new diseases seem to appear that affect wildlife. The recent West Nile Disease has had a noted impact on birds, particularly crows. Just 15 months after the outbreak of West Nile, 60 bird species and 11 mammals were found infected (Enserink 2000). Diseases affecting plant species include the hemlock wooly adelgid, beech bark disease, chestnut blight, Dutch elm disease, and the white pine blister rust. Very few diseases seem to impact rare species, but those diseases that do affect common species and result in a changing landscape (*e.g.*, loss of American chestnut forest due to the chestnut blight) could have indirect impacts on rare species. Regardless, land protection cannot address the impacts of wide-ranging diseases such as those listed above.

In designing a buffer protocol, more emphasis is placed on the upslope land than the downslope land. Swift (1986) recommends adding a base buffer distance plus 2.0 times the slope percent within general forest management areas, 3.86 times the slope percent on moderate erosion hazard soils, and 4.78 on severe erosion hazard soils. For the base buffer distance, we are using 100 meters as this buffer was most commonly recommended in the literature to abate development pressures and invasive species impacts. If any developed land is located within 100 meters of this buffer, the final buffer will be expanded as the remaining undeveloped portions should be considered a high protection priority. Likewise, if a road is present within 200 meters of the rare plant population, the buffer is moved out to the edge of the road. All unsuitable habitat (defined as developed lands on the MLRC) are clipped out of the merged polygons. Then 10 meters is added to the original polygon (to protect from trampling) and it is added to the buffered polygons to create the final polygon.

During the production of the conservation priority areas, only extant rare plant populations (EO rank A-E) with a high locational accuracy will be targeted for mapping (need to test medium accuracy to see if buffered polygons represent an accurate protection area). This focus will ensure that conservation priority efforts are directed towards what is known (green space protection may use historical data to speculate what may be protected). While the New York Natural Heritage Program has found that the success rate of rediscovery of historical populations may be as high as 25% (unpublished data), local planners and conservation organizations should first aim their limited resources towards what is known. Future survey efforts will continue to evaluate historical populations and ensuring these new populations are highlighted as the conservation priority maps are revised.

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Methodology for creating “important habitat zones”

1. The maps for this project will only include extant populations that are relatively well mapped. This will exclude all extirpated sites, failed to find populations, historical records, and known sites with poor location information. A pre-selection of targeted occurrences should take place before running the population polygons through John’s AML.
2. If the EO Rep has an area of 250,000 square meters or more, use the EO Rep as is. Do not run these larger EO Reps though the AML process that adds additional buffers to their polygon coverage. If the EO Rep is less than 250,000 square meters, then continue through the model as is.
3. Determine cover type within the polygon for each targeted plant EO.
4. If cover type of polygon is composed of 50% or greater wetland community, then proceed to step 4.A. If cover type of polygon is composed of less than 50% wetland designation, then proceed to 4.B.
   A. Coverage is 50% or greater wetland.
      a. Capture entire wetland signature
      b. If plant polygon (EO polygon) is less than 10% of the total size of the wetland, then buffer original plant polygon 100 meters (use 90 meters at this point and add 10 meters as last step to remove polygon “worms”) and merge with wetland signature. If plant polygon is more than 10% the total size of the wetland, then buffer the wetland polygon 100 meters (use 90 meters at this point and add 10 meters as last step to remove polygon “worms”). This distinction assumes that a plant occupying more than 10% of the total area of a selected wetland is very dependant upon the wetland and the influences upon that wetland for survival; whereas a plant occupying only a small portion of that wetland may be more dependent upon a small niche within the wetland and that niche is the most important protection focus. A 100-meter buffer is used as a minimum buffer based on the work of Ehrenfeld and Schneider (1991), Matlack (1994), and Mladenoff *et al.* (1994).
   B. If coverage is less than 50% wetland, then buffer plant polygon 100 meters (use 90 meters at this point and add 10 meters as last step to remove polygon “worms”)
5. Using original EO, assess slope and cover type from areas adjacent to polygon. If slope is away from wetland, do not buffer. If slope is towards the wetland and:
   A. area is forested, increase buffer distance 2.0 X slope % (per Swift 1986).
   B. area is not forested, increase buffer distance based on soil erodability (per Swift 1986).
   Apply the following to each erosion hazard type:
      Low (Kfact 0-0.22): 2.98 X slope %
      Medium (Kfact 0.23-0.40): 3.86 X slope %
      High (0.41-1.0): 4.78 X slope %
      Unknown: if unknown or data not available, assume medium erodability and use 3.86 X slope %.
      Use the average Kfact values from the SSURGO layer Tim created (located at W:\Hudson_River_2000_AND_THREE_Project\Dutchess_land_cover). The average Kfact was calculated (Tim Howard) by averaging the Kfact in the first two layers (LAYERNUM) for each SEQNUM and then calculating a weighted average across all SEQNUMs for each MUID (see Tim’ s community methodology Appendix 1.1 for more information).
   C. Add slope buffer from this step to the wetland buffer in step 4.
6. In order to reduce impact from development, assess the existing buffer zone’s position relative to roads. We would prefer to use the MLRC developed lands signature instead of roads, but we road too many errors with the data layer. Instead, we will buffer the existing buffer zone 50 meters and buffer the road layer 50 meters and select the areas where the two overlap. Add this overlap area to the total protection area.
7. If there are any roads (Tiger roads dataset) within 200 meters of the EO polygon, buffer raw polygon out to edge of road. Merge this with above polygons.
8. Using the Tiger roads dataset (1:24,000), cut out all road areas.
9. Delete any islands, other than those created by roads, that are separated from the “core” polygon containing the actual rare plant population.
10. Take original plant polygon and buffer 10 meters. This 10-meter buffer assures minimal trampling protection for rare plants that may be present within developed landscapes.
11. Merge polygon from steps 9 and 10.
12. As mentioned in step 4, add a 10 meter buffer to the entire polygon.
13. Add all of the polygons removed in step 2 to those created in step 12 to produce a final shapefile of area needed to protect each plant population.

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