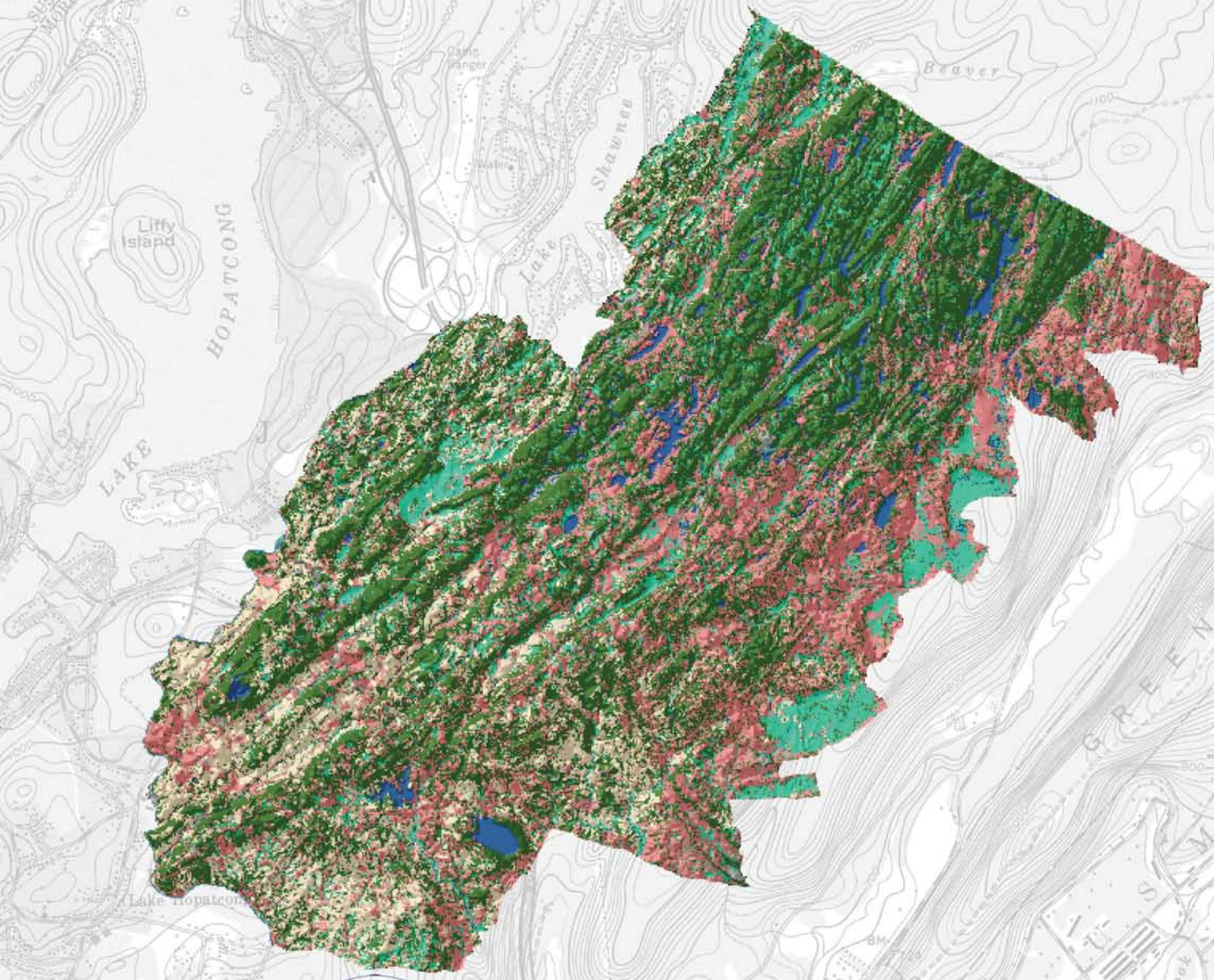
New Jersey's Landscape Project

(Version 3.0 Highlands):
A species-based patch approach to rare and imperiled wildlife habitat mapping for community land-use planning and species conservation



NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

NEW JERSEY DIVISION OF
Fish and Wildlife

New Jersey Department of Environmental Protection

Conserve Wildlife

New Jersey Endangered & Nongame Species Program

NJ Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program

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Maps and methodologies described in this document have been peer reviewed by:

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Terms & Definitions

Biological and Conservation Database (BCD) - Biodiversity data management software developed by NatureServe, which was formerly used by the New Jersey Department of Environmental Protection's Natural Heritage Program and Division of Fish and Wildlife's Endangered and Nongame Species Program before it was replaced by Biotics in 2004.

Biotics - Biodiversity data management software used by the Endangered and Nongame Species Program (ENSP). The successor to the Biological and Conservation Database, this data management software was developed by NatureServe and, within New Jersey, is maintained jointly by ENSP (animal data) and the Natural Heritage Program (plant and ecological community data).

certified vernal pool - Four criteria must be satisfied in order for a vernal pool to be classified as certified. These criteria are: 1. The area must occur in a confined basin or depression without a permanently flowing outlet; 2. The pool must feature evidence of breeding by at least one obligate or two facultative vernal habitat species (these species are identified in N.J.A.C. 7:7A, Appendix 1); 3. The area must maintain ponded water for at least two continuous months between March and September of a normal rainfall year, and; 4. The area must remain free of fish populations throughout the year, or it must dry up at some time during a normal rainfall year.

endangered species - Pursuant to Highlands Water Protection and Planning Act Rules at N.J.A.C. 7:38-1.4, "Endangered species" means (with regard to wildlife) a species included on the list of endangered species that the Department promulgates pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-13 et seq. and any species or subspecies of wildlife appearing on any Federal endangered species list. The Endangered and Nongame Species Conservation Act defines an endangered species (with respect to wildlife) to be a species or subspecies of wildlife whose prospects for survival or recruitment are in jeopardy or are likely within the foreseeable future to become so due to any of the following factors: (1) the destruction, drastic modification, or severe curtailment of its habitat, or (2) its over-utilization for scientific, commercial or sporting purposes, or (3) the effect on it of disease, pollution, or predation, or (4) other natural or manmade factors affecting its prospects of survival or recruitment within the State, or (5) any combination of the foregoing factors. The term shall also be deemed to include any species or subspecies of wildlife appearing on any Federal endangered species list.

feature label - A label assigned to each occurrence that describes the occurrence type (i.e. nest, den, dead on road, etc.).

Highlands Extended Boundary – Includes the Highlands Region established by the Highlands Water Protection and Planning Act (N.J.S.A 13:20-1 et seq.) with boundaries specifically described at N.J.S.A 13:20-7 as well as, where the statutory Highlands Region boundary is not a major roadway, an additional area extending outward from that boundary to the nearest major roadway.

Highlands Region - The New Jersey Highlands Region is the area designated pursuant to the Highlands Water Protection and Planning Act, at N.J.S.A. 13:20-7; an over 800,000 acre region covering over 1,250 square miles and 88 municipalities in seven counties (Bergen, Hunterdon, Morris, Passaic, Somerset, Sussex and Warren). The Highlands Region is an essential source of drinking water for half of the residents of New Jersey.

imperiled species - Includes all wildlife species considered to be endangered or threatened as defined elsewhere in this document.

location use class - A label used for aerial and marine migrants that occupy disjunct locations by season (i.e. breeding or nonbreeding). Applies to migratory species only.

major roadway - A roadway classified by the New Jersey Department of Transportation as a 600 Series County Route or higher. Major roadways are Interstate Highways, U.S. Routes, NJ State Highways, Toll Authority Routes and 500 and 600 Series County Routes.

Natural Heritage methodology - A set of standard procedures for gathering, organizing, and managing information on biodiversity, used in common throughout the NatureServe network.

NatureServe - A non-profit conservation organization that provides scientific information and tools to help guide effective conservation action. NatureServe represents an international network of biological inventories (known as natural heritage programs or conservation data centers) operating in all 50 states, Canada, Latin America, and the Caribbean.

NJDEP Landuse/Landcover (LU/LC) - A geographic information system (GIS) dataset produced by visually interpreting color infrared aerial photography of New Jersey. Through this process, photo-interpreters examine each image, and based on their knowledge of photo signatures, classify the image into various land use/ land cover categories. The classifications are converted into a land use/land cover GIS digital file, with each delineated polygon representing a distinct land use/land cover type.

rare species - Pursuant to Highlands Water Protection and Planning Act Rules at N.J.A.C. 7:38-1.4, a rare wildlife species is one that is not an endangered or threatened wildlife species, but is considered by the Department to be rare. In the Highlands Rules, wildlife are classified as S1 (critically imperiled in New Jersey because of extreme rarity), S2 (imperiled in New Jersey because of rarity), S3 (rare in New Jersey), G1 (critically imperiled globally), G2 (imperiled globally because of rarity) or G3 (globally very rare and local throughout its range or found locally in a restricted range). Generally speaking, a rare species of animal is a native species that exists in low numbers or in isolated areas.

riparian - Of, or pertaining to, the bank of a river or stream.

Rutgers University Center for Remote Sensing and Spatial Analysis (CRSSA) - An active research and development program focusing on advancing the application of various geo-spatial technologies including remote sensing, geographic information systems and global positioning systems. CRSSA also develops spatial-statistical analysis/modeling techniques for the environmental, agricultural and natural resource sciences and management.

species occurrence area - A species-specific polygon that is applied to all occurrences in the Biotics database that is used to value habitat in the Landscape Project. The area of the polygon is generally based on the average home range/territory size, or other appropriate life-history parameter as reported in peer-reviewed scientific literature or from information obtained through ENSP research. When searching the scientific literature to gather information to support the occurrence area polygon size, efforts were made to select research that was conducted in habitat types similar to those found in New Jersey. For many species that value habitat patches in the Landscape Project maps, insufficient information exists in the scientific literature to support the designation of an occurrence area. In these cases, a default occurrence area (71.25m radius) is applied to take into account locational uncertainty. These occurrence areas are used to value patches of habitat. In Version 2.0 of the Landscape Project, a species occurrence area was referred to as a "species model."

species of special concern - Nongame wildlife species that, based upon review by a panel of experts, warrant special attention because of inherent vulnerability to environmental deterioration or habitat modification that would result in their becoming Threatened or Endangered or ranked S3 in New Jersey's Biotics database. This category would also be applied to species that meet the foregoing criteria and for which there is little understanding of their current population status in the state.

threatened species - Pursuant to Highlands Water Protection and Planning Act Rules at N.J.A.C. 7:38-1.4, "Threatened species" means (with regard to wildlife) an indigenous nongame wildlife species of New Jersey designated pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A.23:2A-13 et. seq., and its implementing rules, N.J.A.C. 7:25-4.17, as most recently amended. Threatened species are generally defined to be species that may become endangered if conditions surrounding them begin or continue to deteriorate.

vernal pool - Vernal pools are confined depressions, either natural or man-made, that hold water for at least two consecutive months out of the year, and are devoid of breeding fish populations. Vernal pools provide habitat to many species of amphibians, insects, reptiles, plants, and other wildlife. The absence of fish is the essence of these ecosystems.

Geographic Information Systems Terminology
from Environmental Systems Research Institute's Online GIS Dictionary
(http://support.esri.com/index.cfm?fa=knowledgebase.gisDictionary.gateway)

ArcView - Full-featured geographic information system software for visualizing, analyzing, creating, and managing data with a geographic component.

ArcView Shapefile - A vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.

dissolve - A geoprocessing command that removes boundaries between adjacent polygons that have the same value for a specified attribute.

feature class - In ArcGIS, a collection of geographic features with the same geometry type (such as point, line, or polygon), the same attributes, and the same spatial reference. Feature classes can be stored in geodatabases, shapefiles, coverages, or other data formats. Feature classes allow homogeneous features to be grouped into a single unit for data storage purposes.

feature dataset - In ArcGIS, a collection of feature classes stored together that share the same spatial reference; that is, they share a coordinate system, and their features fall within a common geographic area. Feature classes with different geometry types may be stored in a feature dataset.

geodatabase - A database or file structure used primarily to store, query, and manipulate spatial data. Geodatabases store geometry, a spatial reference system, attributes, and behavioral rules for data. Various types of geographic datasets can be collected within a geodatabase, including feature classes, attribute tables, raster datasets, network datasets, topologies, and many others.

geoprocessing - A geographic information system (GIS) operation used to manipulate GIS data. A typical geoprocessing operation takes an input dataset, performs an operation on that dataset, and returns the result of the operation as an output dataset. Common geoprocessing operations include geographic feature overlay, feature selection and analysis, topology processing, raster processing, and data conversion. Geoprocessing allows for definition, management, and analysis of information used to form decisions.

GIS - Acronym for *geographic information system*. An integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes. A GIS provides a framework for gathering and organizing spatial data and related information so that it can be displayed and analyzed.

GPS – Acronym for *Global Positioning System.* A system of radio-emitting and –receiving satellites used for determining positions on the earth. The orbiting satellites transmit signals that allow a GPS receiver anywhere on earth to calculate its own location through trilateration. Developed and operated by the U.S. Department of Defense, the system is used in navigation, mapping, surveying, and other applications in which precise positioning is necessary.

raster - A spatial data model that defines space as an array of equally sized cells arranged in rows and columns, and comprised of single or multiple bands. Each cell contains an attribute value and location coordinates. Unlike a vector structure, which stores coordinates explicitly, raster coordinates are contained in the ordering of the matrix. Groups of cells that share the same value represent the same type of geographic feature.

union - A topological overlay of two or more polygon spatial datasets that preserves the features that fall within the spatial extent of either input dataset; that is, all features from both datasets are retained and extracted into a new polygon dataset.

vector - A coordinate-based data model that represents geographic features as points, lines, and polygons. Each point feature is represented as a single coordinate pair, while line and polygon features are represented as ordered lists of vertices. Attributes are associated with each vector feature, as opposed to a raster data model, which associates attributes with grid cells.

Conversions

Area:

1 hectare = 2.47 acres

Distance:

1 meter = 3.28 feet

1 kilometer = 0.62 miles

New Jersey's Landscape Project

(Version 3.0 Highlands): A Species-Based Patch Approach

New Jersey is the most densely populated state in the nation. One of the consequences of this distinction is the extreme pressure that is placed on our natural resources. As the population grows, we continue to lose or impact the remaining natural areas of the state. As more and more habitat is lost or impacted, people are beginning to appreciate the benefits and necessity of maintaining land in its natural state. For example, we know that wetlands play a critical role in lessening the severity of floods and naturally breaking down contaminants in the environment. Forests and grasslands protect the quality of our drinking water, improve the quality of the air we breathe and provide important areas for outdoor recreation. Collectively, these habitats are of critical importance to the diverse assemblage of wildlife found in New Jersey, including endangered (E), threatened (T) and other rare species.

In 1994, the New Jersey Division of Fish and Wildlife's (DFW) Endangered and Nongame Species Program (ENSP) adopted a landscape level approach to endangered, threatened and other rare species conservation by developing the Landscape Project. Through geographic information system (GIS) technology, the Landscape Project uses species location and land-use/land-cover as well as species life history information to produce maps that depict imperiled and rare wildlife habitat throughout the state. The goal of the project is to protect New Jersey's biological diversity by maintaining and enhancing endangered, threatened and other rare wildlife populations within healthy, functioning ecosystems.

WHY WE NEED THE LANDSCAPE PROJECT

As people leave our cities to live in the "country," suburban sprawl has consumed land at a rapid rate. Some analysts predict that at current patterns all remaining available land would be developed within 40 years, making New Jersey possibly the first state in the nation to reach build-out (Hasse and Lathrop 2001).

Despite New Jersey's protection efforts, which include strict land-use regulations and an aggressive open space acquisition program (Green Acres), we continue to lose critical wildlife habitat at an alarming rate. The Landscape Project serves as a tool to help reverse this trend (***Figure 1).***

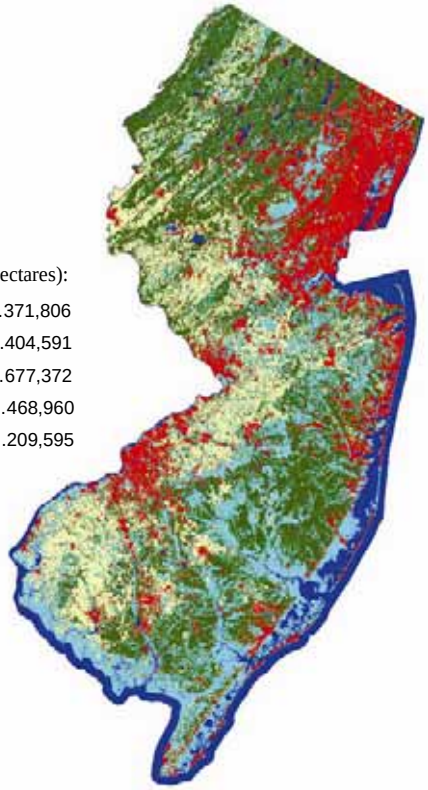
THE PURPOSE OF THE LANDSCAPE PROJECT

The Landscape Project has been designed to provide users with peer-reviewed, scientifically sound information that is easily accessible and can be integrated with the planning, protection and land management programs of non-government organizations and private landowners and at every level of government – federal, state, county and municipal. As in Version 2.0, Version 3.0 (Highlands) of the Landscape Project has gone through an extensive peer review process. Landscape maps and overlays provide a basis for proactive planning, such as the development of local habitat protection ordinances, zoning to protect critical wildlife areas, management guidelines for imperiled species conservation on public and private lands, and land acquisition projects.

Most importantly, the critical area information provided by the Landscape Project can be used for planning purposes before any actions such as proposed development, resource extraction (eg. timber harvests) or conservation measures occur. Proactive planning with accurate, and legally and scientifically sound information will result in less conflict. Less time will be wasted, and less money spent, attempting to resolve after-the-fact endangered and threatened species issues.

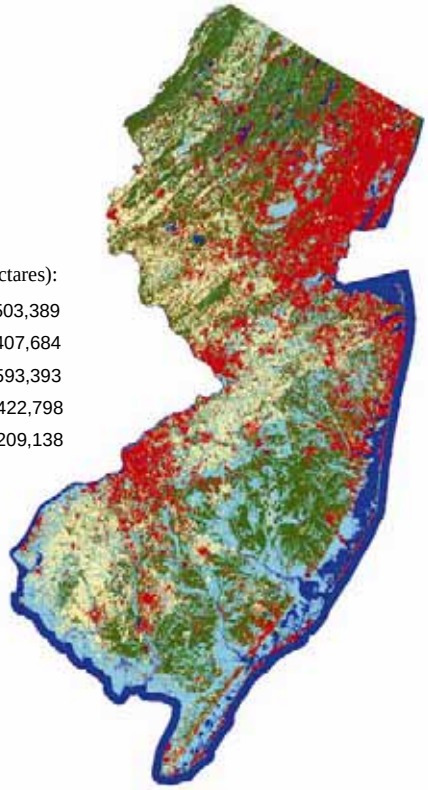
New Jersey's Changing Landscape

1972



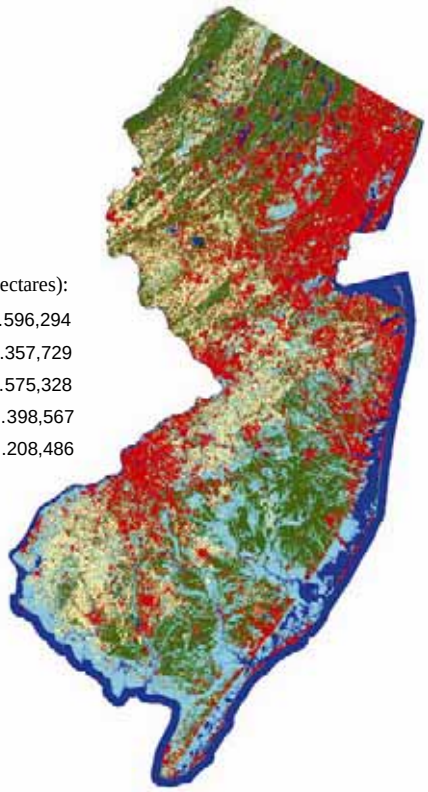
Land Cover (hectares):
Developed……371,806
Grassland…….404,591
Forest……677,372
Wetland…… …468,960
Water……..209,595

1984



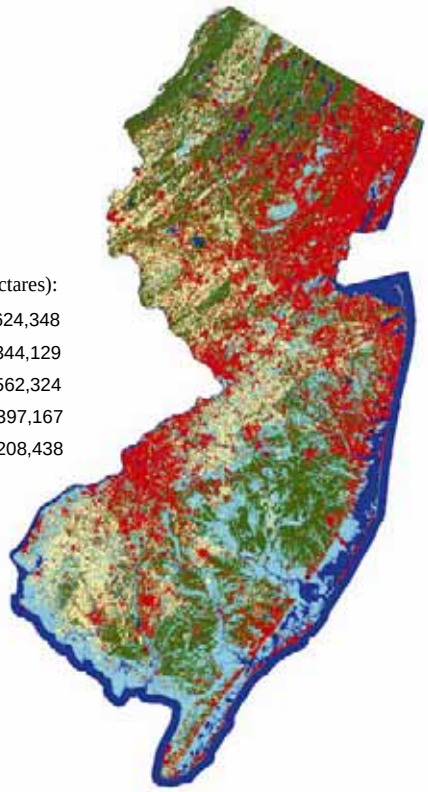
Land Cover (hectares):
Developed……503,389
Grassland…….407,684
Forest……593,393
Wetland…… …422,798
Water……..209,138

1995



Land Cover (hectares):
Developed……596,294
Grassland…….357,729
Forest……575,328
Wetland…… …398,567
Water……..208,486

2001



Land Cover (hectares):
Developed……624,348
Grassland…….344,129
Forest……562,324
Wetland…… …397,167
Water……..208,438

Figure 1. *New Jersey's Landscape is rapidly changing. Since 1972, more than 8,000 hectares/year of wildlife habitat has been lost. Moreover, much of the habitat that remains is less suitable for wildlife due to habitat fragmentation. This is especially detrimental to rare and imperiled wildlife, as many of these species require large, contiguous tracts of habitat to survive. The goal of the Landscape Project is to reverse this trend by identifying, delineating and ultimately protecting habitat critical to the long-term survival of New Jersey's wildlife.*

LANDSCAPE PROJECT APPLICATIONS

DEP Agencies:

- **Division of Land Use Regulation:** The Division of Land Use Regulation (DLUR) uses the Landscape Project maps to identify and protect habitat for endangered and threatened species. Several state land use regulations contain provisions for the protection of habitats determined to be critical to endangered and threatened wildlife. These include the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A), the Coastal Zone Management Rules (N.J.A.C. 7:7E), the Flood Hazard Area Control Act Rules (NJAC 7:13), and the Highlands Water Protection and Planning Act, Special Adopted Rules (NJAC 7:38).

  Landscape Project data is reviewed to determine whether a particular site contains "documented habitat" for State or Federally listed species. Within areas of documentation, ground surveys are typically conducted to confirm actual site suitability for a specifically documented species. Permit applications received by DLUR are now better prepared because the public has access to the Landscape Project data. Since applicants now have access to base line data concerning endangered and threatened species occurrences, they can better address potential impacts to State or Federally listed species in their permit applications or environmental impact statements, thereby minimizing environmental impacts and the time required to issue permits.

  Green Acres: The Landscape Project is used by the Green Acres Program (GAP) to support the preservation of high quality natural resources in three valuable ways. First, the mapped data is represented on site-specific planning maps showing habitat locations so that consideration is given to these prime areas during decision making. Site specific maps are also submitted as part of the application for the Federal Land & Water Conservation Fund to show characteristics of those applicant properties. Lastly, but perhaps most importantly, the data is used in the evaluation of lands offered to the state for acquisition. GAP scores all land offers based on their natural resource values. Wildlife occurrence is one of the criteria evaluated. The Landscape Project data format allows for statistical analysis to determine the quality and quantity of state and federal endangered species habitats on the offered properties.

- **NJDEP's Natural and Historic Resources:** The Natural & Historic Resources (N&HR) programs within NJDEP are responsible for managing over 900,000 acres of parks and forests, recreation areas, historic sites, wildlife management areas, and natural areas. A newly established policy requires land managers to obtain prior Department review when proposing any activity on state lands that may modify the terrestrial or aquatic landscape. Land managers use Landscape Project maps to conduct an initial screen to determine the presence of landscape patches ranked 3, 4 or 5. If these features are on the proposed project site the land manager is required to request a detailed review by ENSP. The project may be approved, approved subject to conditions or recommended for denial in order to minimize damage to critical imperiled species habitat.

- **DFW's Landowner Incentive Program:** The Landscape Project is an important tool for the Landowner Incentive Program (LIP). When applications are submitted to LIP, biologists use the Landscape Project as a screening tool to determine the species that may inhabit the site. Based on the Landscape Project and the project description, biologists determine if the project warrants a site visit and use the Landscape Project to create a map of the site and surrounding landscape. LIP staff also use the Landscape Project to support the species and habitat management plan developed for each property.

Federal Agencies:

- **U.S. Fish and Wildlife Service:** The U.S. Fish and Wildlife Service (USFWS), New Jersey Field Office uses the data layers in the Landscape Project to assist with project planning, assessment, and implementation of habitat restoration projects through the *Partners for Fish and Wildlife* program. Specifically, information in the Landscape Project on wetlands, sensitive species, grasslands, and other habitat types assist the Service in large-scale geographic planning and targeting of habitat restoration projects. The Landscape Project is also useful for site-specific assessments of wetland restoration and creation opportunities.

- **US Department of Agriculture Natural Resources Conservation Service:** The Natural Resources Conservation Service (NRCS) has utilized the Landscape Project for several years as part of its day to day activities. NRCS field staff conducts environmental evaluations for all projects where federal funds are utilized as part of its National Environmental Policy Act (NEPA) responsibilities. These evaluations include threatened and endangered species assessments of planned NRCS actions.

  The Landscape Project provides invaluable information as to the possibility of threatened and endangered species occurrence at a site and helps guide NRCS planning efforts. The Landscape Project has also been used for several years in the competitive ranking of Wildlife Habitat Incentive Program (WHIP) projects. Projects that will have positive impacts to threatened and endangered species habitat receive additional points in the WHIP ranking system and have a greater chance of being funded. The Landscape project data is used as the basis for the threatened and endangered portion of the ranking.

Other Agencies and Private Citizens:

- **Prioritize conservation acquisitions:** The Landscape Project is used to prioritize land parcels for purchase through acquisition programs such as Farmland Preservation and the USFWS's refuge system.

- **Guide regulators and planners:** Landscape Maps provide land-use regulators and state, county and local planners with the tools they need to enhance protection through the regulatory and planning process.

- **Provide citizens with conservation tools:** The Landscape Project provides the tools to guide citizen actions to protect imperiled and rare species habitat at the local level. By combining critical area maps with other GIS data layers such as roads, development and publicly owned lands, important areas in need of protection can be easily identified.

- **Guide stewardship of conserved areas:** New Jersey already has more than 400,000 hectares of open space. These lands are managed by a variety of agencies and organizations, both public and private. Landscape Maps identify important imperiled and rare species habitats on these lands. ENSP biologists work hand-in-hand with land managers and landowners to develop appropriate best management practices for the long-term conservation of imperiled and rare species.

WHO BENEFITS

Protecting large expanses of fields, forests and wetlands helps to ensure that imperiled and rare species will remain a part of New Jersey's future. In addition to identifying habitat important for the conservation of imperiled and rare species, the Landscape Project will result in more open space for outdoor recreation, as well as public health and environmental benefits. Recent surveys by the US Fish and Wildlife Service (2006) reveal more than 87.5 million U.S. residents sixteen and older participate in some form of wildlife-related recreation. Open spaces provide places where

people can escape the confines and stresses of urban and suburban living. Retaining habitats in their natural state provides other benefits such as reducing the threat of flooding, allowing for the biodegradation of environmental contaminants and recharging ground water reserves. In short, the Landscape Project provides potential benefits for everyone.

NEW JERSEY'S LANDSCAPE REGIONS

Since animal populations require large expanses of natural habitat for their long term survival, the Landscape Project focuses on large areas called Landscape Regions where plant and animal communities are ecologically similar (***Figure 2***). ENSP has identified and mapped habitat for imperiled and rare species within each Landscape Region utilizing an extensive database that combines imperiled and rare wildlife location information with land-use/land-cover classification data and species' habitat requirements, These landscape maps provide a highly accurate, reliable and scientifically sound basis for habitat protection within each landscape.

One of the Landscape Project's unique features is its focus on the big picture, and not just on individual locations of imperiled and rare species as those areas become threatened. Thus, within large landscapes, the Landscape Project identifies areas of imperiled and rare wildlife habitat that must be preserved now if we want to ensure the conservation and recovery of New Jersey's imperiled and rare wildlife for future generations.

- *Skylands Landscape*

This landscape region combines two of New Jersey's physiographic regions, the Ridge and Valley and the Highlands. It encompasses all or parts of Sussex, Warren, Hunterdon, Somerset, Passaic, Essex, Bergen, and Morris counties. The region contains extensive tracts of contiguous upland and wetland forests that support diverse animal populations including red-shouldered hawk, northern goshawk, cerulean warbler, timber rattlesnake, long-tailed salamander, and the state's only known wintering populations of Indiana bat. Bog turtles and great blue herons inhabit the extensive freshwater wetland systems found throughout the region.

- *Piedmont Plains Landscape*

This landscape region also combines two of New Jersey's physiographic regions, the Piedmont and the Inner Coastal Plain. It encompasses all or parts of Burlington, Gloucester, Salem, Mercer, Middlesex, Monmouth, Hunterdon, Somerset, Union, Essex, Hudson, Passaic, and Bergen counties. It is dominated by the Delaware and Raritan rivers and is characterized by farmed areas, extensive grasslands, fragmented woodlands and tidal freshwater marshes that are among the world's most productive. Imperiled and rare species within this landscape include grassland birds such as the endangered upland sandpiper and woodland raptors such as the barred owl and Cooper's hawk.

- *Atlantic Coastal Landscape*

This landscape encompasses parts of Monmouth, Ocean, Cape May, and Atlantic counties. New Jersey's Atlantic Coast beaches and marshes are among the most productive coastal habitats in the country. Despite heavy development, they support important portions of Atlantic Coast populations of colonial nesting birds, such as common tern, little blue heron and great egret, and endangered beach-nesting birds such as least tern and piping plover. The coastal habitats also support most of the state's ospreys, peregrine falcons and northern diamondback terrapins, as well as a large number of northern harriers and large concentrations of wintering waterfowl.

- *Pinelands Landscape*

This landscape encompasses all or parts of Atlantic, Ocean, Burlington, Camden, and Gloucester counties. An internationally recognized ecosystem and National Reserve, the Pinelands supports extremely diverse reptile, amphibian and invertebrate populations including northern pine snake, corn snake, Pine Barrens treefrog, Pine Barrens bluet and arogos skipper. Extensive cedar swamps and wetland systems contain numerous insect species, as well as sustainable populations of many neotropical birds. Its waterways support aquatic communities unique among mid-Atlantic states.

New Jersey's Landscape Regions

Figure 2. *New Jersey's Landscape Regions.*

- *Delaware Bay Landscape*

This landscape encompasses all or parts of Cape May, Atlantic and Cumberland counties. It features significant populations of bald eagle, barred owl, eastern tiger salamander, Cope's gray treefrog and other endangered and threatened species. The vast woodland tracts of this region are among the largest in the state and support a large portion of New Jersey's neotropical birds and interior-forest bird populations. The extensive saltwater marsh and sandy overwash beaches support a significant horseshoe crab breeding area and shorebird migration, including the red knot, of worldwide ecological significance. Despite the heavy loss of habitat, the Cape May Peninsula remains one of the country's most important migratory "stopovers" for hundreds of bird and insect species. The expansive habitat mosaic of rivers and streams flowing into the tidal Delaware Bay supports concentrations of imperiled and rare wildlife and wintering waterfowl.

COMPARISON OF PREVIOUS AND CURRENT VERSIONS OF THE LANDSCAPE PROJECT

Version 1.0: Released in 2001, the land-use/land-cover data that formed the basis of Version 1.0 of the Landscape Project was a raster-based classification developed by Rutgers University Center for Remote Sensing and Spatial Analysis (CRSSA). ENSP selected CRSSA's raster-based dataset over the DEP's vector-based land-use/land-cover dataset (LU/LC) primarily because it could be easily updated to reflect the rapidly changing habitat conditions within New Jersey.

Version 2.0: In early 2004, Version 2.0 of the Landscape Project was released replacing Version 1.0. For this version ENSP opted to use the DEP's air photo-based LU/LC data as the base layer to maintain consistency with other departmental geographic data and mapping applications. The improved resolution of the aerial photo-based data and the commitment by the DEP to update the 1995 data with 2002 imagery provided additional rationale for using the NJDEP LU/LC data.

Version 3.0 (Highlands): The Highlands Region was the first area of the state for which the Department completed an update of the 1995/97 LU/LC data set using 2002 aerial imagery. This 2002 LU/LC now forms the base layer for Version 3.0 of the Landscape Project, a species-based patch approach. The DEP started with the Highlands Region because on August 10th, 2004, the Highlands Water Protection and Planning Act was passed. The Act mandated the establishment of the New Jersey Highlands Water Protection and Planning Council (Highlands Council) that is charged with the task of developing a Regional Master Plan (RMP). One of the major goals of the Highlands RMP is protecting natural and cultural resources. Therefore, an update of the Landscape Project was warranted. The methods for delineating imperiled and rare species habitat areas in Version 3.0 are described in the following sections of this report: "General Methodology for Delineating Imperiled and Rare Species Habitat within the Highlands Extended Boundary," "Species Data," "Base Layer Preparation," "New Layers," and "Detailed Methodology for Delineating Imperiled and Rare Species Habitat within the Highlands Extended Boundary."

Version 2.1: Concurrent with the release of Version 3.0 within the Highlands Region, the Department released Version 2.1 of the Landscape Project in the area of the state outside the Highlands Extended Boundary. With some minor exceptions, the update from Version 2.0 to 2.1 employed the same methodology used in Version 2.0. Version 2.1 incorporated updated LU/LC data and new species occurrence information. See the following document for further information: *New Jersey's Landscape Project (Version 2.1).*

FUTURE UPDATES

The Department will continue to update the Landscape Project using Version 3.0 methodology until it is completed statewide. As the remainder of the state is updated to Version 3.0, it will become the standard for all Department applications. Version 2.1 will be erased in areas where Version 3.0 becomes available. These updates and any schedule of future releases can be found on the Landscape Project website (http://www.state.nj.us/dep/fgw/ensp/landscape/).

GENERAL METHODOLOGY FOR DELINEATING IMPERILED AND RARE SPECIES HABITAT WITHIN THE HIGHLANDS EXTENDED BOUNDARY

NJDEP aerial photo-based data are used to delineate imperiled and rare species habitat within the Highlands Region. The 1995 LU/LC was recently updated with 2002 imagery and includes 69 unique LU/LC classes within the Highlands Region as described in Anderson et al. (1976).

In Version 2.0 the unique LU/LC classes are combined into five general habitat types: forest, forested wetland, grassland, emergent wetland and beach. In Version 3.0 for the Highlands, each of the 69 LU/LC classes is retained. The method for delineating imperiled and rare species habitat areas in Version 2.0 is as follows: First, the relevant classes for each habitat type (forest, grassland, forested wetland, emergent wetland and beach) are extracted from the NJDEP's LU/LC data layer. Dissolving the different LU/LC classes for each habitat type creates contiguous habitat polygons. Using boundaries between habitat types and major roads (500 Series County Routes and above), contiguous patches for each habitat type are delineated. Each patch is then assigned a unique link ID. For each species one or more of the five habitat types is designated as an appropriate potential habitat. Species occurrence areas are then intersected with appropriate habitat type patches. Habitat patches are then classified based on the status of the species present.

In Version 3.0, instead of combining the unique LU/LC classes into the five habitat types, each species now has a specific set of LU/LC classes that are combined into a potential layer relating to that species needs. Individual species occurrence areas are then intersected with species-specific appropriate habitat patches. Habitat patches are then classified based on the status of the species present. Retaining the original LU/LC class delineations allows greater flexibility and potential for a more accurate representation of presumed imperiled and rare species habitat based on individual species-habitat associations. This "species-based" patch approach provides ENSP biologists with the ability to assign a specific set of LU/LC classifications to be valued for each individual species.

Although the base data and methodology differ in Version 3.0 from that of Version 2.0, the same ranking criteria apply.

- **Rank 5** is assigned to species-specific patches containing one or more occurrences of wildlife listed as endangered and threatened pursuant to the Federal Endangered Species Act of 1973.
- **Rank 4** is assigned to species-specific patches with one or more occurrences of State endangered species.
- **Rank 3** is assigned to species-specific patches containing one or more occurrences of State threatened species.
- **Rank 2** is assigned to species-specific patches containing one or more occurrences of species considered to be species of special concern (this rank represents "rare species" of wildlife as defined in the Highlands Water Protection and Planning Act Rules).
- **Rank 1** is assigned to species-specific patches that meet habitat-specific suitability requirements such as minimum size criteria for endangered, threatened or priority wildlife species, but that do not intersect with any confirmed occurrences of such species.
- **Rank 0** is assigned to species-specific patches that do not contain any species occurrences and do not meet any habitat-specific suitability requirements.

SPECIES DATA

In previous versions of the Landscape Project the main source of species data was from the Natural Heritage Program's BCD. ENSP staff reviewed all animal records for acceptability/reliability and subsequently accepted or rejected records for inclusion in the BCD (*Appendix I*). However, maintenance of the database was the responsibility of the NHP staff. Species occurrences were exported from the BCD database to a file format compatible with GIS for use in the Landscape Project. A polygon, referred to as a "species occurrence area," was applied to each species location record in the database. These occurrence areas are used to value patches of habitat (See *Appendix II* for descriptions of all species occurrence areas). Species occurrences in the BCD were derived from a variety of sources including ENSP

surveys, DEP staff reports, private consultant reports and those reports from the general public that were reviewed and accepted by ENSP biologists.

In 2004, ENSP took full control of maintaining animal records, and both programs, ENSP and NHP upgraded from the BCD to an Oracle-based database called Biotics. Biotics is the new standard used throughout the NatureServe network, which extends across all 50 states, Canada, Latin America and the Caribbean, for tracking imperiled and rare species occurrences. It offers many advantages that include multi-user capabilities, a user-friendly interface, established scientific standards for biological inventory and biodiversity data management and an ability to interact with GIS software.

While making the conversion to Biotics, ENSP took full advantage of the opportunity to review all imperiled and rare animal occurrences and supplied new standards for how occurrences would be reviewed and used for the Landscape Project. In previous versions of the Landscape Project, ENSP used all occurrences dated 1970 or later for which there existed precise location information (±70m). The 1970 date for sightings coincides with the time when biologists started to track and record precise locations of imperiled and rare species. It also coincides with the start of ENSP, which began in 1973. The 1970 cut-off date and high precision requirements are still being used, but all records were reviewed to verify that suitable habitat remains in the immediate vicinity of the occurrence. If suitable habitat no longer exists in the vicinity of the occurrence it is not used to value patches in the Landscape Project. All occurrences now receive a 'feature label' as well as a 'location use class." Both of these are used to record more information about the occurrence. A feature label describes the type of occurrence, e.g. nest, den, etc. A 'location use class' is specified for migratory species and indicates the season or behavior that is associated with the occurrence. ENSP has defined an occurrence area for every feature label assigned to a species that is used to value patches in the Landscape Project. An example depicting the occurrence areas for several types of timber rattlesnake feature labels is described below.

Timber Rattlesnake

Landscape Rank	Common Name	Feature Label	Migratory Type	SOA
4	Timber Rattlesnake	Skylands Telemetry: Partial Activity Range	Non-Migratory	Telemetry Area
4	Timber Rattlesnake	Skylands Telemetry: Home Range	Non-Migratory	Telemetry Area
4	Timber Rattlesnake	Skylands Occurrence by Den	Non-Migratory	4.0 Kilometer Radius
4	Timber Rattlesnake	Skylands Occupied Habitat	Non-Migratory	20 Meter Radius
4	Timber Rattlesnake	Skylands Gestation Site	Non-Migratory	4.0 Kilometer Radius
4	Timber Rattlesnake	Skylands Hibernaculum	Non-Migratory	4.0 Kilometer Radius

BASE LAYER PREPARATION

In order to prepare the Landscape Project base layer, the following steps were performed:

- **Highlands Extended Boundary**

  In order to create the Landscape Project within the Highlands Region as defined by the Highlands Council, ENSP needed to extend the Highlands Region to the nearest major roadway. This was required because the Landscape Project methodology uses major roads, as defined below, as one means of delineating a patch boundary. The resulting area includes the Highlands Region established by the Highlands Water Protection and Planning Act (N.J.S.A 13:20-1 et seq.) with boundaries specifically described at N.J.S.A 13:20-7 as well as, where the statutory Highlands Region boundary is not a major roadway, an additional area that extends outward from that boundary to the nearest major roadway.

- **Major Roads**

  NJ Department of Transportation (DOT) Major Roadways (2004) are stored as a GIS line file representing the centerline of the roadways. A subset of roads defined by ENSP as "major roadways" (Interstate Highways, U.S.

Routes, NJ State Highways, Toll Authority Routes and 500 and 600 Series County Routes) were buffered, creating a polygon file to bisect LU/LC classifications and serve as a boundary between contiguous level 3 LU/LC classes. Roadway lines classified as 500 and 600 Series County Routes were buffered by 25 feet, while lines classified as Interstate Highways, U.S. Routes, NJ State Highways and Toll Authority Routes were buffered by 37.5 feet. These road widths were determined by randomly selecting roads and averaging measured widths using the 2002 aerial imagery. The completed major roads polygon file was then combined with the 2002 LU/LC in order to bisect contiguous areas of habitat.

- Riparian Corridor

The Landscape Project was developed as a method of identifying landscapes essential for long term viability of imperiled and rare species populations. While Version 2.0 of the Landscape Project mapping delineates habitats for upland, coastal, and wetland species, the value of essential aquatic habitat and associated riparian corridors are not represented. The Riparian layer identifies those streams and riparian habitats that are essential to imperiled and rare aquatic, semi-aquatic, and floodplain wildlife based on the occurrence records in the Biotics database. The inclusion of aquatic habitat completes the Landscape Project mapping and will be a tool for land planning by land managers, watershed agencies and associations, and other conservation organizations. Specifically, the mapping will provide the Divisions of Water Quality and Watershed Management with vital information that can serve as an index related to the quality of riparian corridors. This information can be used to determine necessary restrictions and protection levels when reviewing water use/discharge permit applications.

The basic principles involved in producing the Riparian Layer are defined in the CRSSA Technical Report 0101 "*A Methodology for Defining and Characterizing the Health of Riparian Areas in the Musconetcong and the Pohatcong Watersheds using Geographic Information Systems (GIS)*" (Hughes & Lathrop 2001). An area is defined as riparian if it is prone to flooding, contains hydric soils, or is delineated as freshwater wetlands. A few minor changes were made to the CRSSA model methodology as described below. There are 5 GIS datasets used to create the ENSP riparian corridor: NJDEP USGS Flood-Prone Areas; U.S. Department of Agriculture, Natural Resources Conservation Service Soil Survey Geographic Soils 2005 (SSURGO); NJDEP 2002 Land use/Land cover Update for New Jersey; NJDEP 2002 Streams Update for New Jersey; and NJDEP 2002 Land use/Land cover- Highlands Study Area (FINAL). In the CRSSA model, these datasets were converted to a raster dataset of 40 foot grid cells. For our analysis the datasets were used in their original vector formats. Each dataset was recoded as follows:

- NJDEP USGS Flood-Prone Areas – all areas coded as "1 USGS Documented Flood-prone Area" or "8 Water" are recoded as "1", all others recoded as "0"
- SSURGO – all soils defined as "hydric" recoded as "1", all others recoded as "0"
- NJDEP 2002 Land use/Land cover Update for New Jersey – all Type02 coded as "wetlands" get recoded to "1", all others recoded as "0"

All polygons coded as "1" from the above layers are combined and dissolved into one layer. Next, all streams (NJDEP 2002 Streams Update for New Jersey) and water bodies (*NJDEP 2002 Land use/Land cover Update for Highlands Study Area (FINAL)*) are buffered by 30 feet to create a continuous corridor surrounding all water sources and capture any areas that were not previously included because they were not coded as flood prone, hydric, or wetlands, or they occur in an urban LU/LC class, or are bounded by steep slopes. This 30 foot buffer is combined and dissolved with the previous layer into a riparian corridor. Next the streams layer is overlaid on this resultant corridor. Any polygon that does not intersect the streams layer is deleted. The resulting layer is the final Landscape Project Riparian Corridor. This layer is combined with the NJDEP 2002 LULC dataset, which is the base layer for ENSP's Version 3.0 of the Landscape Project.

NEW LAYERS

Two new layers were added to the Landscape Project to accommodate the mapping of some aquatic and semi-aquatic species. The method for creating those layers is described below.

- **Streams**

An update to the DEP Streams layer was completed with the DEP 2002 LU/LC update and was incorporated into Version 3.0. Streams and associated aquatic species were not represented in previous versions of the Landscape Project. In Version 3.0, within the Highlands Extended Boundary, stream and water body centerlines are valued exclusively by freshwater mussel species.

Within Biotics, freshwater mussel species' occurrences may be mapped as a point, line, or polygon source feature depending upon the specifics of the observation. A point source feature is utilized when, for instance, a small area (less than 6.25 meters) or a single occurrence is observed. A line source feature is utilized when multiple occurrences are observed along a stream segment – this is most often used for small streams where digitizing a polygon based on 2002 color infrared aerial images would not be feasible. A polygon source feature is utilized for areas where multiple occurrences have been observed within an area large enough to be identified and digitized on 2002 color infrared aerial images.

For ease of use, ENSP chose to value water body centerline and stream centerline data with mussel occurrence areas rather than water body polygons from the 2002 LU/LC. Additional GIS processing was performed on the stream layer to allow users the ability to identify centerlines associated with water bodies. All centerline data within the Highlands Extended Boundary were extracted from the 2002 LU/LC Stream layer. In order to form "patches," within the stream layer, centerlines were broken at the following points:

- The confluence of two or more streams
- The inflow/outflow of a water body

Water body centerline data in the Streams layer are coded with an ID ("OBID") that relate to water body polygons in the 2002 LU/LC. The minimum mapping unit (MMU) is 1 acre for polygonal water features and a width of thirty feet. Only water body centerlines of LU/LC water body polygons coded as "ARTIFICIAL LAKES" (LU02: 5300), "STREAMS AND CANALS" (LU02: 5100) and "NATURAL LAKES" (LU02: 5200), were assigned an "OBID."

Freshwater mussel occurrences within the Highlands are represented as either polygon or point feature types. All mussel point occurrences within the Highlands Extended Boundary get a 50 meter occurrence area. Streams intersected by a mussel point occurrence or a mussel polygon occurrence, were valued for that occurrence. All valued streams were buffered by 0.75 kilometers upstream and downstream. The 0.75 kilometer distance was chosen as a conservative buffer estimate because scientific literature, which is based largely upon larval transport by host fishes, states that if there are 2 occurrences within 2.0 kilometers of each other (assuming unsuitable habitat between), these occurrences should be considered as one occurrence. In the cases where stream buffers of separate occurrences of the same species met, either upstream or downstream, the stream segments between those occurrences were also valued for that species.

- **Vernal Habitat**

In 2001 ENSP partnered with Rutgers University Center for Remote Sensing and Spatial Analysis (CRSSA) to develop a method for mapping potential vernal pools throughout New Jersey. Through an on-screen visual interpretation of digital orthophotography, CRSSA identified over 13,000 potential pools throughout the state. A subset of these pools was field verified and confirmed, with an 88% accuracy rate (Lathrop et al. 2005), to meet the physical characteristics to qualify as a vernal pool.

Prior versions of the Landscape Maps have not included mapping of vernal habitat areas. In accordance with N.J.A.C. 7:7A-1.4, the term "vernal habitat" includes a vernal pool - or the area of ponding - plus any freshwater wetlands adjacent to the vernal pool. The Department has included mapping of vernal habitat areas in Version 3.0 that relies upon data developed by the DEP and CRSSA to identify sites that should be field checked for possible identification as vernal habitats areas. DEP staff is in the process of field-verifying these pools. The Department also maps vernal habitat areas based upon on-the-ground assessment of sites not captured by the CRSSA mapping. In Version 3.0 of the Landscape Maps, all of the CRSAA-identified sites, as well as sites identified by on-the-ground reconnaissance, are categorized as either "potential vernal habitat areas" or "vernal habitat areas" as defined below:

- Potential vernal habitat area - These are areas identified by CRSSA as possibly containing a vernal pool that meets the criteria of a "vernal habitat" pursuant to N.J.A.C. 7:7A-1.4. These sites include sites that have been field inspected and have been found to meet the physical characteristics of a vernal habitat, but for which biological criteria have not yet been measured, as well as sites that have not been checked by DEP staff.
- Vernal habitat areas - These are areas that contain pools that have been field-verified by the Department and have been determined to meet both the physical and biological characteristics of a vernal habitat in accordance with N.J.A.C. 7:7A-1.4.

All areas mapped as "potential vernal habitat areas" and "vernal habitat areas" include a point location estimated to be the center of an individual vernal pool, plus all areas within 300 meters of the point. Note that the occurrence area is not intended to suggest or correspond with any specific regulatory requirement. Rather, the area added around the point accounts for variations in the size of individual vernal pools, variations in the width of freshwater wetlands adjacent to the pool, plus adjacent habitats sufficient to include the estimated home range for vernal pool obligate species. If there is an overlap between areas mapped around two or more nearby points, the boundaries are conjoined to generate contiguous patches. If such a patch contains areas mapped as "vernal habitat area" and areas mapped as "potential vernal habitat areas," the patch is labeled as a "vernal habitat area."

DETAILED METHODOLOGY FOR DELINEATING POTENTIAL IMPERILED AND RARE SPECIES HABITAT WITHIN THE HIGHLANDS EXTENDED BOUNDARY

Patch Types (See *Appendix IV for patch-type description illustrations*)

With the implementation of the species-based patch methodology, ENSP has developed new methods for dealing with different groups of species and how they interact with the species-based patch approach. Species are grouped into the following patch type categories.

A. LU/LC level 3 classes are not dissolved/combined into patches for these species. Species occurrence areas value any non-urban LU/LC polygons with which they intersect.

B. For each species, lists of LU/LC level 3 classes are chosen. These are dissolved/combined into species-specific patches of habitat. Species occurrence areas are overlaid on the habitat patches and they value any patch with which they intersect.

C. Species in this group have a minimum patch size requirement. They follow the same protocol as defined in Patch Type B. However, a patch must meet a size requirement before an occurrence area can value that patch.

D. This type relates to our colonial water birds. Nesting occurrences in this group receive two types of occurrence areas; a nesting occurrence area and a foraging occurrence area. Lists of level 3 LU/LC classes are chosen for each type of occurrence area. Similar to Patch Type A, LU/LC level 3 classes are not dissolved/combined into patches. Species occurrence areas are overlaid and value any chosen LU/LC polygons with which they intersect.

E. Species in this type follow the protocol described in Patch Type B. However, there is a second step. After the patches have been created for the species, second lists of LU/LC level 3 classes are identified. If these LU/LC level 3 polygons are adjacent to, or within, a specified distance (species-specific) they are dissolved and become part of the valued area.

F. Red-headed woodpecker has its own patch type because it follows the protocol described in Patch Type E, but has different requirements based on whether it is a breeding or non-breeding occurrence.

G. Species in this group have a minimum "core area" size requirement. They follow the same protocol as defined for Patch Type B. However, a patch must meet the core requirement before a species occurrence area can value it. Core areas are determined by buffering patches inward from the perimeter by 90 meters and erasing the buffered area from each patch. If the remaining area is 10 hectares or greater, then the original patch is coded as core.

H. Bobcat also has its own patch type. LU/LC class 2100 (cropland and pastureland) patches less than or equal to 3 hectares in size are combined with other selected LU/LC classifications and contiguous patches are formed **(see Appendix III)**. The minimum core requirement is then applied so that a patch must meet or exceed 10 hectares core area before a bobcat occurrence area can value that patch.

I. Freshwater mussel occurrence areas are used to value stream and water body centerlines. They do not value water body polygons in the 2002 LU/LC.

Below is a table of Highlands Region species that are ranked Special Concern (rank 2) through Federally Listed (rank 5) and the associated attributes.

Group	Common Name	Scientific Name	Season	Landscape Rank	Patch type
Mammal	Bobcat	Lynx rufus	N/A	State Endangered (4)	H
Mammal	Eastern Small-footed Myotis	Myotis leibii	N/A	Special Concern (2)	B
Mammal	Indiana Bat	Myotis sodalis	N/A	Federally Listed (5)	B
Bird	American Bittern	Botaurus lentiginosus	BR	State Endangered (4)	B
Bird	American Kestrel	Falco sparverius	BR	Special Concern (2)	B
Bird	Bald Eagle nesting	Haliaeetus leucocephalus	BR	State Endangered (4)	B
Bird	Bald Eagle foraging	Haliaeetus leucocephalus	BR	State Endangered (4)	NA
Bird	Barred Owl	Strix varia	BR	State Threatened (3)	G
Bird	Black Rail	Laterallus jamaicensis	BR	State Threatened (3)	B
Bird	Black-crowned Night-heron nesting	Nycticorax nycticorax	BR	State Threatened (3)	D
Bird	Black-crowned Night-heron foraging	Nycticorax nycticorax	BR	State Threatened (3)	D
Bird	Black-throated Green Warbler	Dendroica virens	BR	Special Concern (2)	B
Bird	Bobolink	Dolichonyx oryzivorus	BR	State Threatened (3)	B
Bird	Canada Warbler	Wilsonia canadensis	BR	Special Concern (2)	B
Bird	Cerulean Warbler	Dendroica cerulea	BR	Special Concern (2)	B
Bird	Cliff Swallow	Petrochelidon pyrrhonota	BR	Special Concern (2)	B
Bird	Cooper's Hawk	Accipiter cooperii	BR	State Threatened (3)	B
Bird	Eastern Meadowlark	Sturnella magna	BR	Special Concern (2)	B
Bird	Golden-winged Warbler	Vermivora chrysoptera	BR	Special Concern (2)	E
Bird	Grasshopper Sparrow	Ammodramus savannarum	BR	State Threatened (3)	B
Bird	Great Blue Heron nesting	Ardea herodias	BR	Special Concern (2)	D
Bird	Great Blue Heron foraging	Ardea herodias	BR	Special Concern (2)	D
Bird	Henslow's Sparrow	Ammodramus henslowii	BR	State Endangered (4)	B
Bird	King Rail	Rallus elegans	BR	Special Concern (2)	B
Bird	Least Bittern	Ixobrychus exilis	BR	Special Concern (2)	B
Bird	Long-eared Owl	Asio otus	BR	State Threatened (3)	B
Bird	Migrant Loggerhead Shrike	Lanius ludovicianus migrans	BR	State Endangered (4)	B
Bird	Northern Goshawk	Accipiter gentilis	BR	State Endangered (4)	B
Bird	Northern Harrier	Circus cyaneus	BR	State Endangered (4)	B
Bird	Osprey	Pandion haliaetus	BR	State Threatened (3)	B
Bird	Pied-billed Grebe	Podilymbus podiceps	BR	State Endangered (4)	B
Bird	Red-headed Woodpecker	Melanerpes erythrocephalus	BR	State Threatened (3)	F
Bird	Red-shouldered Hawk	Buteo lineatus	BR	State Endangered (4)	G
Bird	Savannah Sparrow	Passerculus sandwichensis	BR	State Threatened (3)	B
Bird	Sedge Wren	Cistothorus platensis	BR	State Endangered (4)	B
Bird	Upland Sandpiper	Bartramia longicauda	BR	State Endangered (4)	C
Bird	Veery	Catharus fuscescens	BR	Special Concern (2)	B
Bird	Vesper Sparrow	Pooecetes gramineus	BR	State Endangered (4)	C
Bird	Winter Wren	Troglodytes troglodytes	BR	Special Concern (2)	B
Bird	Worm-eating Warbler	Helmitheros vermivorus	BR	Special Concern (2)	B
Bird	Yellow-crowned Night-heron nesting	Nyctanassa violacea	BR	State Threatened (3)	D
Bird	Yellow-crowned Night-heron foraging	Nyctanassa violacea	BR	State Threatened (3)	D
Reptile	Bog Turtle	Clemmys muhlenbergii	N/A	Federally Listed (5)	B
Reptile	Eastern Box Turtle	Terrapene carolina carolina	N/A	Special Concern (2)	E
Reptile	Northern Copperhead Snake	Agkistrodon contortrix mokasen	N/A	Special Concern (2)	B
Reptile	Timber Rattlesnake	Crotalus horridus horridus	N/A	State Endangered (4)	B
Reptile	Wood Turtle	Glyptemys insculpta	N/A	State Threatened (3)	E
Amphibian	Blue-spotted Salamander	Ambystoma laterale	N/A	State Endangered (4)	E
Amphibian	Jefferson Salamander	Ambystoma jeffersonianum	N/A	Special Concern (2)	E
Amphibian	Longtail Salamander	Eurycea longicauda longicauda	N/A	State Threatened (3)	B
Amphibian	Marbled Salamander	Ambystoma opacum	N/A	Special Concern (2)	E
Butterfly	A Silver-bordered Fritillary	Boloria selene myrina	N/A	State Threatened (3)	B
Butterfly	Arogos Skipper	Atrytone arogos arogos	N/A	State Endangered (4)	B

Group	Common Name	Scientific Name	Season	Landscape Rank	Patch type
Dragonfly/Damselfly	Arrowhead Spiketail	Cordulegaster obliqua	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Brook Snaketail	Ophiogomphus aspersus	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Brush-tipped Emerald	Somatochlora walshii	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Harpoon Clubtail	Gomphus descriptus	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Maine Snaketail	Ophiogomphus mainensis	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Midland Clubtail	Gomphus fraternus	N/A	Special Concern (2)	A
Dragonfly/Damselfly	New England Bluet	Enallagma laterale	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Rapids Clubtail	Gomphus quadricolor	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Sable Clubtail	Gomphus rogersi	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Ski-tailed Emerald	Somatochlora elongata	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Spatterdock Darner	Rhionaeschna mutata	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Tiger Spiketail	Cordulegaster erronea	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Williamson's Emerald	Somatochlora williamsoni	N/A	Special Concern (2)	A
Dragonfly/Damselfly	Zebra Clubtail	Stylurus scudderi	N/A	Special Concern (2)	A
Freshwater Mussel	Brook Floater	Alasmidonta varicosa	N/A	State Endangered (4)	I
Freshwater Mussel	Creeper	Strophitus undulatus	N/A	Special Concern (2)	I
Freshwater Mussel	Dwarf Wedgemussel	Alasmidonta heterodon	N/A	Federally Listed (5)	I
Freshwater Mussel	Eastern Lampmussel	Lampsilis radiata	N/A	State Threatened (3)	I
Freshwater Mussel	Triangle Floater	Alasmidonta undulata	N/A	State Threatened (3)	I
Freshwater Mussel	Yellow Lampmussel	Lampsilis cariosa	N/A	State Threatened (3)	I

TECHNICAL INFORMATION

Landscape Project maps are available in ArcView shapefile and file geodatabase formats and projected to New Jersey State Plane feet, datum NAD 83, zone 4701. The maps are best viewed using ArcGIS 9.x. These software products allow the user full functionality for viewing and manipulating Landscape Project data. Non-GIS users can view the maps using ArcGIS Explorer, a free GIS data browser that can be downloaded from the ESRI Web site:

- http://www.esri.com/software/arcgis/explorer/index.html

Landscape Project data and maps are available by the following methods:

- GIS Data
  - Download on NJDEP's Bureau of GIS website (http://www.nj.gov/dep/gis).
  - On CD by request to ENSP, at the address below.
- Maps
  - An available GIS layer on NJDEP's interactive mapping application site (http://www.nj.gov/dep/gis/).
  - An available interactive map book on DFW's ENSP website (http://www.nj.gov/dep/fgw/ensp/mapbook.htm).
  - An interactive map book on CD by request to ENSP, at the address below.
- Upon request to:

  New Jersey's Landscape Project
  Department of Environmental Protection
  Division of Fish and Wildlife
  Endangered and Nongame Species Program
  PO Box 400
  Trenton, NJ 08625-0400
  Phone: (609) 292-9400
  Fax: (609) 984-1414

Appendices

Appendix I. Protocol for Accepting or Rejecting Species Sighting Reports.

1. When a sighting report arrives at the ENSP office it is logged in and tracked in a database, regardless of acceptability.
2. If no additional information is needed, the sighting report is sent to the appropriate ENSP biologist for review.
3. If additional information is needed, an attempt is made to obtain the required information. This can include sending a map to the observer to mark the location of the sighting, a telephone interview to clarify information, etc. After all of the required information is obtained the report is sent to the appropriate ENSP biologist for review.
4. ENSP biologist receives the sighting report and reviews it for acceptability/reliability. A species sighting is accepted or rejected based on the following criteria:

- Did the sighting occur within the known range of the species?
- Did the sighting occur in the known/recognized habitat for the species?
- Is the species easily identified, or is it often confused with another?
- Did anyone else confirm the sighting, or can someone else vouch for the observer's identification skills?
- Do we have first-hand knowledge of the observer's identification skills?
- Did the observer include a photograph?
- Is the species listed as endangered, threatened or special concern for the season in which it was reported? (Some species can have a separate status for breeding season and non breeding season.)
- If uncertainty remains about the validity of the sighting, the observer is interviewed by the ENSP biologist.

a. If sufficient information accompanies the sighting report the record is either accepted or rejected by an ENSP biologist.
b. If accepted, the reviewing biologist assigns the sighting a feature label and determines whether the sighting should be used in the Landscape Project. For some species, only occurrences assigned specific feature labels are included in the Landscape Project. For example, for many of the raptors a sighting of a migrating bird may be considered valid, but not for inclusion in the Landscape Project. The report is then returned to ENSP's GIS staff and advances to step 5 if accepted.
c. The reviewing biologist may determine that it is necessary to gather additional information (e.g., ascertain observer experience, ask if there have been additional sightings, ask for photos, ask for verifications by second observer, etc.) before the record can be accepted. If the record is accepted, advance to step 5.
d. If the reviewing biologist determines that the sighting must be field checked, it is initially rejected until fieldwork can be scheduled to verify the sighting.
5. ENSP GIS staff digitizes the sighting location and prepares the data in a standardized format to enter into the Biotics database.
6. ENSP staff perform a quality check of the documentation, mapping and data entry before the record is complete and filed.

Appendix II. Species Occurrence Area Justifications

MAMMALS:

Bobcat

Feature Label	Occurrence Area
Sighting	2.82 km radius
Den	2.82 km radius
Dead on road	2.82 km radius
Capture location	2.82 km radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

Bobcat home range sizes are highly variable, both geographically and intrasexually in the same geographic area particularly if suitable habitat components have a patchy distribution (Lovallo 1999). The home range size of males is generally larger than that of females. In New Jersey, the annual home range of a male in 2002 was 121 km^2 with a core of 19 km2 and the home range of a female in 2003 was 90 km2 with a core of 11.7 km^2, as estimated by kernel home range method. We apply a 25 km^2 buffer (2.82 km radius) around bobcat sightings, which is larger than the core area we estimated for a male and female bobcat in the state, and midway between the male and female home range sizes Lovallo (2000) estimated in north central Pennsylvania. It is a conservative estimate based on sizes reported for bobcats in the northeastern United States (Lovallo 2000).

Literature supporting occurrence area(s):

Conner, M., B. Plowman, B.D. Leopold, C. Lovell. 1999. Influence of time-in-residence on home range and habitat use of bobcats. Journal of Wildlife Management 63(1):261-269.

In east central Mississippi the male home range was 15.34 $\pm$ 2.12 km^2 and 15.67 $\pm$ 2.61 km^2 in consecutive years. The female annual home range was 7.81 $\pm$ .91 km^2 and 6.40 $\pm$ .57 km^2 in consecutive years.

Litvaitis, J.A., J.A. Sherburne, J.A. Bissonette. 1986. Bobcat habitat use and home range size in relation to prey density. Journal of Wildlife Management 50(1):110-117.

In Maine the average home range size of males was 95.7 km^2 and that of females was 31.2 km^2.

Lovallo, M.J., E.M. Anderson. 1996. Bobcat (Lynx rufus) home range size and habitat use in northwest Wisconsin. American Midland Naturalist 135(2): 241-252.

In northwestern Wisconsin the annual male home ranges were 60.4 km^2 $\pm$ 23.4 km^2 and the female home ranges were 28.5 km^2 $\pm$ 3.7 km^2.

Lovallo, J.M. 1999. Multivariate models of bobcat habitat selection for Pennsylvania Landscape. Ph.D. dissertation. The Pennsylvania State University, University Park. 146pp.

Attributes the highly variable home range estimates of both males and females to the patchy distribution of suitable habitat components.

Lovallo, M.J. 2000. Bobcat home range size and intraspecific social relationships. Pennsylvania Game Commission Bureau of Wildlife Management Research Division Project Annual Job Report: Bobcat Research/Management 06630.
Median female home range was 16 km^2 (MCP) and median male home range was 42 km^2 (MCP). Lovallo (2000) also summarizes other home range sizes in the northeastern U.S. as being 36-326 km^2 for males in New York State, 71-112 km^2 for males in Massachusetts, and 28-33 km^2 for females in Maine.

Last researched by Gretchen Fowles in fall 2005.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Eastern Small-footed Myotis

Feature Label	Species Occurrence Area
Breeding Maternity Roost	2 km radius buffer
Breeding Capture Location	2 km radius buffer
Breeding Foraging Area	Hand-digitized polygon
Nonbreeding Hibernaculum	4 km radius buffer
Nonbreeding Roosting Area	2 km radius buffer
Nonbreeding Capture Location	2 km radius buffer
Nonbreeding Foraging Area	Hand-digitized polygon

Occurrence Area Rule: "Hibernaculum" is mapped as a point, line, or polygon, which then receives the specified radius. "Foraging Area" features are mapped as polygons which represent the Species Occurrence Areas. All other feature labels are mapped as points, which then receive the radii specified above.

Justification text:

There is a lack of knowledge regarding size of Myotis leibii home ranges and foraging areas. It is currently accepted in the scientific community that habitat requirements of Myotis leibii parallel those of other Myotis species. Therefore, the landscape models determined for Myotis sodalis are being applied to Myotis leibii until further research warrants changes.

Literature supporting occurrence area(s):

To be reviewed.

Last researched by Melissa Craddock in February 2007.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Indiana Bat

Feature Label	Species Occurrence Area
Breeding Maternity Roost	2km radius buffer
Breeding Capture Location	2 km radius buffer
Breeding Foraging Area	Hand-digitized polygon
Nonbreeding Capture Location	2 km radius buffer
Nonbreeding Foraging Area	Hand-digitized polygon
Nonbreeding Roosting Area	2 km radius buffer
Nonbreeding Hibernaculum	4 km radius buffer
Travel corridor	Hand-digitized polygon

Occurrence Area Rule: "Hibernaculum" is mapped as a point, line, or polygon, which then receives the specified radius. "Foraging Area" and "Travel Corridor" are mapped as polygons which represent the Species Occurrence Area. All other feature labels are mapped as points, which then receive the radii specified above.

Justification text:

Fall roosting and foraging distance from hibernacula ranged from 2.4km-6.8km with an average distance of 4.33km. A 4km radius buffer was therefore selected to protect foraging and roosting habitat surrounding hibernacula. Summer roosting and foraging distances ranged from 0.679km – 5km to create an average radius buffer of 2km.

Literature supporting species occurrence area(s):

Callahan, E.V., R.D. Drobney, and R.L. Clawson. 1997. Selection of summer roosting sites by Indiana bats (Myotis sodalist) in Missouri. J. Mamm. 78:818-825.

The furthest distance documented between roosts occupied by bats within a single maternity colony was 5km.

Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1991a. Summer roost selection and roosting behavior of Myotis sodalist (Indiana bat) in Illinois. Unpublished report, Illinois Natural History Survey, Champaign, Illinois.

Radiotelemetry showed that during the maternity period, home range of Indiana bats is generally no larger than 2km in breadth.

Gardner, J.E., J.D. Garner, and J.E. Hofmmann. 1991b. Summary of Myotis sodalis summer habitat studies in Illinois: with recommendations for impact assessment. Special Report. Illinois Natural History Survey, Illinois Dept. of Conservation. Champaign, Illinois. 28 pp.

Stream, associated with floodplain forests, and impounded bodies of water are preferred foraging habitats for pregnant and lactating Indiana bats, some of which may fly up to 2.5 km from upland roosts. Mean distance moved by reproductively active females between foraging and roosting habitat was 1.04km. Maximum distance moved by reproductively active females between foraging and roosting habitat was 2.40km.

Kiser, J.D. and C.L. Elliott. 1996. Foraging habitat, food habits, and roost tree characteristics of the Indiana bat (Myotis sodalist) during autumn in Johnson County, Kentucky. Final report, Kentucky Dept. of Fish and Wildl. Resources, Frankfort, Kentucky. 65 pp.

In Kentucky, Kiser and Elliott found male Indiana bats roosting primarily in dead trees on upper slopes and ridgetops within 2.4km of their hibernaculum. In the fall, male Indiana bats tend to roost and forage in upland and ridgetop forests, but may also forage in valley and riparian forest; movements of 2.5-6.8km have been reported in Kentucky and Missouri.

Menzel, J.M., W.M. Ford, M.A. Menzel, T.C. Carter, J.E. Gardner, J.D. Garner, J.E. Hofmann. 2005. Summer habitat use and home-range analysis of the endangered Indiana bat. Journal of Wildlife Management 69(1):430-436.

Home ranges were determined from radio telemetry of 7 female and 4 male Indiana bats in Illinois. No significant differences were found in home-range size between male and female bats or between study years. The mean home-range size for the Indiana bats tracked was 144.7ha, which calculates to a radius of 0.679km.

Stihler, C. West Virginia Division of Natural Resources, pers observ. October 1996. Reference excerpted from USFWS Indiana Bat Revised Recovery Plan, March 1999.

During September in West Virginia, male Indiana bats roosted within 5.6km [of hibernacula] in trees near ridgetops, and often switched roost trees from day to day.

Last researched by Melissa Craddock in June 2006.
Model applied in Version 3 of the Landscape Project for the Highlands region.

BIRDS:

American Bittern

Feature Label	Occurrence Area
Confirmed/Known Breeding Location	Mapped extent of occurrence or 500 meter radius around confirmed/known breeding location point.
Suspected Breeding Location	500 meter radius around suspected breeding point location.

Occurrence Area Rule: If mapped as a polygon, the polygon is the occurrence area. If mapped as a point, the occurrence area is the area defined by the point and the specified radius.

Justification:

A study in Minnesota determined that the average home range of males and females differed considerably. Males averaged 415 ha while females averaged 337 ha (Brininger 1996). A second study, also conducted in Minnesota, found a significantly smaller average home range (males only) of 127 ha (n=20). However, the average core area (where the bittern was found more than 50% of

the time) was only 25 ha (Azure 1998). These two studies led NatureServe to apply a minimum inferred extent of 0.5 km (NatureServe 2006). ENSP will use the NatureServe minimum inferred extent of 0.5 km until such time as that is changed or we have additional information, including New Jersey-specific data, to justify a change in this value.

Literature supporting occurrence area(s):

Azure. 1998. Aspects of American bittern ecology in northwestern Minnesota. MS thesis. University if North Dakota, Grand Forks, North Dakota. 139 pgs.
In a Minnesota study where n=20, the average home range of males was 127 ha. The average size of the core use area (defined as the area of the home range where the bittern was located >50% of the time) was 25 ha.

Brininger. 1996. The ecology of the American bittern in northwest Minnesota. MS thesis/ St. Cloud State University, St. Cloud, MN, USA.
In Minnesota, the average home range of males was 415 ha. The average female home range was 337 ha.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.
The inferred minimum extent of habitat use (when actual extent is unknown) is 0.5 km. This is based on an average core home range of 25 ha (Azure 1998). Include only the nesting marsh within the boundaries of the inferred extent polygon.

Last researched by Christina Kisiel in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

American Kestrel

Feature Label	Occurrence Area
Foraging (Breeding & Non-breeding)	100 meter radius
Nest	100 meter radius
Sighting (Breeding & Non-breeding)	100 meter radius

Occurrence Area Rule: Observations for all both feature labels are mapped as points, which then receive the radii specified above.

Justification:

This species has small breeding territories but are area sensitive. The buffer was chosen based on breeding territory size and increased for the species' mobility and need for large patches. Until more is discovered about the mobility of the species, a 100 meter radius buffer will be used.

Literature supporting occurrence area(s):

Smallwood, J. A., and D. M. Bird. 2002. American Kestrel (*Falco sparverius*). *In* The Birds of North America, No. 602 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA

Tend to occupy areas > 25 ha in size. Little information is available on breeding territory size, but estimates from breeding densities indicate territories may range from 0.5 – 1 ha.

Migratory stopover habitat consists of open patches. Wintering habitat is similar to breeding habitat but with more woody vegetation. Winter territories range from 1.4 – 3.5 km.

Last researched by Sharon Petzinger in winter 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Bald Eagle

Feature Label	Occurrence Area
Nest	1.0 km radius
Foraging	Bald Eagle Foraging Model
Wintering	Hand-digitized polygon plus 500 meters radius

Occurrence Area Rule: Only points receive the specified radius for the "Nest" feature label. The "Wintering" feature label is mapped as a polygon which is the occurrence area. The "Foraging" feature label is mapped outside of Biotics as a stand-alone model, which represents the occurrence area for that feature label.

Justification:

All habitats (forest, field, wetlands) within 1 km of a nest are designated as critical habitat for bald eagles. Home range size for nesting bald eagles is variable depending on the habitat resources of the area such as food abundance, distance to adequate foraging habitat, etc (Stalmaster 1987, Therres, et al. 1993, Buehler 2000, Harmata and Montopoli 2001). Successful and continued occupancy of a nest site by eagles is also influenced by distance to human disturbance often associated with residential housing, roads, extractive industries (mining, timber) and others. The 1 km radius for nest site habitat protection equals approximately 3 km^2 of area. This is one-third larger than what may be the mean territory size (summarized in Buehler 2000), though local data are lacking.

Bald eagle foraging habitat is defined as the amount of habitat required to support a nesting pair of eagles throughout the year, as breeding bald eagles are year-round residents in NJ. Bald eagles hunt in open water for fish, waterfowl and other aquatic species, but usually do so from perches along the water's edge (Stalmaster 1987). The model calculates open water area by increasing the radius around each nest incrementally one cell (30 m) at a time until an area of 660 ha of

foraging habitat has been identified. Foraging habitat is defined as all open water bodies greater than 8 ha. A 90 m buffer is applied to the identified waters to protect perching sites. All suitable habitat patches (i.e., forest and forested wetlands) that intersect with the foraging habitat and 90 m buffer are designated as critical for eagles.

Wintering sites were identified using specific Eagle Midwinter Survey data and biologist interpretation of essential habitat, as well as recorded sightings of eagles during the winter period of November 1-January 31. Patches of suitable habitat (forest, forested wetlands, and open waters) within 500 meters of each site are designated as critical habitat. This habitat designation was not applied in Landscape Version 1 or 2, but will be included in Landscape Version 3. The Wintering feature label was not used in Highlands's release of version 3.0.

From Birds of North America (Buehler 2000): Estimates of territory size (defended part of home range) vary widely based on nesting density, food supply, and method of measurement. Most reliable estimates based on radio-telemetry are limited. Stalmaster (1987) suggested 1–2 km^2 as typical territory size. Average territory radius (n = 10) was 590 m in Minnesota, as measured by presentation of decoy bird to elicit defensive reactions (Mahaffy and Frenzel 1987). Assuming circular territories, average territory size was about 1 km^2. Minimum territory size was 4 km^2 for radio-tagged pair in Saskatchewan (Gerrard et al. 1992b). Spacing: About 1 nest/1.6 km of shoreline reported historically on Chesapeake Bay (Kirkwood 1895).

Literature supporting occurrence area(s):

Stalmaster, M. V. 1987. The Bald Eagle. Universe Books, New York. 227 p.

Buehler, D. A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). In The Birds of North America, No. 506 (A. Poole and F. Gill, eds.). The Birds of North America Inc., Philadelphia, PA.

Home range sizes are variable (in Florida, 2–8 km^2, larger in other areas, as small as 1 km^2 in some). Minimum territory size in Saskatchewan was 4 km^2 (Gerrard et al. 1992, in Buehler 2000). Wintering habitat is defined by food availability, presence of roost sites that provide protection from weather and absence of human disturbance (Buehler 2000).

Harmata, A. R., and G. J. Montopoli. 2001. Analysis of bald eagle spatial use of linear habitat. J. Raptor Res. 35(2):207-213.

Primary foraging areas may need protection to maintain performance of eagles nesting along rivers.

Therres, G. D., M. A. Byrd, D. S. Bradshaw. 1993. Transactions of the North American Wildlife and Natural Resources Conference, 58:62-69.

The effects of development activities on nesting bald eagles depend on the distance of the activities from the nest, the view the eagles have of the activities and the time of year the development occurs. Other factors that may contribute include the nesting history of the eagles, the birds' previous experience with humans, the availability of alternative nest sites and the amount of development in the area.

Buehler, D. A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). *In* The Birds of North America, No. 506 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Last researched by Kathy Clark in 2006.
Occurrence area applied in Version 3 of the Landscape Project.

Barred Owl

Feature Label	Occurrence Area
Nest	1.0 km radius
Sighting	1.0 km radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

Barred owl home ranges are highly variable geographically and are generally larger during the non-breeding season (Mazur and James 2000). Home range results identified within the literature (below) illustrate this variability. As year-round residents to NJ, the barred owls are protected during both the breeding and non-breeding seasons. As such, Elody and Sloan's, 1985, estimate of home range during the non-breeding season (282 ha) was incorporated into the ENSP's determination of an appropriate occurrence area depicting critical habitat. Using the home ranges 228.6 ha, 507.8 ha, and 282 ha (Nichols and Warner 1972, Fuller 1979, and Elody and Sloan 1985, respectively), the mean home range is 339.47 ha, equivalent to 1.04 km radius. Landscape species occurrence areas are not represented by proportional figures, therefore the ENSP has accepted a conservative estimate by rounding this range territory to a 1 km radius (314 ha).

Literature supporting occurrence area(s):

Nichols, T.H. and D.W. Warner. 1972. Barred owl habitat use as determined by radiotelemetry. J. Wildlife Manage. 36(2):213-224.

- Average home range was 228.6 ha, with a range of 86.1-369.0 ha.

Fuller, M.R. 1979. Spatiotemporal ecology of four sympatric raptor species. Ph.D. Dissertation. University of Minnesota, St. Paul. 396 pp.

- Average cumulative home range, based on minimum area, was 507.8 ha.

Elody, B.J. and N.F. Sloan. 1985. Movements and habitat use of barred owls in the Huron Mountains of Marquette County, Michigan, as determined by radiotelemetry. Jack-pine Warbler 63(1):3-8.

- Average home range size was 282 ha which decreased to 118 ha during the breeding season.

Mazur, K. M., and P. C. James. 2000. Barred Owl (*Strix varia*). *In* The Birds of North America, No. 508 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Note: We used 314 ha = 1 km radius

Mean: 228.6, 507.8, and 282 = 339.47 ha = 1.04 km radius

Last researched by Melissa Craddock & Kris Schantz in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Black-crowned Night-heron

Feature Label	Occurrence Area
Nesting Colony	Mapped extent of nesting colony, if available, otherwise, radius of 71.25 meters (seconds precision circle) around confirmed/known breeding location point.
Nesting Colony Foraging	9.6 km (6 mile) radius around nesting colony.

Occurrence Area Rule: If mapped as a polygon, the polygon is the occurrence area. If mapped as a point, the occurrence area is the area defined by the point and the specified radius.

Justification:

Nesting area is defined by the area the herons actually use, as these birds do not defend a territory except immediately around their individual nests. The boundaries of the colony are defined as much by social attraction phenomenon and by habitat suitability. Consequently there is now immediately apparent justification for buffering the mapped extent of a nesting area. Where the mapped extent of a colony was available it was used. Where the mapped extent was not available the default “seconds precision” circle was used around the recorded nesting location point.

ENSP reviewed the literature regarding commuting distance for colonial nesting long-legged wading birds which fairly consistently indicates that the importance of suitable foraging habitat decreases with the distance from the nesting area (e.g. Dowd and Flake 1985, Custer et al. 2004, Kelly et al 1993, Thompson 1978). This is not surprising considering the energy demands of long commutes and the fact that, all other things being equal, if suitable foraging habitat is randomly distributed within the possible foraging range, simple geometry would argue that availability would increase with the square of the distance from the colony. Consequently, a particular type of wetland or riparian habitat is more critical if it is located close to a nesting area than a similar area located near the edge of the “energetically feasible” foraging range from the colony. It would therefore be unjustifiable to use the maximum foraging distance figures to define all potential foraging habitat as “critical” foraging habitat for a particular nesting colony. Conversely, using an average foraging distance figure may “under-include” suitable habitat by omitting some foraging areas that are important because they provide particularly rich and easily exploited feeding habitat. Further, research (Custer et al. 2004) indicates that longer commuting distances are more frequent during high-demand and demographically critical nestling rearing period. Where the literature on commuting distance includes several studies, there can be wide variability in the mean commuting distances between different studies. When such was the case, we either averaged the reported

mean commuting distances or used the information from the study with a large sample size or from an area most ecologically similar to New Jersey. We then doubled this figure.

Black-crowned night heron foraging flight distances in South China differed between high and low tides. At high tide, the average flight was 0.47 km, with a range of 0.03-1.10 km. At low tide, the average flight was 0.57 km, with a range of .03-1.38 km (Wong 1999). The Birds of North America, however, cites foraging flights of up to 24 km (Davis 1993). NatureServe sets a minimum inferred extent of 3 km for black-crowned night herons (NatureServe 2006). Since there is very little information available for this species, we apply a conservative 9.6 km radius occurrence area to nesting colony foraging areas.

Literature supporting occurrence area(s):

Custer, C.M., S.A. Suarez, D.A. Olsen. 2004. Feeding habitat characteristics of the Great Blue Heron and Great Egret nesting along the Upper Mississippi River, 1995-1998. Waterbirds 27(4): 454-68.

The majority of the herons in this study fed <5 km from the nesting site, and avoided areas > 10 km away. They flew farther to sites during the brood-rearing period than during incubation. Only 10% of the feeding flights ended at a location where another heron was present, indicating that they prefer to feed alone.

Davis, W.E.Jr. 1993. Black-crowned night heron (*Nycticorax nycticorax) In* The Birds of North America No. 74 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

Foraging commuting distance can be up to 24 km.

Dowd and Flake. 1985. Foraging habits and movements of nesting Great Blue Heron in prairie river ecosystem, South Dakota. Journal of Field ornithology 56: 377-87.

A study in South Dakota found that the average distance that great blues flew from their colony to a foraging site was 3.1 km, and the maximum observed distance was 24.4 km. Eighty-five percent of the herons in the study fed within 4 km of the colony.

Kelly J. P., H. M. Pratt, P. L. Greene. 1993. The distribution, reproductive success, and habitat characteristics of heron and egret breeding colonies in the San Francisco Bay area. Colonial Waterbirds. 16:18–27.

> 95% of great blue herons and >90% great egrets fed within 20 km of their colony.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.

The inferred minimum extent of habitat use (when the actual extent is unknown) in 3 km. This is based on a low mean foraging range size.

Thompson. 1978. Feeding areas of Great Blue Herons and Great Egrets nesting in the floodplain of the upper Mississippi River. Proc. Colonial Waterbird Group. 2: 202-13.

In central Minnesota the average distance that the herons flew from the colony to a foraging area was 6.5 km, and the maximum observed was 20.4 km. Fifty-three percent of the herons in the study fed within 4 km of the colony.

Wong. 1999. Foraging flights of nesting egrets and herons at Hong Kong Egretry, South China. Waterbirds 22(3): 424-434.

In South China, foraging flight distances differed between high and low tides. At high tide, the average flight was 0.47 km, with a range of 0.03-1.10 km. At low tide, the average flight was 0.57 km, with a range of .03-1.38 km.

Last researched by Christina Kisiel in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Black Rail

Feature Label	Occurrence Area
Confirmed/Known Breeding Location	Mapped extent of occurrence or 100 meter radius around point.
Suspected Breeding Location	Mapped extent of occurrence or 100 meter radius around point.

Occurrence Area Rule: If mapped as a polygon, the polygon is the occurrence area. If mapped as a point, the occurrence area is the area defined by the point and the specified radius.

Justification:

Black rail research from different locales around the country report similar home ranges for clapper rails. In Arizona, the average home range was 0.4 ha $\pm$ 0.2 ha, with a range of 0.1 ha – 1.8 ha (Flores 1991). In Florida, the male average home range was 1.3 ha and the female was 0.62 ha (Legare and Eddleman 2001). In the lower Colorado River, a telemetry study revealed the average home range as 0.43 ha, with a core use area of 0.10 ha (NatureServe 2006). The only report that deviates from this range (0.1-0.43) is from Maryland, where the home range is suspected to lie between 3-4 ha (NatureServe 2006). The minimum inferred extent set by NatureServe is 0.1 km. ENSP will use the NatureServe minimum inferred extent of 0.1 km until such time as that is changed or we have additional information, including New Jersey-specific data, to justify a change in this value.

Literature supporting occurrence area(s):

Flores. 1991. Ecology of black rail in southwest Arizona. Final Report, US Bureau of Reclamation, Yuma Project Office and Arizona Department of Game and Fish. Yuma, AZ.

In Arizona, California black rails had an average home range of 0.4ha $\pm$ 0.2 ha. Home ranges observed in the study ranged between 0.1-1.8 ha.

Legare. M.L., W.R. Eddleman. 2001. Home range size, nest site selection and nesting success of black rails in Florida. Journal of Field Ornithology 72 (1): 170-7.

A telemetry study in Florida revealed that males kept an average home range of 1.3 ha, while the females averaged 0.62 ha.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.

Personal comments by R. Flores set an average home range of 0.43 ha, with a significant core size of 0.10 ha based on a telemetry study in the Lower Colorado River. Personal comments by J.G. Weske estimate a 3-4 ha home range for bitterns in Maryland.
The inferred minimum extent of habitat use (when actual extent is unknown) is 0.1 km.

Last researched by Christina Kisiel in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Black-throated Green Warbler

Feature Label	Occurrence Area
Breeding	50 meter radius

Occurrence Area Rule: Only points receive the specified radius.

Justification:

Little is known about the territory size of BTNW, but it does depend on the type of habitat. Because the favored spruce habitat is not common in New Jersey, the territory size will likely be larger than territories in favored habitat (0.25 ha). Thus, the upper range of listed territory sizes was chosen to create the breeding occurrence area. Non-breeding black-throated green warblers are listed as stable in New Jersey so no occurrence area was specified.

Literature supporting occurrence area(s):

Morse, D. H. and A. F. Poole (2005). Black-throated Green Warbler (*Dendroica virens*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Laboratory of Ornithology.

Habitat consists of boreal coniferous forests and transition areas between coniferous and deciduous forests – prefers coniferous forests but can inhabit mixed and deciduous forests, often associated with hemlock forests.

Little data on territory size. Territory size depends on habitat – smaller territories occur in favored habitat of coniferous forest compared to less favored mixed forests. Smallest territory in favored habitat is 0.25 ha. Ontario territories ranged from 0.3 – 0.9 ha.

Last researched by Sharon Petzinger in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Bobolink

Feature Label	Occurrence Area
Breeding	150 meter radius
Non-breeding	150 meter radius

Occurrence Area Rule: Observations for both feature labels are mapped as points, which then receive the radii specified above.

Justification:

Breeding territories range from 0.45 – 2.5 ha (Dechant et al. 1999, Martin and Gavin 1995). The breeding occurrence area was chosen based upon the upper limit of 2.5 ha and level of movement of post-fledging chicks (Martin and Gavin 1995). No minimum patch size was chosen due to the possible occurrence on patches < 5 ha in size (Mitchell et al. 2000). Little is known about migratory stopover territories so the non-breeding occurrence area was chosen based upon the mobility of the species alone.

Literature supporting occurrence area(s):

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, A. L. Zimmerman, and B. R. Euliss. 1999 (revised 2001). Effects of management practice on grassland birds: Bobolink. Northern Prairie Wildlife Research Center, Jamestown, ND. 24 pages.

Territories did not vary much with location. Wisconsin mixed hayland floodplain territories ranged from 0.45 – 0.69 ha where dry pasture territories were 2.5 ha, New York hayfields contained territories of 0.5 ha, tame hayfields in Michigan had territories of 1.4 ha. Illinois minimum area for tallgrass prairie was 10-30 ha. Nebraska minimum area for wet meadows was 46 ha and perimeter-area ratio of 0.010.

Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

Maine had 40% incidence at 500 ha, but not in optimal habitat for bobolink (see Vickery et al. below). New York's minimum area was 16 ha with a mean of 56.6 ha. Another study in NY had 96% incidence at 10-20 ha, 68% incidence at 5-10 ha, and 18% incidence at 3-6 ha. Illinois had 50% incidence at 50 ha and a minimum area of 10-30 ha.

Martin, S. G. and T. A. Gavin. 1995. Bobolink (Dolichonyx oryziorus. In The Birds of North America, No. 176 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Territories vary according to the density of bobolinks and type of habitat. In Wisconsin territories ranged from 0.7 – 2 ha. Mean territory size in New York was 0.49 ha, Oregon was 0.74 – 1.45 ha. Courtship occurs within 40 m of nest. Gathering nesting materials occurs within 80 m of nest. Fledglings can move up to 70 m the first day out of nest.

Mixed-sex and -age flocks begin forming in late Jun. In some locations flocks leave nesting hay fields and meadows by late Jul; in others, flocks remain until mid-Aug. Birds then seek shelter of freshwater marshes and coastal areas to complete Prebasic molt before migration. This species has not been studied intensively outside the breeding season, habitat use during Aug–Sep is probably the least-known period of its annual cycle.

Vickery, P. D., M. L. Hunter, Jr. and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4): 1087-1097.

Bobolinks have positive area effects but had low incidence because sites did not have enough graminoid cover to be a preferred site.

Last researched by Sharon Petzinger in winter 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Canada Warbler

Feature Label	Occurrence Area
Breeding	100 meter radius buffer
Migrant	71.25 meter radius buffer

Occurrence Area Rule: Only points receive the specified radius.

Justification text:

Little data are available on territory size. The mean of the territories provided was 0.66 ha, but it was noted that Canada warblers feed fledglings 60 – 90m away (Conway 1999) and 100 m buffer from wetland edge is adequate for a Canada warbler territory (Lambert and Faccio 2005), so the breeding occurrence area chosen was 100 meters. There is little information about the territories during migration, so the default occurrence area will be used for non-breeding Canada warblers.

Literature supporting occurrence area(s):

Conway, C. J. 1999. Canada Warbler (*Wilsonia canadensis*). *In* The Birds of North America, No. 421 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Wide range of deciduous and coniferous forests. Most abundant in moist, mixed coniferous-deciduous forests with a well-developed understory. Often near open water. At lower elevations, often restricted to cool, wet, low-lying areas: cedar (Cupressaceae) woods, swampy forests, sphagnum (*Sphagnum* spp.) bogs, moist forest clearings and woodland edges, spruce (*Picea* spp.)–tamarack (*Larix laricina*) bogs, aspen (*Populus* spp.) and moist spruce-birch (*Betula* spp.) forests, and alder (*Alnus rugosa*) and willow (*Salix* spp.) stands along stream banks. Less common in shrub wetlands.

In Ontario, average territory size 0.2 ha in Algonquin Provincial Park; one territory in Québec 0.4. Two paired males apparently defended areas of 0.8 and 1.2 ha in New York. Two pairs feeding newly fledged young just out of nest only 60–90 m apart. Three pairs nesting <30 m away from

each other along stream in West Virginia and 5 nests found along 46 m of stream in Vermont (Cornell Nest Records Program [CNRP]). Size of singing area for 1 male in New York State was 0.24 ha, but he ranged over a 0.8 ha area (1.2 ha for another male) after nesting began.

Lambert, D. J. and S. D. Faccio. 2005. Canada warbler population status, habitat use, and stewardship guidelines for northeastern forests. Vermont Institute of Natural Science, Woodstock, VT.

Inhabits lowland and upland habitats, including swamps, streamside thickets, brushy ravines, moist forests, and regenerating timber cuts with well-developed shrub layer and structurally complex forest floor. They are area sensitive in "settled" areas but not in forest-dominated regions. In Rhode Island, the greatest incidence occurred in swamps > 6 ha and where forest covered 50% of landscape within 2km. "A 100-m distance from shoreline or wetland edge is adequate to encompass a typical Canada warbler territory."

Last researched by Sharon Petzinger in Feb 2007.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Cerulean Warbler

Feature Label	Occurrence Area
Breeding	65 meter radius
Migrant	65 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

The breeding occurrence area distance was chosen based upon the upper confident limit of the mean territory size (1.04 ha ± 0.16 SE), which calculates to 1.35 ha. Little is known about non-breeding territories, but based on the area-sensitivity of the species, the breeding occurrence area distance was chosen.

Literature supporting occurrence area(s):

Hamel, P. B. 2000. Cerulean Warbler (*Dendroica cerulean*). *In* The Birds of North America, No. 511 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Routinely identified with predominantly forested landscapes, mature forest, large and tall trees of broad-leaved, deciduous species with an open understory; in wet bottomlands, or upland situations including mesic slopes, and mountains, from <30 to >1,000 m elevation. Expanding populations in ne. North America now occupy landscapes formerly cleared for agriculture. Thus, species will occupy second-growth as well as mature forest. Minimum habitat requirements of this species along the Roanoke River in N. Carolina: (1) a closed canopy; (2) presence of scattered, very tall, old-growth canopy trees; (3) distinct zonation of canopy, subcanopy, shrub, and ground-cover layers. In Missouri breeding habitats, canopy cover averaged 85%, minimum value 65%.

Usually considered an area-sensitive species. Minimum forest-tract size varies, e.g. from 20–30 ha in Ohio to 700 ha in the Middle Atlantic states and 1,600 ha in Mississippi Alluvial Valley of Tennessee. Mueller et al. (1999) suggest tracts >8,000 ha may be required to support stable breeding populations in the Mississippi Alluvial Valley. In Ontario, however, found breeding in tracts as small as 10 ha (J. Jones pers. comm.). Species response to habitat fragmentation may reflect factors that covary with fragment size, such as intensity of Brown-headed Cowbird (*Molothrus ater*) parasitism and of predation, rather than particular behavioral aversion to small fragment size or to edges

Mean breeding territory size of 1.04 ha ± 0.16 SE based on 18 Ontario territories that ranged in size from 0.38 to 2.4 ha. Maximum breeding densities on published Breeding Bird Censuses suggest that territories smaller than these are possible.

Rosenberg, K. V., R. W. Rohrbaugh, Jr., S. E. Barker, J. D. Lowe, R. S. Hames, and A. A. Dhondt. 1999. A land manager's guide to improving habitat for scarlet tanagers and other forest-interior birds. The Cornell Lab of Ornithology.

Cerulean warblers share some habitat characteristics with Scarlet Tanagers. In the Piedmont Plains and Delaware Bay regions, they prefer areas at least 70% forested, deciduous or mixed, and the suitability increases with proximity of forest patches to larger, contiguous forest patches. In the Highlands, they prefer areas at least 50% forest, deciduous, and mixed and occasionally coniferous, and the suitability increases with proximity of forest patches to larger, contiguous forest patches.

Last researched by Sharon Petzinger in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Cliff Swallow

Feature Label	Occurrence Area
Breeding	71.25 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

The species occurrence area is generally based on the average home range/territory size, or other appropriate life-history parameter as reported in peer-reviewed scientific literature or from information obtained through ENSP research. When searching the scientific literature to gather information to support the occurrence area polygon size, efforts were made to select research that was conducted in habitat types similar to those found in NJ. For many species that value habitat patches in the Landscape Project maps, insufficient information exists in the scientific literature to support the designation of an occurrence area. In these cases, a default occurrence area (71.25 meter radius) is applied to take into account location uncertainty. These occurrence areas are used to value patches of habitat.

Literature supporting occurrence area(s):

Not available.

Last researched by Michael Valent in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Cooper's Hawk

Feature Label	Occurrence Area
Breeding Sighting	1.0 km radius
Foraging (Breeding)	1.0 km radius
Nest	1.0 km radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

The home ranges of Cooper's hawks' are highly variable, both geographically and seasonally. Only breeding records of Cooper's hawks are used in the Landscape Project to value habitat. Home range calculations reported in the literature for Cooper's hawks during the breeding season range from 65.5 ha to 784 ha. The average being 348 ha, or an area equivalent to having a 1.1 km radius. The ENSP uses a 1.0 km radius to represent the occurrence area boundary for all Cooper's hawk breeding records used in the Landscape Project. This represents a slightly conservative estimate of the breeding season home ranges of Cooper's hawks as reported in the literature.

Literature supporting occurrence area(s):

Mannan, R. W. and C. W. Boal. 2000. Home range characteristics of male Cooper's hawks in an urban environment. Wilson Bull. 112(1):21-27.

- Average home range during breeding season was 65.5 ha, with a range of 13.3-130.6 ha.

Murphy, R.K., M.W. Gratson, and R.N. Rosenfield. 1988. Activity and habitat use by a breeding male Cooper's Hawk in a suburban area. J. Raptor Res. 22:97-100.

- Average home range during breeding season was 784 ha.

Craighead, F., and J. Craighead. 1956. Hawks, owls, and wildlife. Dover Publ. Inc., New York.

- Average home range during the breeding season for four pairs of Cooper's hawks was 1.43 sq miles, 1.55 sq miles, 0.37 sq miles, and 1.45 sq miles. Using the conversion of 1 square mile equals 640.0 acres and 1 acre equals 0.4046856 hectares, the average home ranges were 370 ha, 401 ha, 96 ha, and 376 ha.

The above studies result in mean = 348 ha, or 1.1 km radius

Last researched by Melissa Craddock and Kris Schantz in 2005 and 2006, respectively. Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Eastern Meadowlark

Feature Label	Occurrence Area
Breeding	250 meter radius
Wintering	250 meter radius

Occurrence Area Rule: Observations for both feature labels are mapped as points, which then receive the radii specified above.

Justification:

Breeding territories range from 1.2 – 6.1 ha (Hull 2000, Lanyon 1995). Breeding occurrence area based upon the upper limit of the range of territory sizes reported and the mobility of the species. No minimum patch size was chosen due to evidence that this species occurs in areas as low as 1.4 ha (Hull 2000).

Literature supporting occurrence area(s):

Hull, S. D. 2000 (revised 2002). Effects of management practice on grassland birds: Eastern Meadowlark. Northern Prairie Wildlife Research Center, Jamestown, ND. 35 pages.

Territories range from1.2 – 4.8 ha and seem to prefer areas > 5 ha for breeding. Not affected by core area (or lack thereof). Had 50% incidence at 5 ha. Wisconsin territories ranged from 1.2 – 6 ha with an average of 2.3 ha. Oklahoma territories averaged 2 ha. In PA they were found in warm and cool-season grasses and fields > 1.4 ha. Not considered area sensitive by studies in New York and Missouri. 50% incidence at 5 ha. In Maine 40% incidence at 500 ha grassland barrens.

Lanyon, W. E. 1995. Eastern Meadowlark (*Sturnella magna*). *In* The Birds of North America, No. 160 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Territories in Wisconsin varied from 1.2 to 6.1 ha but commonly 2.8–3.2 ha. In New York, 15 territories averaged 2.8 ha. Wintering habitat consists of open country, including cultivated fields and feedlots; also marshes. Northern limit of winter range correlated with temperature: absent from regions having mean minimum winter temperature below -12°C.

Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

Meadowlarks tend to use areas > 20 ha.

Vickery, P. D., M. L. Hunter, Jr. and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4): 1087-1097.

Meadowlarks have positive area effects but had low incidence because sites did not have enough graminoid cover to be a preferred site.

Last researched by Sharon Petzinger in winter 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Golden-winged Warbler

Feature Label	Occurrence Area
Breeding	800 meter radius with 20-m buffer into adjacent forest from valued habitat
Non-breeding	250 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

In New Jersey, territory sizes ranged from 0.17 to 7.84 hectares with the mean territory size of 1.66 (± 0.42) hectares and males have been observed in areas > 800 meters from their nest and defended territory (DeFalco pers. obs.). Territories in New York ranged from 0.4 – 6 ha (Confer 1992). The breeding buffer was chosen based upon the mean territory size and mobility of the species. This species predominately uses scrub-shrub habitat but will use the forest edges up to 30 meters into the forest (Confer 1992).

Literature supporting occurrence area(s):

Confer, John L. 1992. Golden-winged Warbler. *In* The Birds of North America, No. 20 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

Territories range from 0.4 – 6 ha, depending on density of male, and can extend 5-30 m into forest. No information was provided on migratory stopover habitat.

Last researched by Sharon Petzinger in winter 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Grasshopper Sparrow

Feature Label	Occurrence Area
Breeding	150 meter radius
Non-breeding	150 meter radius

Occurrence Area Rule: Observations for both feature labels are mapped as points, which then receive the radii specified above.

Justification:

Mean breeding territories range from 0.19 to 1.4 ha (Vickery 1996). The breeding buffer size was chosen based upon the upper limit of a territory size of 1.5 ha and mobility of the species. There is no minimum area due to evidence of occurrence on small patches (Dechant et al. 1998, Mitchell et al. 2000, Vickery 1996). Little is known about the stopover habitat, so the non-breeding buffer was chosen based upon the mobility of the species alone.

Literature supporting occurrence area(s):

Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 1998 (revised 2002). Effects of management practice on grassland birds: Grasshopper Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. 28 pages.

Average territory size < 2 ha. Minimum area need to support breeding population may be > 30 ha. Illinois minimum area 10-30 ha, not found in areas <10 ha, Nebraska 8- 12 ha with perimeter-area ratio of 0.018.

Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

Maine 50% incidence at 100 ha, but periphery species there (see Vickery et al. 1994 below). New York minimum area 16.2 ha but mean 49.1 ha. Another study in NY found GRSP in fields 4.6 -17.4 ha (only in cool-season grasses). Missouri minimum area of 1-10 ha and Illinois 10-30 ha. Abundance increases with field size.

Vickery, P. D. 1996. Grasshopper Sparrow (Ammodramus savannarum). In The Birds of North America, No. 239 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Minimum area requirements in Maine was 100 ha, Illinois 30 ha. Historically found in natural clearings a few ha in size. Pennsylvania territories average 0.8 ha, Connecticut 0.66 ± 0.39 (SE) ha in 1986 (n = 11) and 0.78 ± 0.24 (SE) ha in 1987, Wisconsin 0.85 ha, Michigan 1.4 ha, Florida 1.8 ± 0.96 ha. Western PA territories 0.19 ± 0.13 SD, W. Virginia 0.32 ha, s. California 0.37 ± 0.16 SD. Territories shift during breeding season with arrival of late males.

Vickery, P. D., M. L. Hunter, Jr. and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4): 1087-1097.

In Maine, Grasshopper sparrows reached 50% incidence at 100 ha, which may differ from other areas due to rarity of species in Maine.

Last researched by Sharon Petzinger in winter 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Great Blue Heron

Feature Label	Occurrence Area
Nesting Colony	Mapped extent of nesting colony, if available, otherwise, radius of 71.25 meters (seconds precision circle) around confirmed/known breeding location point.
Nesting Colony Foraging	12 km (7.5 mile) radius around nesting colony.
Roosting Area (Non-breeding)	Mapped extent, if available, otherwise, radius of 71.25 meters (seconds precision circle) around roosting area point.

Occurrence Area Rule: If mapped as a polygon, the polygon is the occurrence area. If mapped as a point, the occurrence area is the area defined by the point and the specified radius.

Justification:

Nesting area is defined by the area the birds actually use, as these birds do not defend a territory except immediately around their individual nests. The boundaries of the colony are defined as much by social attraction phenomenon and by habitat suitability. Consequently there is now immediately apparent justification for buffering the mapped extent of a nesting area. Where the mapped extent of a colony was available it was used. Where the mapped extent was not available the default “seconds precision” circle was used around the recorded nesting location point

ENSP reviewed the literature regarding commuting distance for colonial nesting long-legged wading birds which fairly consistently indicates that the importance of suitable foraging habitat decreases with the distance from the nesting area (e.g. Dowd and Flake 1985, Custer et al. 2004, Kelly et al 1993, Thompson 1978). This is not surprising considering the energy demands of long commutes and the fact that, all other things being equal, if suitable foraging habitat is randomly distributed within the possible foraging range, simple geometry would argue that availability would increase with the square of the distance from the colony. Consequently, a particular type of wetland or riparian habitat is more critical if it is located close to a nesting area than a similar area located near the edge of the “energetically feasible” foraging range from the colony. It would therefore be unjustifiable to use the maximum foraging distance figures to define all potential foraging habitat as “critical” foraging habitat for a particular nesting colony. Conversely, using an average foraging distance figure may “under-include” suitable habitat by omitting some foraging areas that are important because they provide particularly rich and easily exploited feeding habitat. Further, research (Custer et al. 2004) indicates that longer commuting distances are more frequent during high-demand and demographically critical nestling rearing period. Where the literature on commuting distance includes several studies, there can be wide variability in the mean commuting distances between different studies. When such was the case, we either averaged the reported mean commuting distances or used the information from the study with a large sample size or from an area most ecologically similar to New Jersey. We then doubled this figure.

The average foraging flight for great blue herons has been firmly established in the literature. The average foraging flight has been observed at 2.3 km – 6.5 km (Butler 1991, Custer and Galli 2002, Dowd and Flake 1985, Parris 1979, Thompson 1978). The range of distance flown falls between <1 km- 27 km (Custer and Galli 2002, Thompson 1978). Although great blue herons have been recorded feeding as far away as 27 km, three studies found that the majority (at least 50%, and in one study 85%) of nesting herons fed within 4 or 5 km of the colony (Custer et al. 2004, Dowd and Flake 1985, Thompson 1978). Kelly, et al (1993) found that > 95% of great blue herons in their study fed within 20 km of the colony. The NatureServe minimum inferred extent is 3 km (NatureServe 2006). We apply a 12 km radius around a colony to protect foraging areas, which is likely to capture the majority of the foraging habitat for that colony.

Literature supporting occurrence area(s):

Butler. 1991. Habitat selection and time of breeding in the Great Blue Heron. PhD dissertation. University of British Columbia, Vancouver.
The average foraging commute in this study is btw. 2.3-6.5 km.

Custer, C.M., J. Galli. 2002. Feeding habitat selection by Great Blue Herons and Great Egrets nesting in east central Minnesota. Waterbirds 25(1): 115-24.
In a study conducted in Minnesota great blue herons flew a median distance of 2.7 km (n=63) from their colony to a foraging area. The range of distances flown fell between <1 km – 27 km. Most wetlands that herons were located at were >350 ha.

Custer, C.M., S.A. Suarez, D.A. Olsen. 2004. Feeding habitat characteristics of the Great Blue Heron and Great Egret nesting along the Upper Mississippi River, 1995-1998. Waterbirds 27(4): 454-68.
The majority of the herons in this study fed <5 km from the nesting site, and avoided areas > 10 km away. They flew farther to sites during the brood-rearing period than during incubation. Only 10% of the feeding flights ended at a location where another heron was present, indicating that they prefer to feed alone.

Dowd and Flake. 1985. Foraging habits and movements of nesting Great Blue Heron in prairie river ecosystem, South Dakota. Journal of Field ornithology 56: 377-87.
A study in South Dakota found that the average distance that great blues flew from their colony to a foraging site was 3.1 km, and the maximum observed distance was 24.4 km. Eighty-five percent of the herons in the study fed within 4 km of the colony.

Kelly J. P., H. M. Pratt, P. L. Greene. 1993. The distribution, reproductive success, and habitat characteristics of heron and egret breeding colonies in the San Francisco Bay area. Colonial Waterbirds. 16:18–27.
> 95% of great blue herons and >90% great egrets fed within 20 km of their colony.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.
Inferred minimum extent of habitat use (when actual extent is unknown) is 3 km. This is based on a low mean foraging rate for this group.

Parris. 1979. Aspects of Great Blue Heron foraging ecology in southwest Lake Erie. MS Thesis. Ohio State University, Columbus, Ohio.
The average foraging commute in this study is btw. 2.3-6.5 km.

Thompson. 1978. Feeding areas of Great Blue Herons and Great Egrets nesting in the floodplain of the upper Mississippi River. Proc. Colonial Waterbird Group. 2: 202-13.
In central Minnesota the average distance that the herons flew from the colony to a foraging area was 6.5 km, and the maximum observed was 20.4 km. Fifty-three percent of the herons in the study fed within 4 km of the colony.

Last researched by Christina Kisiel in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Henslow's Sparrow

Feature Label	Occurrence Area
Breeding	100 meter radius
Non-breeding	100 meter radius

Occurrence Area Rule: Observations for both feature labels are mapped as points, which then receive the radii specified above.

Justification:

Breeding territories range from 0.18 – 1 ha (Herkert 2001, Herkert et al. 2002). The occurrence area size was chosen based upon a 1-ha territory size and the mobility of the species. There is not minimum patch size because of evidence of occurrence in patches < 5 ha.

Literature supporting occurrence area(s):

Herkert, J. R. 1998 (revised 2002). Effects of management practice on grassland birds: Henslow's Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. 17 pages.
Individual territories range from 0.18 – 1 ha. In Kansas and New York, HESP are found in areas > 30 ha of grasslands. Illinois had 50% incidence in areas >55 ha. Another study in New York had HESP in areas > 8 ha. Largest patches occupied first, but patches < 50 ha can also be used for breeding. Isolated patches may also affect use of patch – used 16-ha patch that was within 1.6km of larger occupied patch, but absent from 28-ha isolated patch. Territory size in Michigan was 0.3 ha, 0.7 ha ± 0.26 SD (n = 4) in Wisconsin, 0.18 ha ± 0.05 SD (n = 22) in w PA. Territories shift during breeding season.

Herkert, J. R., P. D. Vickery, and D. E. Kroodsma. 2002. Henslow's Sparrow (Ammodramus henslowii). In The Birds of North America, No. 672 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Average territory size was 0.3 ha in Michigan, 0.18 ha ± 0.05 SD in w. PA.

Migratory stopover habitat includes brushy places, along hedgerows, at edges of shrubby places as well as in grassy fields, prairies, and wet meadows

Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

There were 5 studies in New York: one had minimum area of 36 ha and mean of 66 ha, another minimum of 33.2 ha and mean 51.7 ha, another had habitat size ranging from 4.5 – 8.7 ha, another between 3 and 20 ha, and another stating that at low population numbers Henslows may require larger patches than actual minimum. In Illinois, habitat size ranged from 10-30 ha with 50% incidence at 55 ha. Missouri habitat size ranged from 10 – 100 ha.

Pruitt, L. 1996, Henslow's Sparrow Status Assessment. USFWS, Bloomington, IN.
This species can possibly breed in New Jersey and was confirmed breeding in the 1980s. They do, however, migrate through New Jersey.

Last researched by Sharon Petzinger in winter 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Horned Lark

Feature Label	Occurrence Area
Breeding	150 meter radius
Migrant	150 meter radius
Wintering	150 meter radius

Occurrence Area Rule: Only points receive the specified radius.

Justification text:

Territories range from 0.008 – 5.1 ha (Beason 1995, Dinkins et al. 2000) and there is no minimum patch size (Dinkins et al. 2000, Mitchell et al. 2000). The breeding occurrence area is based upon the upper limit of the largest mean territory size and increased to incorporate the mobility of the species. The migrant and wintering occurrence areas are based upon the wandering flocks formed while migrating and wintering.

Literature supporting occurrence area(s):

Beason, R. C. 1995. Horned Lark (*Eremophila alpestris*). *In* The Birds of North America, No. 195 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, D.C.

Territories range from 0.6 – 3.1 ha in the midwest, 0.3 – 5.1 ha in Colorado. Territory size is related to density of males in a patch. Adults will fly 40 meters to discard fecal sacs and land 20 m from

nest and walk in to feed young. Wintering birds are not territorial and form large flocks that are nomadic and wander over large areas for food.

Migratory stopover habitat is similar to breeding habitat but with increased use of beaches and sand dunes; also mowed areas such as airfields. North American flocks of migrants often intermix with resident conspecifics, and even form mixed-species flocks with other migrants such as longspurs and buntings. Wintering habitat is similar to habitats occupied during breeding and migration periods. In Oklahoma, for example, the shortest vegetation available, in Massachusetts, ocean beaches, sand dunes, airfields. Frequently concentrated along roadsides when ground is covered with deep snow.

Dinkins, M. F., A. L. Zimmerman, J. A. Dechant, B. D. Parkin, D. H. Johnson, L. D. Igl, C. M. Goldade, and B. R. Euliss. 2000 (revised 2002). Effects of management practices on grassland birds: Horned Lark. Northern Prairie Wildlife Research Center, Jamestown, ND. 34 pages.

Colorado territories in lightly-grazed pastures ranged from 0.3 – 1.5 ha and average 0.7 ha; heavily grazed pastures had territories ranging from 1 – 1.7 ha and average 1.5 ha; mixed-grass pasture average 1.1 ha; idle mixed-grass averaged 1.6 ha. Midwestern cropland territories ranged from 0.6 – 3.1 ha and averaged 1.6 ha; hayland territories ranged 1 – 2.5 ha. One Illinois territory was 0.008 ha. Found on patches < 10 ha in Illinois.

Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

Areas range from 1-10 ha

Last researched by Sharon Petzinger in Feb. 2007.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

King Rail

Feature Label	Landscape Model
Confirmed/Known Breeding Location	Mapped extent of occurrence or 100 meter radius.
Suspected Breeding Location	Mapped extent of occurrence or 100 meter radius.

Occurrence Area Rule: If mapped as a polygon, the polygon is the occurrence area. If mapped as a point, the occurrence area is the area defined by the point and the specified radius.

Justification text:

There is very little information on the home ranges of king rails, so the models are based on a similar species, the clapper rail, for which many studies have been conducted. Clapper rail home ranges are widely reported in the literature and vary by study. Studies from Arizona, California and Louisiana report average breeding season home ranges between 0.40-6 ha (Eddleman 1988, Eddleman 1989, Zembal et al. 1989, and Sharp 1976). Other studies from South Carolina, Virginia and Louisiana report average breeding season home ranges between 31-487 m (Bland 1963, Conway, et al. 1993, Meanley 1985 and Roth et al. 1972). Additionally, males maintain slightly larger home ranges than females (Eddleman 1989). In New Jersey, a six-year study revealed a nesting density of 1-1.16 per ha (Mangold 1974). NatureServe has set a minimum extent at 0.1-km (NatureServe 2006). We are accepting the NatureServe minimum inferred extent of 0.1 km until such time as that is changed or we have additional information, including New Jersey-specific data, to justify a change in this value.

Literature supporting occurrence area(s):

Bland. 1963. Renesting and multiple brooding studies of marked clapper rails. Proc. Ann. Conf. Southeast Game and Fish Commission 17"60-68.

The range of values for the home range of clapper rails in South Carolina was 183-274 m.

Conway, et al. 1993. Seasonal changes in Yuma clapper rail vocalization rate and habitat use. Journal of Wildlife Management 56:282-90.

The average movement per day (in meters) of the clapper rail varied throughout the year. In Jan-Feb, the average movement was 140 m (n=88). In Mar-Apr it was 155 m (n=151). In May-Jun it was 111m (n=495). In Aug-Oct it was 121 m (n+305). In Nov-Dec it was 161 m (n=57).

Eddleman, W.R. 1988. Conservation of North American Rallids. Wilson Bulletin 100: 458-475.

The average home range size of clapper rails in Arizona was 3-6 ha.

Eddleman, W.R. 1989. Biology of the Yuma clapper rail in the southwest United States and northwest Mexico. Final Report, Intra-Agency Agreement No. 4-AA-30-02060, US Bureau of Reclamation, Yuma Project Office, Yuma, Arizona.

In Arizona, the average home range for males was 24 ha $\pm$ 15.7 ha SD (n=6) and 21 ha $\pm$ 8.7 ha SD (n=8) in January and February. During incubation, the average home range for males was 3.6 ha $\pm$ 2.8 ha SD (n=4) and 2.2 ha $\pm$ 1.8 ha SD for females.

Eddleman, W.R., Conway, C.J. 1998. Clapper rails (*Rallus longirostris*). In the Birds of north America, No. 340 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

The volume for clapper rails presents a range of values for home range of 0.12-3.59 ha in Arizona.

Kozicky, E.L., F.W. Schmidt. 1949. Nesting habits of the clapper rail in New Jersey. Auk 66:355-64.

If a barrier (such as vegetation) was present, the minimum distance between nests in New Jersey was 13 m. If no barrier was present, the minimum distance between nests was 23 m.

Mangold. 1974. Clapper rail studies. 1974 Final Report, USFWS Accelerated Research Program. Contract No. 14-16-0008-937. Trenton, NJ.
Density of clapper rails nesting in New Jersey ranged between 1-1.6 per ha during a six year study.

Meanley, B. 1985. The marsh hen: A natural history of the clapper rail of the Atlantic coast salt marsh. Tidewater Publishing. Centreville, MD.
The smallest territory observed for a clapper rail in Virginia was 0.1 ha.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.
The inferred minimum extent of habitat use (when actual extent is unknown) is 0.1 km.

Roth, R.D., J.D. Newman, L.L. McNease.1972. The daily and seasonal behavior pattern of the clapper rail in the Louisiana coastal marshes. Proc. SE Assoc. Game Fish Commission. 26:136-59.
In December- February in Louisiana, the mean max. movement of clapper rails along canals was 154 ± 37m SD to 487 ± 467 SD. The mate of an incubating clapper rail was usually within 15 meters of the incubating bird (and therefore the nest).

Sharp. 1976. Predation and distribution of the clapper rail in a Louisiana salt marsh. MS Thesis, Louisiana State University, Baton Rouge, Louisiana.
In Louisiana the average breeding home range of clapper rails was 0.53 ha and the average daily home range was 0.44 ha (n=3).

Zembal, et al. 1989. Movements and activity patterns of light-footed clapper rails. Journal of Wildlife Management 53:39-42.
The home range of clapper rails in California ranged from 0.4-1.7 ha. Individuals only used a small portion during a single day and the home range of adjacent individuals overlapped considerably.

Last researched by Christina Kisiel in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Least Bittern

Feature Label	Landscape Model
Confirmed/Known Breeding Location	Mapped extent of occurrence or 175 meter radius
Suspected Breeding Location	Mapped extent of occurrence or 175 meter radius

Justification text:

Very little research has been conducted on this secretive marsh bird. One telemetry study in New York reported a mean home range for adults was 9.7 ha with a range of 1.8 ha – 35.7 ha. NatureServe does not suggest an inferred extent for this species. The New York Study appears to be the most relevant to New Jersey. A mean home range of 9.7 ha equates to a circle of radius 0.175km. We will use this value as an "inferred extent" until such time as we have additional information, including New Jersey-specific data, to justify a change in this value.

Literature supporting occurrence area(s):

Bogner, H.C., G.A. Baldassarre. 2002. Home range, movement and nesting of least bittern in western New York. Wilson Bulletin 114(3): 297-308.

A telemetry study in New York tracked 33 adults and 12 chicks. The mean home range of the adults was 9.7 ha, with a range of 1.8-35.7 ha (which depended on whether the birds used one or two breeding sites per season). The mean movement of the chicks was 13.4 m between capture and 23 days post-hatch and 29.4 m between 24-27 post-hatch.

Last researched by Christina Kisiel in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Loggerhead Shrike

Feature Label	Occurrence Area
Migrant	250 meter radius

Occurrence Area Rule: Only points receive the specified radius.

Justification text:

Little is known about the occurrence of this species in New Jersey, but it is unlikely that this species breeds in New Jersey (Pruitt 2000). Elsewhere, territories ranged from 2.7 to 34 ha (Dechant et al. 1998, Yosef 1996). The occurrence area was chosen based upon the upper range of territory size.

Literature supporting occurrence area(s):

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, M. P. Nenneman, A. L. Zimmerman, and B. R. Euliss. 1998 (revised 2002). Effects of management practices on grassland birds: Loggerhead Shrike. Northern Prairie Wildlife Research Center, Jamestown, ND. 19 pages.

Territories 6-9 ha averaging 2.7 ha in Alberta to 25 ha in Idaho. Alberta ROW territories were 8.5 ha. Average Missouri territories were 4.6 ha.

Pruitt, L. 2000. Loggerhead Shrike Status Assessment. USFWS, Bloomington, IN.
This species has not been documented breeding in New Jersey since the early 1900s. It is a partial migrant only in northern part of range and migration may depend on severity of winter and food availability in breeding habitat during wintertime. Stopover sites are different in spring than fall and individuals may migrate between wintering sites.
Winter habitat is not different from breeding habitat. May move from pastures to more shrub-forest habitat in winter, particularly when snow-covered. Could also use more cropland in winter.

Yosef, R. 1996. Loggerhead Shrike (*Lanius ludovicianus*). *In* The Birds of North America, No. 231 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, D.C.
Breeding territories averaged 13.4 ha in Alberta, 34 ha in California, 4.6 ha in Missouri, 7.5 ha in New York, 8.35 ha in Florida, and 8.9 ha and 25 ha in Idaho. No information on minimum patch size was provided. Breeding territories maintained year-round in Florida and S. Carolina, but not in California.
No information provided on migratory habitat – assume similar to breeding habitat. Winter habitat also similar to breeding habitat but hay fields and idle pastures used in addition to scrub-shrub and open forest habitat.

Last researched by Sharon Petzinger in Feb. 2007.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Long-eared Owl

Feature Label	Species Occurrence Area
Nest	400 meter radius
Sighting - Breeding	400 meter radius
Roosting Area – Non-breeding	400 meter radius
Sighting – Non-breeding	400 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification text:

No information was found regarding home range/territory sizes for long-eared owls in the northeast. Reported home ranges for this species are highly variable and range from 0.7 – 20.25 km^2 (Kirschbaum and Ivory 1999). Craighead and Craighead (1956) reported home ranges for long-eared owls in Wyoming ranging from 34 – 106 ha with an average of 51 ha. Knight and Erickson (1977) estimated breeding densities along the Columbia River to be approximately 1 pair/12 linear km. Along the Snake River in Idaho an average of 0.28 – 0.42 nesting pairs per square km was estimated, as compared to areas in southern Idaho where from 0.64 – 1.55 pairs per square kilometer where found (Marks 1986). Due to the paucity of information on home range for long-eared owls, especially in the northeast, a conservative home range estimate of 50 ha has been adopted based on the available literature.

Literature supporting occurrence area(s):

Craighead, J.J., and F.C. Craighead, Jr. 1956. Hawks, owls and wildlife. Stackpole Books, Harrisburg, PA. 443pp. Home ranges in Wyoming ranged from 34 – 106 ha with an average of 51 ha.

Kirschbaum, K.,and A. Ivory. 1999. Asio Otus (On-line) Animal Diversity Web. Accessed April 4, 2007 at http://animaldiversity,ummz.umich.edu/site/accounts/information/Asio_otus.html **.**
Reported that home ranges were highly variable and ranged from 0.7 – 20.25 square kilometers.

Knight, R.L., and A.W. Erickson. 1977. Ecological notes on long-eared and great horned owls along the Columbia River. Murrelet 58:2-6.

Reported 1 pair per 12 linear kilometers of riparian habitat in Washington.

Marks, J.S. 1986. Nest site characteristics and reproductive success of long-eared owls (*Asio otus*) in southwestern Idaho. Wilson Bull. 98:547-60.
Reported home ranges in Idaho along the Snake River ranging from 238 to 357 ha. Elsewhere in southeastern Idaho home ranges varied from 65 to 155 ha.

Marks, J. S., D. L. Evans, and D. W. Holt. 1994. Long-eared Owl (*Asio otus*). *In* The Birds of North America, No. 133 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.
Two breeding pairs were tracked for 8-9 nights and were found to use a core area within 1 km of the nest with occasional forays up to 3 km from the nest.

Last researched by Mick Valent in spring 2007.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Northern Goshawk

Feature Label	Occurrence Area
Sighting (Non-Breeding)	1.0 km radius
Sighting (Breeding)	1.0 km radius
Nest	1.0 km radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

Northern goshawks' home range sizes vary both seasonally and by sex. Males generally have larger territories than females, although there are exceptions, and both sexes have larger territories during the non-breeding season than during the breeding season (Squires and Reynolds 1997). Breeding habitats are more selective, the hawks preferring large, contiguous tracts of mature forests and forested wetlands (Squires and Reynolds 1997, Bosakowski and Speiser

1994), while non-breeding habitats may also include young forests, scrub-shrub habitats and ecotones between forest and open fields and agricultural lands (Squires and Reynolds 1997, Bosakowski and Speiser 1994). Results from research on home ranges sizes vary greatly and no home range size determination has been developed for eastern populations. However, due to the similarity in habitat preferences and behavior of northern goshawks and red-shouldered hawks in NJ and NY (Bosakowski and Speiser 1994), the same occurrence area will be used as a conservative estimate of northern goshawk critical habitat until new research suggests differently.

Literature supporting occurrence area(s):

Squires, J. R., and R. T. Reynolds. 1997. Northern Goshawk (*Accipiter gentilis*). *In* The Birds of North America, No. 298 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

- Home range studies varied in methodology and focused on western populations of northern goshawks:
  - Arizona males' ranges varied from 1,758 ha ± 500 (std. dev.) (range 896 – 2,528 ha).
  - New Mexico males' ranges varied from 2,106 ha ± 635 (std. dev.) (range 1,698 – 2,837 ha); New Mexico females' ranges varied from 569 ha ± 473 (std. dev.) (range 95 – 1,292 ha).
  - California males' ranges varied from 1,340 ha ± 810 (std. dev.) (2 males, one with 1,790 ha range and 3,010 ha range).
  - Northern California males' ranges varied from 2,425 ha (1,083 ha – 3,902 ha); Northern California females' ranges varied from 3,774 ha (2,007 – 6908 ha).

Bosakowski, Thomas and Robert Speiser. 1994. Macrohabitat Selection by Nesting Northern Goshawks: Implications for Managing Eastern Forests. Studies in Avian Biology. 16:46-49.

Last researched by Kris Schantz in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Northern Harrier

Feature Label	Occurrence Area
Nest	500 meter radius
Foraging (Breeding)	500 meter radius
Sighting (Breeding)	500 meter radius
Foraging (Non-breeding)	300 meter radius
Sighting (Non-breeding)	300 meter radius

Occurrence Area Rule: Observations for all feature labels are mapped as points, which then receive the radii specified above.

Justification:

Breeding territories range from about 1 ha to over 1,500 ha (Dechant et al. 1998, MacWhirter and Bildstein 1996). The breeding occurrence area was chosen based upon evidence of large territories, the distance traveled for foraging, and the mobility of the species (Dechant et al. 1998). The non-breeding occurrence area was chosen based upon evidence of smaller territories (MacWhirter and Bildstein 1996) than breeding territories and the mobility of the species. No minimum patch size was chosen due to evidence that harriers will use smaller patches (Dechant et al. 1998).

Literature supporting occurrence area(s):

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, M. P. Nenneman, and B. R. Euliss. 1998 (revised 2002). Effects of management practices on grassland birds: Northern Harrier. Northern Prairie Wildlife Research Center, Jamestown, ND. 15 pages.

In North Dakota, uncommon in areas < 100 ha. In Illinois, nested in grasslands 8-120 ha in size. May respond to total amount of grassland in area instead of patch size – small fragments may be used if located near larger patches. Missouri nesting density: 121 ha per pair. Male home ranges averaged 890 ha. In Manitoba males defended 27.7 ha centered on nest. In Minnesota traveled over 259 ha to hunt. Idaho territories averaged 1570 ha for males and 113 ha for females.

MacWhirter, R. B., and K. L. Bildstein. 1996. Northern Harrier (*Circus cyaneus*). *In* The Birds of North America, No. 210 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Not very territorial except of the nest. In New Brunswick male breeding territories were 100 ha, female territories 10 ha. In Idaho, male territories were 0.8 ha. Nonbreeding territories were 65 ha in SE US, California ranged from 3.9 – 125 ha and a mean of 33.6 ha.

Last researched by Sharon Petzinger in winter 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Osprey

Feature Label	Occurrence Area
Nest	300 meter radius

Occurrence Area Rule: Nests are mapped as point features only, which then receive the specified radius.

Justification:

All wetland habitats within 300 meters of a nest are designated as critical habitat. Home range size is much larger than 300 meters and determined by availability of food (fish); only the nest area itself is defended.

Literature supporting occurrence area(s):

Poole, A. F., R. Bierregaard, and M. S. Martell. 2002. Osprey (*Pandion haliaetus*). In The Birds of North America, No. 683 (A. Poole and F. Gill, eds.). The Birds of North America Inc., Philadelphia, PA.

The nest area is determined by food availability, nest structure availability, and type of nest structure (artificial nest-pole, tree, channel marker, cell tower) and height.

Poole, A. F. 1989. Ospreys: a natural and unnatural history. Cambridge Univ. Press. Cambridge, U.K.

Nests in MA were spaced 140 m apart in a salt marsh area with artificial nest structures, farther in upland situations (Table 8.6 in Poole 1989).

In NJ colonies, some nests are as close as 120 meters, but most are more than 500 meters apart (KEC). While ospreys generally tolerate and nest in proximity to people, human activity of certain types and at certain times of the season will disrupt nesting and can cause injury or mortality to young.

Last researched by Kathy Clark in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Pied-billed Grebe

Feature Label	Landscape Model
Confirmed/Known Breeding Location	Mapped extent of occurrence or 110 meter radius.
Suspected Breeding Location	Mapped extent of occurrence or 110 meter radius.

Occurrence Area Rule: If mapped as a polygon, the polygon is the occurrence area. If mapped as a point, the occurrence area is the area defined by the point and the specified radius.

Justification text:

The average home range in one study was found to be 1.3 ha, although another study reports a home range as large as 35 ha (Glover 1953, Muller 1995). A similar species, the red-necked grebe, had a home range of 114 meters (Palmer 1962). Pied-billed grebes will defend a circular area with a radius of 46 m from the nest, but sometimes the radius will be smaller than this (Johnsgard 1987). NatureServe reports a minimum inferred extent of 0.11 km (NatureServe 2006). We are accepting the NatureServe minimum inferred extent of 0.11 km until such time as that is

changed or we have additional information, including New Jersey-specific data, to justify a change in this value.

Literature supporting occurrence area(s):

Glover. 1953. Nesting ecology of the pied-billed grebe in northwestern Iowa. Wilson Bulletin 65:32-9.
The average home range of pied-billed grebes in Iowa was 1.3 ha (n=44), which is roughly a circle with a diameter of 130 m.

Johnsgard. 1987. Diving birds of North America. University of Nebraska Press. Lincoln xii. 292 pp.
An area of a radius of 46 m around the nest is defended by pied-billed grebes, though it is sometimes smaller than this.

Muller. 1995. Pied-billed grebes nesting on Green Lake, Seattle Washington. Washington Birds 4:35-59.
Some pied-billed grebes had a home range as large as 35 ha.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.
Inferred minimum extent is 0.11 km.

Palmer. 1962. Handbook of North American birds. Vol 1. Loons through flamingoes. R.S. (ed.). Yale University Press, New Haven. 567 pgs.
Red-necked grebes had a home range of approximately 114 meters.

Last researched by Christina Kisiel in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Red-headed Woodpecker

Feature Label	Occurrence Area
Breeding	250 meter radius
Non-breeding	250 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

Breeding territories range from 3.1 – 8.5 ha while wintering territories range from 0.05 – 1 ha (Smith et al. 2000). The breeding buffer size was chosen based upon the upper limit of the breeding territory size and the species mobility. The non-breeding buffer size was based upon the

upper limit of the wintering territory size and evidence that this species will travel beyond its territory to forage.

Literature supporting occurrence area(s):

Smith, K. G., J. H. Withgott, and P. G. Rodewald. 2000. Red-headed Woodpecker (*Melanerpes erythrocephalus*). *In* The Birds of North America, No. 518 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Little is known about breeding territories. In Florida, size of summer territories (3.1–8.5 ha) larger than in winter, with overlap between adjacent territories, although overlap areas not used as much as exclusive portion.

Little information on habitat use in migration. Forages on living oak, maple (*Acer*), and hickory (*Carya*) trees and dead trees during spring in Illinois. Uses shelterbelts in spring migration on Great Plains. Forms loose flocks in fall in Florida that seek mast or fruit-bearing trees in orchards, oak hammocks, and urban areas where mature oaks or fruit trees are plentiful. Some suggest that species use forest edges more in fall.

Winter habitat in north, found in mature stands of forest, particularly oak forests; oak-hickory, maple, ash (*Fraxinus*), or beech woodlands; and old oak woodlots containing overmature trees with many cavities and dead. In south, pine and pine-oak areas. Favors areas with numerous standing snags (dri-ki) resulting from flooding or girdling by beavers, beaver ponds, marshes, and swamps. Also favored elm trees that had succumbed to fungal Dutch elm disease. Presence of mast as a winter food has long been recognized as single most important factor determining winter distribution in northern part of range, leading to the rule, “No mast, no redheads”. A positive relationship existed between numbers and acorn abundance in most counties studied in Missouri and large acorn-bearing oaks in Illinois, suggesting that species may respond to acorn abundance on a local scale, but this relationship remains unstudied.

Winter territories can be small; e.g., 0.05 ha ± 0.03 SD (*n* = 8) for adults and 0.03 ha ± 0.03 (*n* = 6) for juveniles, but more typically 0.17 ha ± 0.04 SE (*n* = 20) to 0.38 ha ±0.04 (*n* = 18), to 0.5–0.6 ha to as large as 1 ha.). Acorns often gathered from beyond territory, and several individuals may be seen gathering acorns at same source, such that individuals defend their storage sites, not source of acorns.

Last researched by Sharon Petzinger in winter 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Red-shouldered Hawk

Feature Label	Occurrence Area
Breeding Sighting	1.0 km radius
Non-breeding Sighting	1.0 km radius
Nest	1.0 km radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

According to the scientific literature home range sizes for eastern populations of red-shouldered hawks' are highly variable, both seasonally and by sex. Males generally have larger territories than females and both sexes have larger territories during the non-breeding season than during the breeding season (Crocoll 1994). Crocoll, 1994, reported that the average breeding season home range of eastern populations varied from 108.9 ha to 339 ha. The mean breeding season home range being 224 ha, an area equivalent to a circle having a 0.71 km radius. ENSP selected a slightly larger occurrence area boundary for red-shouldered hawks to account for the larger territory size used by the birds during the non-breeding season.

Literature supporting occurrence area(s):

Crocoll, S.T. Red-shouldered hawk. The Birds of North America, No. 107, 1994. The Academy of Natural Sciences, Philadelphia.

- Home range of red-shouldered hawk varies from 108.9 ha to 339 ha in eastern populations during the breeding season, with a computed average of 224 ha.

Highlighted studies result in mean = 224 ha, or 0.71 km radius.

Last researched by Melissa Craddock & Kris Schantz in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Savannah Sparrow

Feature Label	Occurrence Area
Breeding	150 meter radius

Occurrence Area Rule: Only points receive the specified radius.

Justification text:

Breeding territories range from 0.05 – 1.25 ha (Swanson 1998, Wheelwright and Rising 1993). The breeding occurrence area was selected based upon the upper limit of the territory range and increased to accommodate shifting territories for second nesting attempts and nomadic behavior of juveniles (Wheelwright and Rising 1993). No minimum patch size was selected based upon evidence that the species can occupy areas < 2 ha (Swanson 1998). Non-breeding savannah sparrows are not listed in New Jersey so no non-breeding occurrence area was assigned.

Literature supporting occurrence area(s):

Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

Maine had 50% incidence at 10 ha and that 5-10 ha is minimum size for birds to breed (see Vickery et al. 1994 below). New York had minimum area of 11.7 ha and mean patch size of 53.6 ha. Another study in New York had 97% incidence in areas 20 ha and larger, 88% incidence in 10-20 ha patches, 63% incidence in 5-10 ha patches, and 28% incidence in 3-5 ha patches. Missouri had minimum areas of 1-10 ha, and Illinois 10-30 ha.

Swanson, D. A. 1998 (revised 2002). Effects of management practice on grassland birds: Savannah Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. 30 pages.

Territories range from 0.05 – 1.25 ha and they may occupy areas < 5 ha in size. In Illinois, none occurred in areas < 10 ha and 50% incidence at 40 ha.

Vickery, P. D., M. L. Hunter, Jr. and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4): 1087-1097.

In Maine, 50% incidence for SAVS was reached at 10 ha.

Wheelwright, N. T. and J. D. Rising. 1993. Savannah Sparrow (Passerculus sandwichensis). In The Birds of North America, No. 45 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Breeding territories vary in size between regions, habitats, seasons, and years. Mean size or range: Michigan, 0.11 ha, Wisconsin, 0.53–0.86 ha, coastal Nova Scotia, 0.17 ha, Kent Is., NB, 0.05–0.30 ha (NTW); Sable Is., NS 0.38–0.53 ha in densely vegetated habitat, 1.09–1.25 ha in sparse habitat. Territory diameter 60 m in Quebec. Territories tend to expand during the breeding season and females will renest 0.5 – 31 meters from original nest (19m upper conf. limit), 26.7 m in Michigan, range from 7 – 42 m in Nova Scotia. Females are also territorial and are aggressive up to 20 m from nest. Parents will drop fecal sacs 10 – 50 m away from nest. Juveniles form loose flocks after a month post-fledging and wander 500 – 1000 meters daily while foraging.

Stopover habitat includes open fields, roadsides, dune vegetation, coastal marshes, edges of sewage ponds and other ponds in open country; rarely found in open woodlands. Winter habitat includes cultivated fields, pastures, golf courses, roadsides, dumps, dune grass, and salt marshes. *P. s. rostratus* and apparently other salt marsh populations, though generally wintering in salt marshes, can be found in a variety of open habitats, including sparsely vegetated habitats on xeric islands.

Last researched by Sharon Petzinger in Feb. 2007.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Sedge Wren

Feature Label	Occurrence Area
Breeding	200 meter radius
Non-breeding	200 meter radius

Occurrence Area Rule: Observations for both feature labels are mapped as points, which then receive the radii specified above.

Justification:

Breeding territories ranged from 0.12 to 3.4 ha (Dechant et al. 1998, Herkert et al. 2001). The breeding occurrence area was chosen based upon the upper limit of territory size and the mobility of the species. No minimum area was chosen due to evidence that this species occurs in areas < 10 ha in size (Dechant et al. 1998). The non-breeding occurrence area was chosen based upon the mobility of the species alone.

Literature supporting occurrence area(s):

Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 1998 (revised 2002). Effects of management practice on grassland birds: Sedge Wren. Northern Prairie Wildlife Research Center, Jamestown, ND. 17 pages.

In Illinois, area was not important in predictive occurrence and were present in areas < 10 ha. Minnesota territories average 0.2 ha, Illinois territories were 3.4 ha.

Herkert, J. R., D. E. Kroodsma, and J. P. Gibbs. 2001. Sedge Wren (*Cistothorus platensis*). *In* The Birds of North America, No. 582 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Territory boundaries are fluid throughout nesting season, and males may shift activity and defend new areas as season progresses. Territory size for 12 males in Minnesota averaged 1,780 m2 (range 1,274–3,559) (0.178 ha).

Migratory stopover habitats closely resemble preferred breeding habitats, but also occasionally found in other habitats including mesic grasslands; salt marshes; and alfalfa, clover, and rye fields

Last researched by Sharon Petzinger in winter 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Upland Sandpiper

Feature Label	Occurrence Area
Breeding	1 km radius, min. patch size 25 ha
Migrant	500 meter radius

Occurrence Area Rule: Only points receive the specified radius.

Justification text:

Upland sandpipers are area-sensitive grassland birds and sensitive to habitat fragmentation. Breeding territory sizes differ between males and females and average 8 ha for males and 85.6 ha for females (Dechant et al. 1999, Houston and Bowen 2001). This species requires large areas of a mosaic of grassland and open habitats for breeding and rearing young. Minimum patch sizes varied greatly from 26 to 50 ha (Mitchell et al. 2000, Vickery et al. 1994). The minimum patch size of 26 ha reported was located closest to New Jersey than others reported. The breeding occurrence area chosen was based on the female territory size of 85.6 ha and increased because females will travel an average 869 m (and up to 3,275 m) from the nest as well as to incorporate post-fledging habitat (Houston and Bowen 2001). However, due to the area sensitivity of the species, only patches 25 ha and greater should be valued for breeding individuals of this species.

Little is known about the stopover habitat use of migratory upland sandpipers. Therefore, the migrant occurrence area was chosen based upon evidence that upland sandpipers travel a far distance to forage (Houston and Bowen 2001).

Literature supporting occurrence area(s):

Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 1999 (revised 2002). Effects of management practice on grassland birds: Upland Sandpiper. Northern Prairie Wildlife Research Center, Jamestown, ND. 34 pages.

In Wisconsin territory size was 8 – 12 ha. Illinois had minimum area requirements of 30 ha, southwest Missouri 75 ha, Nebraska had 50% incidence at 50 – 61 ha, and Maine had 50% incidence at 200 ha (see Vickery et al. below).

Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

A study in the northeastern United States showed minimum habitat requirement to be at least 100 ha but found 50% incidence at 30 – 40 ha. Two other studies in New York show minimum habitat requirements to be 26 ha and 46 ha. In St Lawrence River, habitat size ranged from 160 – 496 ha with a mean of 375 ha. In the Midwest, 50% incidence was found between 30 and 100 ha.

Houston, C. S. and D. E. Bowen, Jr. 2001. Upland Sandpiper (Bartramia longicauda). In The Birds of North America, No. 580 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Nests in loose colonies with little or no evidence of territoriality. Nesting territories were usually grouped. Courtship flight displays 200 – 400 m in diameter. North Dakota had an annual nesting density of 9.8 – 21.8 nests per 100 ha with a mean of 12.4 nests per 100 ha (1 nest per 8 ha). Minnesota had fledglings move 300 m and 500 m from the nest. Illinois also had recent fledglings fly 170 – 410 m from the nest. Migratory stopover habitat in Texas includes plowed fields, rarely

bottomlands. Females have large home ranges (85.6 ha) and can move and average 869 m from the nest. Males have smaller home ranges (8.5 ha).

Stopped at dry salt-hay marshes in New Jersey in summer and autumn, and in harvested corn (*Zea mays*) and agave (*Agave* sp.) fields and flooded acacia (*Acacia* sp.) and sorghum (*Sorghum vulgar*) near Guadalajara, Mexico (O. Reyna pers. comm.). Along Manu River in sw. Peru, from 21 Aug through 5 Nov, used beach habitats overgrown with *Tessaria* and weeds.

Vickery, P. D., M. L. Hunter, Jr. and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4): 1087-1097.

In Maine: Upland sandpipers have the greatest area requirements of all 10 species in study. They were rare on sites less than 50 ha and increased steadily with area. Reached 50% incidence at 200 ha. Territories are > 8 ha.

Last researched by Sharon Petzinger in Feb. 2007.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Veery

Feature Label	Occurrence Area
Breeding	85 meter radius
Migrant	71.25 meter radius

Occurrence Area Rule: Only points receive the specified radius.

Justification text:

The breeding occurrence area was chosen based upon the upper limit of the mean territory size mentioned below (Bevier et al.), which came to 2.21 ha. There is little information about the territories of non-breeding individuals, so the default occurrence area will be used for migrating species.

Literature supporting occurrence area(s):

Rosenberg, K., R. Hames, R. Rohrbaugh, S. Barker Swarthout, J. Lowe, and A. Dhondt. 2003. A land manager's guide to improving habitat for forest thrushes. The Cornell Lab of Ornithology.

Veeries are area sensitive and intolerant of forest fragmentation even though they use disturbed habitats. Habitat with highest suitability consists of wet areas in 400 ha deciduous or mixed forests with 70% canopy closure. They also use coniferous and hemlock forests. The amount of area needed is related to the amount of fragmentation in the area. They can tolerate smaller fragments of 1 – 8 ha.

Bevier, L., A. F. Poole, and W. Moskoff. (2004). Veery (*Catharus fuscescens*). The Birds of North America Online. (A. Poole, Ed.) Ithaca: Cornell Laboratory of Ornithology; Retrieved from The Birds of North American Online database: http://bna.birds.cornell.edu/BNA/account/Veery/.

Prefers disturbed forest, probably because of denser understory not found in undisturbed forests. In northern hardwood forests, Veery bred in 77% of disturbed and successional habitats available but in only 18% of mature undisturbed habitats available. In mature woodlands, moisture regime is chief factor in habitat selection, more than twice as important as herb cover. Shrub cover is chief vegetative consideration in habitat selection – probably because shrubs provide safe nest sites.

In Middle Atlantic states requires forests of 20 ha for 50% probability of occurrence. In Illinois, of 22 forest patches in which known to breed, only 2 smaller than 100 ha.; average forest size of breeding area 309 ha. In red maple swamps of s. Rhode Island, while occurring in swamps as small as 1 ha, regional forest abundance may be more critical determinant of presence and abundance than swamp size.

Territories range from 0.10 ha to a few hectares. In Ontario (*n* = 61), average size of territory 0.25 ha; in s. Quebec (sugar maple/hemlock stand), 0.5 ha (A. Cyr unpubl.). In Hudson Valley, occasionally build nests within 15-20 m of each other within large, overlapping territories.

Last researched by Sharon Petzinger in Feb. 2007.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Vesper Sparrow

Feature Label	Occurrence Area
Breeding	250 meter radius, min. patch size 5 ha
Non-breeding	250 meter radius

Occurrence Area Rule: Observations for both feature labels are mapped as points, which then receive the radii specified above.

Justification:

Vesper breeding territories range from 0.29 – 8.19 ha in patches 5+ ha in size (Dechant et al. 2000, Jones and Cornerly 2002). The breeding occurrence area size was selected based upon a larger territory size and the mobility of the species. The minimum patch size was based on presence in Ohio in 5-ha open areas (Jones and Cornerly 2002). The non-breeding occurrence area size was chosen based upon the mobility of the species.

Literature supporting occurrence area(s):

Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 2000 (revised 2002). Effects of management practice on grassland birds: Vesper Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. 41 pages.

Montana territories ranged from 0.29 – 3 ha and an average of 1.65 ha. Corn and soybean fields in Iowa had territories ranging from 1.6 – 8 ha and an average of 3 ha. Another Iowa study had territories ranging from 1.8 – 3.2 ha and averaging 2.3 ha. Michigan territories in a 5.6-ha field averaged 0.48 – 0.72 ha. Illinois tallgrass prairies contained vespers in small sites < 10 ha but not large sites (650 ha). Maine found vesper abundance to be positively correlated with area and 50% incidence at 20 ha.

Jones, S. L. and J. E. Cornely. 2002. Vesper Sparrow (Pooecetes gramineus). In The Birds of North America, No. 624 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

In Ohio, used open areas from 5 – 15 ha. Breeding territory size ranges from 0.29 – 8.19 ha. In Michigan, territories averaged 2.59 ha, but open field territories averaged 1.53 ha ± 0.33 SD and 1.03 ha ± 0.77 SD in fields with standing dead trees.

Stopover habitat consists of pastures and weeds bordering cultivated fields and roadsides, hedgerows, and barren to overgrown fields. Throughout much of range, commonly found near grassy or weedy ditches and fencerows, since fields are still barren upon arrival in early spring.

Wintering habitat in e. U.S. consists of patches of cleared and natural openings in forest land.

Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

Maine had 38 pairs in a 210-ha patch and 50% incidence at 20 ha (see Vickery et al. 1994 below). Missouri had a range of patch size from 10 – 100 ha. Illinois had minimum patch size of 10 ha. No information on territory size was provided.

Vickery, P. D., M. L. Hunter, Jr. and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4): 1087-1097.

In Maine, 50% incidence for vespers were reached at 20 ha.

Last researched by Sharon Petzinger in winter 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Winter Wren

Feature Label	Occurrence Area
Breeding	110 meter radius

Occurrence Area Rule: Only points receive the specified radius.

Justification:

The breeding occurrence area was chosen based on the upper confidence limit of the mean habitat size for second nesting attempts (3.3 ha ± 1.2 SD, *n* = 22) (Hejl et al. 2002), which calculates to 3.8 ha. Non-breeding wrens are listed as stable in New Jersey, so no occurrence area was specified.

Literature supporting occurrence area(s):

Hejl, S. J., J. A. Holmes, and D. E. Kroodsma. 2002. Winter Wren (*Troglodytes troglodytes*). *In* The Birds of North America, No. 632 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Winter Wrens use all types of forest near water, especially old-growth structures (snags, downed logs, and large trees) for nesting, foraging, and roosting. Clearcutting and some types of partial logging reduce habitat suitability for the Winter Wren

Shape, size, density, and distribution of territories are influenced by habitat and topography. Territories appear to be preferentially established along streams or other water sources, especially in drier habitats, resulting in patchy distribution

Territory size varies both within and between habitats. In n. Idaho, breeding-territory size overall ranged from 0.8 to 6 ha; 0.8–4.0 ha (mean 1.9 ha ± 0.9 SD; *n* = 17) within old-growth cedar-hemlock forests and 1.0 to 3.3 in fragmented old growth (mean 2.1 ha ± 0.8 SD; *n* = 11) interspersed with 4- to 11-yr-old clearcuts. Averaged 2.0 ha ± 0.9 SD (*n* = 28) for first nesting attempts and 3.3 ha ± 1.2 SD (*n* = 22) for second attempts. Family groups used these areas after nesting. In se. Alaska, territory size ranged from 0.7 to 4.8 ha, averaged 2.2 ha ± 0.3 SD, and differed significantly among 3 sites (*n* = 15). In coastal western hemlock in British Columbia, breeding-territory sizes ranged from 0.48 to 2.21 ha and averaged 1.38 ha ± 0.51 SD (*n* = 14) in 1979 and 1.23 ha ± 0.50 SD (*n* = 12) in 1980. In a separate study in similar habitat of British Columbia, average size of territories over 3 yr ranged from 0.68 to 1.46 ha.

Conservative estimates of fall-territory size ranged from 0.42 to 1.31 ha and winter territory size ranged from 0.14 to 1.45 ha. In Idaho, territories shifted between broods (SJH and JAH). In British Columbia, territory shifts occurred at beginning of winter, at junction with breeding season, and breeding/fall juncture.

Last researched by Sharon Petzinger in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Worm-eating Warbler

Feature Label	Occurrence Area
Breeding	100 meter radius

Occurrence Area Rule: Only points receive the specified radius.

Justification:

The breeding occurrence area was chosen based upon the fact that females will travel up to 100 m from original nest location to renest and post-fledging young will travel outside the territory. The 100 m occurrence area is 23 m further than the upper limit of the mean territory size (1.9 ha). Non-breeding worm-eating warblers are listed as stable in New Jersey so no occurrence area was chosen.

Literature supporting occurrence area(s):

Hanners, L. A. and S. R. Patton. 1998. Worm-eating Warbler (*Helmitheros vermivorus*). *In* The Birds of North America, No. 623 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Occurs regularly where large tracts of mature deciduous or mixed deciduous-coniferous forest overlap with hillsides and smaller patches of shrubs such as mountain laurel (*Kalmia latifolia*) and rhododendron (*Rhododendron maximum*). Suggested minimum area requirements range from 21 to 340 ha. Plant composition of the forest community appears less important to this species than forest age and size, presence of hillsides, and occurrence of dense patches of shrub cover. Species occurs in variety of forest communities, including eastern hemlock (*Tsuga canadensis*), beech-maple (*Fagus-Acer*), and oak-hickory (*Quercus-Carya*) associations, and may be found through a continuum of moist to dry environments

Mean territory size in Connecticut: 1.72 ha ± 0.78 SD (range 0.60–4.95, *n* = 94 territories), derived from mapping repeated observations of singing males, fights, and nest sites. No known relationship between territory size and territory quality.

Second or third nesting attempts are within 10 – 100m of first nest. Individuals may be successful at sites as small as 19 ha, but little is known about return rates of adults to these sites in subsequent years. The species is considered area sensitive and nests in highest densities in forests of at least several hundred hectares. Within first week of fledging, begin following parents widely within territory and sometimes beyond territory boundaries. Unknown when they become totally independent.

Rosenberg, K. V., R. W. Rohrbaugh, Jr., S. E. Barker, J. D. Lowe, R. S. Hames, and A. A. Dhondt. 1999. A land manager's guide to improving habitat for scarlet tanagers and other forest-interior birds. The Cornell Lab of Ornithology.

Worm-eating warblers share some habitat characteristics with Scarlet Tanagers. In the Piedmont Plains and Delaware Bay regions, they prefer areas at least 70% forested, deciduous or mixed, and the suitability increases with proximity of forest patches to larger, contiguous forest patches. In

the Highlands, they prefer areas at least 50% forest, deciduous, and mixed and occasionally coniferous, and the suitability increases with proximity of forest patches to larger, contiguous forest patches.

Last researched by Sharon Petzinger in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Yellow-crowned Night-heron

Feature Label	Occurrence Area
Nesting Colony	Mapped extent of nesting colony, if available, otherwise, radius of 71.25 meters (seconds precision circle) around confirmed/known breeding location point.
Nesting Colony Foraging	2.7 km (1.7 mile) radius

Occurrence Area Rule: If mapped as a polygon, the polygon is the occurrence area. If mapped as a point, the occurrence area is the area defined by the point and the specified radius.

Justification:

Nesting area is defined by the area the birds actually use, as these birds do not defend a territory except immediately around their individual nests. The boundaries of the colony are defined as much by social attraction phenomenon and by habitat suitability. Consequently there is now immediately apparent justification for buffering the mapped extent of a nesting area. Where the mapped extent of a colony was available it was used. Where the mapped extent was not available the default “seconds precision” circle was used around the recorded nesting location point.

ENSP reviewed the literature regarding commuting distance for colonial nesting long-legged wading birds which fairly consistently indicates that the importance of suitable foraging habitat decreases with the distance from the nesting area (e.g. Dowd and Flake 1985, Custer et al. 2004, Kelly et al 1993, Thompson 1978). This is not surprising considering the energy demands of long commutes and the fact that, all other things being equal, if suitable foraging habitat is randomly distributed within the possible foraging range, simple geometry would argue that availability would increase with the square of the distance from the colony. Consequently, a particular type of wetland or riparian habitat is more critical if it is located close to a nesting area than a similar area located near the edge of the “energetically feasible” foraging range from the colony. It would therefore be unjustifiable to use the maximum foraging distance figures to define all potential foraging habitat as “critical” foraging habitat for a particular nesting colony. Conversely, using an average foraging distance figure may “under-include” suitable habitat by omitting some foraging areas that are important because they provide particularly rich and easily exploited feeding habitat.

Further, research (Custer et al. 2004) indicates that longer commuting distances are more frequent during high-demand and demographically critical nestling rearing period. Where the literature on commuting distance includes several studies, there can be wide variability in the mean commuting

distances between different studies. When such was the case, we either averaged the reported mean commuting distances or used the information from the study with a large sample size or from an area most ecologically similar to New Jersey. We then doubled this figure.

A study conducted in North Carolina determined that the average foraging commute was 1.4 km (Custer and Osborn 1978). Research from the Chesapeake Bay found a smaller average foraging commute at <0.5 km. NatureServe recommends a minimum inferred extent of 3 km and justifies it by noting a low mean foraging range size (NatureServe 2006). We apply a 2.7 km radius around a colony to protect foraging areas.

Literature supporting occurrence area(s):

Bentley. 1994. Use of a landscape-level approach to determine the habitat requirements of the yellow-crowned night-heron in the lower Chesapeake Bay. Masters Thesis, College of William and Mary, Williamsburg, Virginia.
Average distance between nest and foraging area was <0.5 km.

Custer and Osborn. 1978. Feeding habitat use by colonially breeding herons, egrets and ibises in North Carolina. Auk 95:733-43.
Average distance between nests and foraging areas was 1.4 km.

Custer, C.M., S.A. Suarez, D.A. Olsen. 2004. Feeding habitat characteristics of the Great Blue Heron and Great Egret nesting along the Upper Mississippi River, 1995-1998. Waterbirds 27(4): 454-68.
The majority of the herons in this study fed <5 km from the nesting site, and avoided areas > 10 km away. They flew farther to sites during the brood-rearing period than during incubation. Only 10% of the feeding flights ended at a location where another heron was present, indicating that they prefer to feed alone.

Dowd and Flake. 1985. Foraging habits and movements of nesting Great Blue Heron in prairie river ecosystem, South Dakota. Journal of Field ornithology 56: 377-87.
A study in South Dakota found that the average distance that great blues flew from their colony to a foraging site was 3.1 km, and the maximum observed distance was 24.4 km. Eighty-five percent of the herons in the study fed within 4 km of the colony.

Kelly J. P., H. M. Pratt, P. L. Greene. 1993. The distribution, reproductive success, and habitat characteristics of heron and egret breeding colonies in the San Francisco Bay area. Colonial Waterbirds. 16:18–27.
> 95% of great blue herons and >90% great egrets fed within 20 km of their colony.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.
The inferred minimum extent habitat use (when actual extent is unknown) is 3 km. This is based on a low mean foraging range size.

Thompson. 1978. Feeding areas of Great Blue Herons and Great Egrets nesting in the floodplain of the upper Mississippi River. Proc. Colonial Waterbird Group. 2: 202-13.
In central Minnesota the average distance that the herons flew from the colony to a foraging area was 6.5 km, and the maximum observed was 20.4 km. Fifty-three percent of the herons in the study fed within 4 km of the colony.

Last researched by Christina Kisiel in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

REPTILES:

Bog Turtle

Feature Label	Occurrence Area
Occupied Habitat	Hand digitized polygon + 200 meter buffer

Occurrence Area Rule: Mapped as a point or polygon, which then receives the specified buffer.

Justification text:

Glyptemys muhlenbergii is a habitat specialist that occupies wetlands that meet certain characteristics of vegetation, soils, and, most importantly, hydrology. The life history of G. muhlenbergii is somewhat unique in that it spends the majority of the year within the wetland complex and often does not venture for great periods of time into the adjacent uplands and therefore the identification of wetlands occupied by the bog turtle is critical to the recovery of this species. A percentage of wetlands with bog turtles are of a small enough size that they are not currently identified as Wetlands in the 2002 Land Use/Land Cover data layer so therefore polygons are hand digitized to reduce the chance of not capturing core habitat.

An additional 200 meters is generated around the Bog Turtle Colony polygons to account for turtle movements not identified during fieldwork as well as habitat that is valuable to the colony, but was not identified by the biologists. This new polygon is the Species Occurrence Area (SOA).

Literature supporting occurrence area(s):

Chase et al. 1989. Habitat Characteristics, Population Size, and Home Range of the Bog Turtle, Clemmys muhlenbergii, in Maryland. Journal of Herpetology 23(4): 356-362.
Discusses bog turtle habitat use as mostly isolated to specific wetland types.

Morrow et al. 2001. Home Range and Movements of the Bog Turtle in Maryland. Journal of Herpetology 35(1): 68-73.
Discusses use of wetlands as primary habitat for bog turtles throughout duration of study.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.

Inferred minimum extent of habitat use for this species is 200 meters.

Last researched by Brian Zarate in 2006.
Occurrence area applied in Version 3 of the Landscape Project.

Eastern Box Turtle

Feature Label	Occurrence Area
Nest	71.25 meters
Occupied Habitat	71.25 meters

Occurrence Area Rule: Only points receive the specified buffer for all feature labels.

Justification:

The species occurrence area is generally based on the average home range/territory size, or other appropriate life-history parameter as reported in peer-reviewed scientific literature or from information obtained through ENSP research. When searching the scientific literature to gather information to support the occurrence area polygon size, efforts were made to select research that was conducted in habitat types similar to those found in NJ. For many species that value habitat patches in the Landscape Project maps, insufficient information exists in the scientific literature to support the designation of an occurrence area. In these cases, a default occurrence area (71.25 meter radius) is applied to take into account location uncertainty. These occurrence areas are used to value patches of habitat.

Literature supporting occurrence area(s):

To be reviewed.

Last researched by Brian Zarate in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Northern Copperhead Snake

Feature Label	Occurrence Area
Gestation Site	71.25 meter radius
Hibernaculum	71.25 meter radius
Occupied Habitat	71.25 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

The species occurrence area is generally based on the average home range/territory size, or other appropriate life-history parameter as reported in peer-reviewed scientific literature or from information obtained through ENSP research. When searching the scientific literature to gather information to support the occurrence area polygon size, efforts were made to select research that was conducted in habitat types similar to those found in NJ. For many species that value habitat patches in the Landscape Project maps, insufficient information exists in the scientific literature to support the designation of an occurrence area. In these cases, a default occurrence area (71.25 meter radius) is applied to take into account location uncertainty. These occurrence areas are used to value patches of habitat.

Literature supporting occurrence area(s):

No literature is available to support the "seconds precision" occurrence area, and ENSP staff was unable to locate literature supporting home range territories.

Last researched by Kris Schantz in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Timber Rattlesnake

Feature Label	Occurrence Area
Gestation Site	4.0 km radius
Hibernaculum	4.0 km radius
Occupied Habitat	20 meter radius
Occurrence by Den	4.0 km radius
Telemetry: Home Range	Rattlesnake Telemetry Model*
Telemetry: Partial Activity Range	Rattlesnake Telemetry Model*

Occurrence Area Rule: For all non-telemetry feature labels, only points received the specified radii.
*The Rattlesnake Telemetry Model was created by taking each individual snake's telemetry points and connecting them in date order (first date to last date) with a line. That line was then buffered 300 meters to produce a polygon which then valued level 3 lu/lc. The polygon itself was not buffered.

Justification:

Timber rattlesnakes' home ranges vary according to sex and age class. Reproductively mature males typically travel greater distances than females and young males in search of mates and/or food resources. ENSP research has shown that sub-adult males often venture farther than non-gravid females, while juveniles and yearlings [males] may maintain a smaller activity range. Non-

gravid females typically maintain a larger activity range than gravid females, and gravid females may venture out to forage early in the season, but return to their gestation site/ birthing rookery by early July which is typically within 500 meters (.3 miles) of her den. Rattlesnake researchers agree that the majority of a den's population will use the habitat within a 1.5 mile (2.4 km) radius of the den with some of the larger males venturing beyond this distance in search of mates. However, telemetry research has shown that males (and less typically, non-gravid females) will travel greater distances in search of food, basking areas, and mates (Brown 1993, Martin 1993, ENSP research 2006). Therefore, the ENSP has determined that a larger occurrence area (4 km radius around a den) is required to adequately protect critical habitat for timber rattlesnake populations. "Occurrence by Den" is typically related to early transient/ basking areas, which also may be used as gestation sites. These are critical sites near dens (thus the same model applies) that are important to the snakes upon spring emergence. These areas provide important early season basking sites before the snakes move onto their foraging grounds or shed sites. "Gestation Site" is often near the den but can be up to 500 meters (.3 miles) from the den. These sites are critical to the survival of timber rattlesnake populations in the northern region and are used for many generations. Young snakes follow scent trails, left by adult females, back to the safety of their dens in the late fall. Due to the females' condition and newborns' inexperience, they are highly vulnerable to predation at these sites. Therefore, the same model has been applied to known gestation sites in an effort to: 1) protect the site and travel corridors to/ from the den, and; 2) to capture the den within the model.

"Occupied Habitat" refers to random sightings of rattlesnakes whereby it is impossible to determine the snake's den location or critical habitat range. These sites are given a standard seconds precision occurrence area (20 meter radius). All suitable habitat that are intersected by this buffer will be valued as potential critical habitat.

Literature supporting occurrence area(s):

Brown, William S. 1993. Timber Rattlesnake: Habitat. *In* Biology, Status, and Management of the Timber Rattlesnake (*Crotalus Horridus)*: A Guide for Conservation (Joseph T. Collins ed.). Museum of Natural History – Dyche Hall, The University of Kansas, Lawrence, Kansas. Pp. 10-15.

Transient habitat is also used by females during their reproductive years…for gestating and birthing.

Brown, William S. 1993. Timber Rattlesnake: Ecology. *In* Biology, Status, and Management of the Timber Rattlesnake (*Crotalus Horridus)*: A Guide for Conservation (Joseph T. Collins ed.). Museum of Natural History – Dyche Hall, The University of Kansas, Lawrence, Kansas. Pp. 15-24.

Mean size home ranges:

- New Jersey males: 207 ha
- New Jersey nongravid females: 42 ha
- New Jersey gravid females: 22 ha

Mean maximum migratory distance from den:

- New Jersey males': 4.07 km (2.5 mi)
- New Jersey nongravid females: 2.05 km (1.3 mi)

Maximum single migratory distance from den:

- New Jersey males': 7.2 km (4.5 mi)

- New Jersey nongravid females: 3.7 km (2.3 mi)

Brown, William S. 1993. Timber Rattlesnake: Land Protection. *In* Biology, Status, and Management of the Timber Rattlesnake (*Crotalus Horridus)*: A Guide for Conservation (Joseph T. Collins ed.). Museum of Natural History – Dyche Hall, The University of Kansas, Lawrence, Kansas. Pp. 39-40.

Home ranges average 160 – 500 ac (65 – 202 ha) for males; 40 – 100 ac (16 – 40 ha) for nongravid females.
A 1.5 mile (2.4 km) radius centered around den would encompass most of the habitat used by snakes from that den. An additional buffer of 1 mile (for a total of 2.5 mile radius, 4.0 km radius) is recommended to protect large males and some nongravid females that venture further and to buffer the habitat used by the greater portion of the individual den population from human activity.

Martin, W.H. 1993. Reproduction of the Timber Rattlesnake (*Crotalus Horridus)* in the Appalachian Mountains. Journal of Herpetology 27(2):133-143.

Females spent most of their gestation period…usually located within 500 m (.3 miles) of their overwintering dens.

Schantz, Kris. 2006. Expert opinion. Endangered and Nongame Species Program Timber Rattlesnake Telemetry Research 1999-2000, 2003-2005.

Last researched by Kris Schantz in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Wood Turtle

Feature Label	Occurrence Area
Nest	500 meter radius
Occupied Habitat	500 meter radius
Wintering	500 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

Although Glyptemys insculpta spend a large part of their life histories in water, they are also New Jersey's second most terrestrial turtle, behind Terrapene c. carolina. As such, G. insculpta can occupy a variety of both wetland and upland habitats, often at great distances from the streams they hibernate in during the colder months.

Research within the state (unpublished data) using both radiotelemetry and mark-recapture has documented in stream movements of up to 1 mile for the species and upland movements of over 300 meters from the home stream, although movements exceeding 1km in a day are commonly documented.

Literature supporting occurrence area(s):

Carroll, T. E. and D. W. Ehrenfeld. 1978. Intermediate-range homing in the wood turtle, *Clemmys insculpta*. Copeia 1978: 117-126.
Intermediate home ranging described up to 2 kilometers when displaced from home range.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.
Inferred minimum extent of habitat use for this species is 500 meters.

Tuttle, S. E. and D. M. Carroll. 2005. *Glyptemys insculpta* (Wood Turtle). Juvenile movement and home range. Herpetological Review 36: 166-167.
Juvenile wood turtles are documented to travel great distances away from streams to 865 meters and may have significantly larger home range sizes than adults; up to 27.6 hectares.

Last researched by Brian Zarate in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

AMPHIBIANS:

Blue-spotted Salamander

Feature Label	Occurrence Area
Breeding	300 meter radius
Non-breeding	300 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

Vernal habitats are utilized by a wide variety of amphibian species. A single vernal habitat and its surrounding upland component serve as critical habitat for a diversity of Ambystomid salamanders, including A. laterale. ENSP has determined that a buffer of 300 meters for both breeding (vernal habitat) and non-breeding (upland component) habitat provides protection for a high percentage of the species year-round range. The majority of Ambystomid salamanders breed in vernal pools in the spring for a limited number of weeks and then return to the uplands for the remainder of the year. Occurrences designated as non-breeding will mostly occur within 300 meters of a breeding habitat and therefore the occurrence area radii are the same for both feature labels.

Literature supporting occurrence area(s):

Bishop, S. C. 1941. The Salamanders of New York. Bulletin 324. Albany, NY: The New York State Museum.
Dispersals recorded past 250 m away from suitable breeding habitats.

Brown, L.J. and R.R. Jung. 2005. An Introduction to Mid-Atlantic Seasonal Pools, EPA/903/B-05/001. U.S. Environmental Protection Agency, Mid-Atlantic Integrated Assessment, Ft. Meade, Maryland. Page 10.
Seasonal pool terrestrial habitat buffer recommendation.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.
Inferred minimum extent of habitat use for this species is 300 meters.

Regosin, J.V., B.S. Windmiller, R.N. Homan, and J.M. Reed. 2005. Variation in terrestrial habitat use among four pool-breeding amphibian species and its conservation implications. Journal of Wildlife Management 69:1481-1493.
Dispersal of > 100 meters by 52% of a blue-spotted salamander population.

Semlitsch, R. D., and J. R. Bodie. 2003. Biological Criteria for Buffer Zones around Wetlands and Riparian Habitats for Amphibians and Reptiles. Conservation Biology 17(5): 1219-1228
Documents home ranges surrounding breeding sites up to 290 meters.

Williams, P.K. 1973. Seasonal movements and population dynamics of four sympatric mole salamanders, genus *Ambystoma*. Unpublished PhD. dissertation, Indiana University.
Documents dispersal distances of various Ambystomid salamanders.

Last researched by Brian Zarate in 2006.
Occurrence area applied in Version 3 of the Landscape Project.

Jefferson Salamander

Feature Label	Occurrence Area
Breeding	300 meter radius
Non-breeding	300 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

Vernal habitats are utilized by a wide variety of amphibian species. A single vernal habitat and its surrounding upland component serve as critical habitat for a diversity of Ambystomid salamanders, including A. jeffersonianum. ENSP has determined that a buffer of 300 meters for both breeding (vernal habitat) and non-breeding (upland component) habitat provides protection for a high percentage of the species year-round range. The majority of Ambystomid salamanders breed in vernal pools in the spring for a limited number of weeks and then return to the uplands for the remainder of the year. Occurrences designated as non-breeding will mostly occur within 300 meters of a breeding habitat and therefore the occurrence area radii are the same for both feature labels.

Literature supporting occurrence area(s):

Bishop, S. C. 1941. The Salamanders of New York. Bulletin 324. Albany, NY: The New York State Museum.
Dispersals recorded as far as 1,610m away from suitable breeding habitats.

Brown, L.J. and R.R. Jung. 2005. An Introduction to Mid-Atlantic Seasonal Pools, EPA/903/B-05/001. U.S. Environmental Protection Agency, Mid-Atlantic Integrated Assessment, Ft. Meade, Maryland. Page 10.
Seasonal pool terrestrial habitat buffer recommendation.

Faccio, S. D. 2003. Postbreeding emigration and habitat use by Jefferson and spotted salamanders in Vermont. Journal of Herpetology 37:479-489.
Documents dispersal distances up to 355m in one movement and macro habitat preferences.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.
Inferred minimum extent of habitat use for this species is 300 meters.

Semlitsch, R. D., and J. R. Bodie. 2003. Biological Criteria for Buffer Zones around Wetlands and Riparian Habitats for Amphibians and Reptiles. Conservation Biology 17(5): 1219-1228
Documents home ranges surrounding breeding sites up to 290 meters.

Williams, P.K. 1973. Seasonal movements and population dynamics of four sympatric mole salamanders, genus *Ambystoma*. Unpublished PhD. dissertation, Indiana University.
Documents dispersal distances of various Ambystomid salamanders.

Last researched by Brian Zarate in 2006.
Occurrence area applied in Version 3 of the Landscape Project.

Longtail Salamander

Feature Label	Occurrence Area
Occupied Habitat	300 meter radius

Occurrence Area Rule: Only points receive the specified radius.

Justification:

Very little primary literature exists on the life history of Eurycea l. longicauda. Much of the information we know about E. longicauda derives from the occurrence data in ENSP's Biotics Database. Ongoing research and personal observations have also contributed to the development of the current occurrence area.

Literature supporting occurrence area(s):

Anderson and Martino. 1966. The Life History of Eurycea l. longicauda Associated with Ponds. The American Midland Naturalist 75(2): 257-279
A unique association of E. longicauda with limestone sink ponds, also breeding areas for Ambystomid salamanders, exists in New Jersey.

Last researched by Brian Zarate in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Marbled Salamander

Feature Label	Occurrence Area
Breeding	300 meter radius
Non-breeding	300 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification text:

Vernal habitats are utilized by a wide variety of amphibian species. A single vernal habitat and its surrounding upland component serve as critical habitat for a diversity of Ambystomid salamanders, including A. opacum. ENSP has determined that a buffer of 300 meters for both breeding (vernal habitat) and non-breeding (upland component) habitat provides protection for a high percentage of the species year-round range. The majority of Ambystomid salamanders breed in vernal pools in the spring for a limited number of weeks and then return to the uplands for the remainder of the year. Marbled salamanders, on the other hand, breed in the fall at vernal pools. Occurrences designated as non-breeding will mostly occur within 300 meters of a breeding habitat and therefore the occurrence area radii are the same for both feature labels.

Literature supporting occurrence area(s):

Brown, L.J. and R.R. Jung. 2005. An Introduction to Mid-Atlantic Seasonal Pools, EPA/903/B-05/001. U.S. Environmental Protection Agency, Mid-Atlantic Integrated Assessment, Ft. Meade, Maryland. Page 10.
Seasonal pool terrestrial habitat buffer recommendation.

Gamble, L.R., McGarigal, K., Jenkins, C.L., and Timm, B.C. 2006. Limitations of regulated "buffer zones" for the conservation of marbled salamanders. *Wetlands* 26(2):298-306.
Documents dispersals up to 1,230 meters by marbled salamanders.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life (web application). Version 4.7. NatureServe, Arlington, VA. Available at: http://www.natureserve.org/explorer.
Inferred minimum extent of habitat use for this species is 300 meters.

Semlitsch, R. D., and J. R. Bodie. 2003. Biological Criteria for Buffer Zones around Wetlands and Riparian Habitats for Amphibians and Reptiles. Conservation Biology 17(5): 1219-1228

Documents home ranges surrounding breeding sites up to 290 meters.

Williams, P.K. 1973. Seasonal movements and population dynamics of four sympatric mole salamanders, genus *Ambystoma*. Unpublished PhD. dissertation, Indiana University.

Documents dispersal distances of various Ambystomid salamanders, including A. opacum, outwards to 450m.

Last researched by Brian Zarate in 2006.
Occurrence area applied in Version 3 of the Landscape Project.

BUTTERFLIES:

A Silver-bordered Fritillary, Arogos Skipper

Feature Label	Occurrence Area
Adult Casual Flyby	71.25 meter radius
Adult Mating	71.25 meter radius
Adult Nectaring	71.25 meter radius
Larvae Sighting	71.25 meter radius
Pupae Sighting	71.25 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

The species occurrence area is generally based on the average home range/territory size, or other appropriate life-history parameter as reported in peer-reviewed scientific literature or from information obtained through ENSP research. When searching the scientific literature to gather information to support the occurrence area polygon size, efforts were made to select research that was conducted in habitat types similar to those found in NJ. For many species that value habitat patches in the Landscape Project maps, insufficient information exists in the scientific literature to support the designation of an occurrence area. In these cases, a default occurrence area (71.25 meter radius) is applied to take into account location uncertainty. These occurrence areas are used to value patches of habitat.

Literature supporting occurrence area(s):

To be reviewed.

Last researched by David Golden in July 2006.

Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

DRAGONFLIES AND DAMSELFLIES:

Arrowhead Spiketail, Brook Snaketail, Brush-tipped Emerald, Harpoon Clubtail, Maine Snaketail, Midland Clubtail, New England Bluet, Rapids Clubtail, Sable Clubtail, Ski-tailed Emerald, Spatterdock Darner, Tiger Spiketail, Williamson's Emerald, Zebra Clubtail

Feature Label	Occurrence Area
Breeding/Courtship	500 meter radius
Casual Flyby	500 meter radius
Exuviae Sighting	500 meter radius
Foraging	500 meter radius
Larvae Sighting	500 meter radius
Territorial Display	500 meter radius

Occurrence Area Rule: Only points receive the specified radius for all feature labels.

Justification:

For many species that value habitat patches in the Landscape Project Maps, insufficient information exists in the scientific literature to support the designation of an occurrence area. In the Landscape Project, an occurrence area equates to the area a species needs to fulfill it's life history requirements (breeding, resting, feeding). Due to the absence of literature concerning Odonate species' spatial requirements, a 500 meter radius was formulated based upon the expert opinion of the biologist responsible for reviewing these species within the NJ Endangered and Nongame Species Program.

Literature supporting occurrence area(s):

To be reviewed.

Last researched by David Golden in July 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

FRESHWATER MUSSELS:

Brook Floater, Creeper, Dwarf Wedgemussel, Eastern Lampmussel, Triangle Floater, Yellow Lampmussel

Feature Label	Occurrence Area
Fresh Dead Individual	50 meter radius. Stream segment valued by that distance was then buffered by .75 km upstream & downstream.
Glochidia Sighting	50 meter radius. Stream segment valued by that distance was then buffered by .75 km upstream & downstream.
Live Individual Sighting	50 meter radius. Stream segment valued by that distance was then buffered by .75 km upstream & downstream.
Shell Sighting	50 meter radius. Stream segment valued by that distance was then buffered by .75 km upstream & downstream.

Occurrence Area Rule: Points, lines and polygons receive the specified occurrence area radius for all feature labels.

Justification:

Although adult freshwater mussels are mostly sedentary, their larvae (glochidia) with few exceptions are obligate parasites on specific fish hosts. Without the host fish, mussel species are unable to complete their reproductive cycle and therefore face extinction (Bogan 1993). Movement of host fishes bearing glochidia is by far the main mechanism of freshwater mussel dispersal (Watters 1992). Given the potential distance of transport by host fishes, D. Strayer (pers. comm.) as reported by Cordeiro, J. (2004) on the NatureServe web site, suggests a separation distance of at least 10 km when reporting freshwater mussel occurrences. Cordeiro (2004) recommends a separation distance in flowing water of 2 kilometers between sightings in unsuitable habitat and 10 km in suitable habitat. Populations/occurrences as defined by NatureServe are based on some evidence of historic or current presence, including live specimens or recently dead shells (including soft tissue still attached and/or nacre still glossy without signs of external weathering or staining) at any given location with potentially recurring existence. Given that separation distance based on potential host fish dispersal is somewhat arbitrary, the application of a 50 m radius buffer which is then buffered upstream and downstream by .75 m is conservative. Also, our recommendations do not take into account distances necessary to protect populations from water quality threats such as heavy metals, pesticides, sewage treatment plant effluents, and other point and nonpoint contaminant sources.

Literature supporting occurrence area(s):

Bogan, A. 1993. Freshwater bivalve extinctions (Mollusca: Unionoida): a search for causes. Amer. Zool. 33:599-609.

Cordeiro, J. (2004). NatureServe Web Site. Population/occurrence delineation for freshwater mussels.

Watters, G.T. 1992. Unionids, fishes, and the species-area curve. Journal of Biogeography 19:481-490.

Last researched by Jeanette Bowers-Altman in 2006.
Occurrence area applied in Version 3 of the Landscape Project for the Highlands region.

Appendix III. Land-use/Land-cover level III Species Habitat Requirements.

ENSP biologists chose Level III LU/LC classes from the NJDEP 2002 Modified Anderson System for each species to include in the species-based patches. The Level III classes and patch types used in the mapping represent what ENSP biologists have determined comprises suitable habitat for each species.

Level III classes and patch rules were chosen using a combination of research findings within peer reviewed literature, analyses using New Jersey species data, and expert opinion. ENSP biologists first made choices based on the literature available for each species. Some interpretation was necessary in this first process, to relate land use/land cover classes described in other research studies to the Modified Anderson System classes. Second, GIS analyses were conducted using New Jersey data to help inform the biologists' choices by intersecting the occurrence areas of each species with the 2002 DEP LU/LC. Biologists were provided with data such as the number of occurrence areas for a given species containing each Level III LU/LC class as well as the mean amount of each Level III LU/LC class within occurrence areas of a given species (used) compared to the mean amount of each Level III LU/LC class contained within the Highlands Extended Region (available). Based on these results, some of the Level III classes were modified. Finally, the biologists examined the outcome of the mapping based on choices made up to this point in the process, and used their own expert opinion to make their ultimate decision about which Level III LU/LC classes to include and what patch rules to apply for each species.

Appendix III. Land-use/Land-cover selections by species

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Mammals				
Bobcat - For an explanation of Patch Type "H", refer to Page 18.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	5, 7
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	5, 7
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	4, 7
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	7
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1,7
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2, 3, 4, 5, 6, 7, 8
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2, 3, 4, 5, 6, 7, 8
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2, 3, 4, 5, 6, 7, 8
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2, 3, 4, 5, 6, 7, 8
4230	FOREST	PLANTATION	N/A	1, 2, 3, 4, 5, 6, 7, 8
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2, 3, 4, 5, 6, 7, 8
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2, 3, 4, 5, 6, 7, 8
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2, 3, 4, 5, 6, 7, 8
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2, 3, 4, 5, 6, 7, 8
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	4, 7
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	1, 4, 7
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	1, 4, 7
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	1, 4, 7
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2, 3, 4, 5, 6, 7, 8
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2, 3, 4, 5, 6, 7, 8
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 4, 7
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 4, 7
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 4, 7
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 4, 7
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 4, 7
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2, 3, 4, 5, 6, 7, 8
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2, 3, 4, 5, 6, 7, 8

Bobcat - Multiple Dissolve Type Justification

There is a minimum core size of 10 ha for certain habitat types that must be met before that habitat will be valued by bobcat occurrence area data. A minimum core size for these habitats is required because bobcats need large contiguous patches of forested habitat for survival in NJ. Woolf et al (2002) reported that bobcats were sighted in areas that contained higher proportions of woods cover types than non-sighting areas. Fuller et al (1985) reported that bobcats in Minnesota had large home ranges (32-61 km2) using the minimum-convex-polygon method and used forested habitats almost exclusively.

In addition, only LU/LC class 2100 (cropland and pastureland) polygons less than 3 ha in size are included with the other chosen LU/LC classes to form the bobcat habitat patches that are available to be valued by bobcat occurrence area data in the Landscape Project mapping. Leopold (1995) and Fredrickson and Mack (1995) both reported that bobcats utilized agricultural lands although to a lesser degree than they used forested habitats. Leopold reported differential utilization of agricultural habitats by bobcats based on the nature of agriculture available on the study sites. Areas farmed using "modern" techniques where fields were tilled from fencerow to fencerow were used less than old fields, small pastures and hayfields that were not farmed as intensively. These agricultural habitats provided ample prey for bobcats (Leopold 1995). The ENSP conducted an analysis of LU/LC classes that occur within high probability areas as identified by the predictive habitat model for bobcats in NJ. The mean size of the agricultural LU/LC's that occurred in these areas was 2.56 ha. Therefore, it was decided that any cropland or pasturelands less than 3 ha would be included in the LU/LC classes that are available to be valued by bobcat occurrence area data (2, 3, 5, 6, 8).

Bobcat - Literature Citations

1. DeGraaf, R.M., M. Yamasaki, W.B. Leak, and J.W. Lanier. 1989. New England wildlife: management of forested habitats. Gen. Tech. Rep. NE-144. Radnor, PA: US Department of Agriculture, Forest Service, Northeast Forest Experiment Station. 271 p.

2. Fredrickson, L.F., and J.L. Mack. 1995. Mortality, home ranges, movements, and habitat preferences of South Dakota bobcats. Fed. Aid Proj. W-75-R-33,34,35 and 36. 97pp.

3. Fuller, T.K., W.E. Berg, and D.W. Kuehn. 1985. Bobcat home range size and daytime cover-type use in northcentral Minnesota. Journal of Mammology. 66(3):568-571.

4. Lariviere, S., and L.R. Walton. 1997. Lynx rufus. Amer. Soc. Mammologists. Mammalian Species No. 563. 8pp.

5. Leopold, B.D. 1995. Ecology of the bobcat (Felis rufus) within a forest management system. Fed. Aid Proj. No. W-48, Study 29. 148pp.

6. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 12, 2006)

7. Schantz, K., and M. Valent. 2003. Bobcat, Felis rufus. In: Beans, B.E. and Niles L. (Eds.), Endangered and Threatened Wildlife of New Jersey. Rutgers Univ. Press, New Brunswick, NJ and London, UK, pp. 23-29.

8. Woolf, A., C.K. Nielsen, T. Weber, and T.J. Gibbs-Kieninger. 2002. Statewide modeling of bobcat, Lynx rufus, habitat in Illinois, USA. Biol. Cons. 104, 191-198.

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Eastern Small-footed Myotis - For an explanation of Patch Type "B", refer to Page 17.				
1419	WATER	BRIDGE OVER WATER	N/A	*
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	*
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	*
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	*
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	*
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	*
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	*
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	*
4230	FOREST	PLANTATION	N/A	*
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	*
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	*
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	*
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	*
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	*
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	*
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	*
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	*
5100	WATER	STREAMS AND CANALS	N/A	*
5200	WATER	NATURAL LAKES	N/A	*
5300	WATER	ARTIFICIAL LAKES	N/A	*
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	*
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	*
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	*
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	*
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	*
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	*
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	*
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	*
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	*
7300	BARREN LAND	EXTRACTIVE MINING	N/A	*

Eastern Small-footed Myotis - Literature Citations
* ENSP biologist expert opinion - M. Craddock

Indiana Bat - For an explanation of Patch Type "B", refer to Page 17.				
1419	WATER	BRIDGE OVER WATER	N/A	1
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	1
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	1
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	2, 4
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	2, 4
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	2, 4
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	7
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	7
4230	FOREST	PLANTATION	N/A	*
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	7
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	7
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	2
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	2
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	5, 6
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	*
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	*
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	*
5100	WATER	STREAMS AND CANALS	N/A	2, 4
5200	WATER	NATURAL LAKES	N/A	5, 6
5300	WATER	ARTIFICIAL LAKES	N/A	5, 6
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	7
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	*
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	*

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Indiana Bat - For an explanation of Patch Type "B", refer to Page 17.				
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	*
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	4
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	7
7300	BARREN LAND	EXTRACTIVE MINING	N/A	3

Indiana Bat - Literature Citations

1. Humphrey, S.R., A. R. Richter, and J. B. Cope. 1977. Summer habitat and ecology of the endangered Indiana bat, *Myotis sodalis*. Journal of Mammalogy, 58:334-346.

2. Callahan, E.V., R. D. Drobney, and R. L. Clawson. 1997. Selection of summer roosting sites by Indiana bats (Myotis sodalis) in Missouri. Journal of Mammalogy, 78(3):818-825.

3. Humphrey, S.R. 1978. Status, winter habitat, and management of the endangered Indiana bat, Myotis sodalis. Florida Scientist, 41(2):65-76.

4. Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1991a. Summer roost selection and roosting behavior of Myotis sodalis (Indiana bat) in Illinois. Final Report. Illinois Natural History Survey, Illinois Dept. of Conservation. Champaign, Illinois. 56pp.

5. US Fish and Wildlife Service, 1999. Indiana bat revised recovery plan. Agency Draft. USFWS, Ft. Snelling, Minnesota.

6. Gardner, J.E., J.D. Garner, and J.E. Hofmann. 1991b. Summary of Myotis sodalis summer habitat studies in Illinois: with recommendations for impact assessment. Special Report. Illinois Natural History Survey, Illinois Dept. of Conservation. Champaign, Illinois. 28pp.

7. Britzke, E.R., M. J. Harvey, and S.C. Loeb. 2003. Indiana bat, Myotis sodalis, maternity roosts in the southern United States. Southeastern Naturalist 2:235-242.

* ENSP biologist expert opinion - M. Craddock

Birds

American Bittern - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	*
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	*
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	*
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	RIPARIAN	*
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	RIPARIAN	*
5200	WATER	NATURAL LAKES	N/A	1, 2
5300	WATER	ARTIFICIAL LAKES	N/A	1, 2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	*
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	N/A	1, 2
7300	BARREN LAND	EXTRACTIVE MINING	N/A	*

American Bittern - Riparian Justification

American bitterns forage in emergent marshes (Sibley 2000). The areas surrounding these water bodies can play an important role in breeding and predator evasion behaviors (Gibbs 1992). The above "upland" LU/LC classes were included only when they were within the riparian habitat layer, since otherwise these habitat classes go unused by these species. These classes were chosen to include known wetlands where American bittern occur that would otherwise not be mapped because the wetland sizes are smaller than the minimum mapping unit of the 2002 LU/LC (i.e., 2.0 acres) (1, 2).

American Bittern - Literature Citations

1. Gibbs, J. P. , S. Melvin, and F. A. Reid. 1992. American Bittern. In The Birds of North America, No. 18 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 10, 2006).

3. Sibley, D.A. (2000). National Audubon Society: The Sibley Guide to Birds. New York: Alfred A. Knopf.

* ENSP biologist expert opinion - D. Jenkins

American Kestrel - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	1
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	1
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	1
1800	URBAN	RECREATIONAL LAND	N/A	1

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
American Kestrel - For an explanation of Patch Type "B", refer to Page 17.				
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	1
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	1
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	1
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	1
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	1
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	1
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1
7400	BARREN LAND	ALTERED LANDS	N/A	1
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	1

American Kestrel - Literature Citation

1. Smallwood, J. A. and D. M. Bond. 2002. American Kestrel: Falco sparverius. In A. Poole and F. Gill (eds.), Birds of North America 602:1-32.

Bald Eagle - For an explanation of Patch Type "B", refer to Page 17.				
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, *
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, *
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1, *
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	1, *
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2, 4
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2, 4, 5
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2, 4
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2, 3, 4, 5
4230	FOREST	PLANTATION	N/A	1, 2
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2, 4, 5
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2, 3
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2, 4
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2, 4, 5
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2, *
4411	FOREST	PHRAGMITES DOMINATE OLD FIELD	N/A	1, 2, *
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	1, 2, *
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	1, 2, *
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	1, 2, *
5100	WATER	STREAMS AND CANALS	N/A	1, 2
5200	WATER	NATURAL LAKES	N/A	1, 2, 6
5300	WATER	ARTIFICIAL LAKES	N/A	1, 2, 6
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2, 6
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2, 4
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2, 3, 4, 5
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 2, 4, 5
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 2, *
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 2, *
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2, 4, 5
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2, 3, 4, 5

Bald Eagle - Literature Citations

1. Buehler, D. A. 2000. Bald Eagle (Haliaeetus leucocephalus). In The Birds of North America, No. 506 (A. Poole and F. Gill, eds.). The Birds of North America Inc., Philadelphia, PA.

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Bald Eagle - Literature Citations				
2. Stalmaster, M. V. 1987. The Bald Eagle. Universe Books, New York. 227 p.				
3. Buehler, D. A., et al. 1991. Winter microclimate of bald eagle roosts on the northern Chesapeake Bay. Auk 108:612-618				
4. Bowerman, W. W., T. G. Grubb, J. P. Giesy, A. J. Bath, and G. A. Dawson. 1993. Population composition and perching habitat of wintering Bald Eagles in northcentral Michigan. Canadian Field Naturalist 107: 273- 278				
5. Buehler, D. A., T. J. Mersmann, J. D. Fraser, J. K. D. Seegar. 1991. Nonbreeding Bald Eagle communal and solitary roosting behavior and habitat use on the northern Chesapeake Bay. J. Wildl. Manage. 55:273-281.				
6. Chandler, S. K., J. D. Fraser, D. A. Buehler, J. K. D. Seegar. 1995. Perch trees and shoreline development as predictors of Bald Eagle distribution on Chesapeake Bay. J. Wildl. Manage. 59: 325–332				
* ENSP biologist expert opinion - K. Clark				

Barred Owl - For an explanation of Patch Type "G", refer to Page 18.				
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	1, 2
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2, 3
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2, 3
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4230	FOREST	PLANTATION	N/A	3
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2, 3
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2, 3
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	*
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	*
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	*
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	3
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	3
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	3
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	3
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	3
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2

Barred Owl - Literature Citations
1. Bosakowski, Thomas, Robert Speiser, and John Benzinger. 1987. Distribution, density, and habitat relationships of the Barred Owl in northern New Jersey in USDA Forest Service General Technical Report RM-142: Biology and Conservation of Northern Forest Owls Symposium, Winnipeg, Manitoba.
2. Laidig, Kim J. and David S. Dobkin. 1995. Spatial overlap and habitat associations of Barred Owls and Great Horned Owls in southern New Jersey. Journal of Raptor Research. 29(3):151-157.
3. Mazur, K. M., and P. C. James. 2000. Barred Owl (Strix varia). In The Birds of North America, No. 508 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
4. Nicholls, Thomas H. and Dwain W. Warner. 1972. Barred Owl habitat use as determined by radiotelemetry. Journal of Wildlife Management. 36(2):213-224.
* ENSP biologist expert opinion - K. Schantz

Black Rail - For an explanation of Patch Type "B", refer to Page 17.				
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2

Black Rail - Literature Citations
1. Eddleman, W. R., R. E. Flores, and M. L. Legare. 1994. Black Rail (Laterallus jamaicensis). In The Birds of North America, No. 123 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.
2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 10, 2006).

Black-crowned Night-heron - For an explanation of Patch Type "D", refer to Page 17.				
1741	URBAN	PHRAGMITES DOMINATE URBAN AREA	N/A	1, 2
1850	WETLANDS	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	N/A	*

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Black-crowned Night-heron - For an explanation of Patch Type "D", refer to Page 17.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4230	FOREST	PLANTATION	N/A	*
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 2
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	N/A	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	*

Black-crowned Night-heron - Literature Citations

1. Davis, W. E., Jr. 1993. Black-crowned Night-Heron (Nycticorax nycticorax). In The Birds of North America, No. 74 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 10, 2006).

* ENSP biologist expert opinion - D. Jenkins

Black-crowned Night-heron Forage - For an explanation of Patch Type "D", refer to Page 17.				
1499	URBAN	STORMWATER BASIN	N/A	1, 2
1741	URBAN	PHRAGMITES DOMINATE URBAN AREA	RIPARIAN	1, 2
1850	WETLANDS	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	RIPARIAN	1, 2
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	RIPARIAN	*
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	RIPARIAN	*
5100	WATER	STREAMS AND CANALS	N/A	1, 2
5200	WATER	NATURAL LAKES	N/A	1, 2
5300	WATER	ARTIFICIAL LAKES	N/A	1, 2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	RIPARIAN	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	RIPARIAN	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	RIPARIAN	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	RIPARIAN	1, 2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	RIPARIAN	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	RIPARIAN	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	RIPARIAN	1, 2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	*

Black-crowned Night-heron - Riparian Justification

Long-legged wading birds (e.g., herons and egrets) forage exclusively in aquatic or wetlands habitats (Sibley 2000). The primary foraging tactic of this suite of species is to stand still (or slowly wade) in the water or along the shoreline and attack prey items with a swift stab of their bill. Foraging birds nearly always enter the water from the adjacent land as opposed to landing in the water, which would create a disturbance that would undermine the stealth they use while foraging. In addition, land areas immediately adjacent to water bodies are often used as resting and roosting habitats whereas land areas of the same classification not adjacent to water bodies would not be used. Therefore, for these species, we included the above LU/LC classes only when they were included in the riparian habitat layer (1, 2).

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Black-crowned Night-heron Forage - Literature Citations				
1. Davis, W. E., Jr. 1993. Black-crowned Night-Heron (Nycticorax nycticorax). In The Birds of North America, No. 74 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.				
2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 10, 2006).				
3. Sibley, D.A. (2000). National Audubon Society: The Sibley Guide to Birds. New York: Alfred A. Knopf.				
* ENSP biologist expert opinion - D. Jenkins				

Black-throated Green Warbler - For an explanation of Patch Type "B", refer to Page 17.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	2
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	2
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	2
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	2
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	2
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	1, 2
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2

Black-throated Green Warbler - Literature Citations
1. Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. Birds of New Jersey. New Jersey Audubon Society.
2. Morse, D. H. and A. F. Poole (2005). Black-throated Green Warbler (Dendroica virens). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Laboratory of Ornithology.

Bobolink - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	1, 2
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	1
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	1
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, 2
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, 2
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	2
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	1, 2
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	1, 2
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	2
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	2
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
7400	BARREN LAND	ALTERED LANDS	N/A	2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	1

Bobolink - Literature Citations
1. Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 1999 (revised 2001). Effects of management practice on grassland birds: Bobolink. Northern Prairie Wildlife Research Center, Jamestown, ND. 24 pages.
2. Martin, S. G. and T. A. Gavin. 1995. Bobolink (Dolichonyx oryziorus. In The Birds of North America, No. 176 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Canada Warbler - For an explanation of Patch Type "B", refer to Page 17.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	1, 2
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	1, 2
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2

Canada Warbler - Literature Citations

1. USFWS, March 2001. Canada Warbler Habitat Model. http://www.fws.gov/r5gomp/gom/habitatstudy/metadata/Canada_warbler_model.htm

2. Conway, C. J. 1999. Canada Warbler (Wilsonia canadensis). In The Birds of North America, No. 421 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Cerulean Warbler - For an explanation of Patch Type "B", refer to Page 17.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1

Cerulean Warbler - Literature Citations

1. Hamel, P. B. 2000. Cerulean Warbler (Dendroica cerulean). In The Birds of North America, No. 511 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Cliff Swallow - For an explanation of Patch Type "B", refer to Page 17.				
1419	WATER	BRIDGE OVER WATER	N/A	1
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	1
5100	WATER	STREAMS AND CANALS	N/A	1
5200	WATER	NATURAL LAKES	N/A	1
5300	WATER	ARTIFICIAL LAKES	N/A	1

Cliff Swallow - Literature Citations

1. Brown, C.R., and M.B. Brown. 1995. Cliff swallow (Petrochelidon pyrrhonota). In The Birds of North America, No. 149 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, D.C.

Cooper's Hawk - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	1
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	4, *
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	2
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1
4230	FOREST	PLANTATION	N/A	1, 2

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Cooper's Hawk - For an explanation of Patch Type "B", refer to Page 17.				
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	3
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	3
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	3
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	3
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 3
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 3
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	4, *
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	4, *
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	4, 5
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	4, *
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 3
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 3

Cooper's Hawk - Literature Citations

1. Liguori, Sherry. 2003. Cooper's Hawk (Accipiter cooperii). In Endangered and Threatened Wildlife of New Jersey (B. Beans and L. Niles, eds.). Rutgers University Press, New Brunswick, New Jersey. Pp 56 – 61.

2. Curtis, O. E. and R. N. Rosenfield (2006). Cooper's Hawk. (Accipiter cooperii). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Laboratory of Ornithology; Retrieved from The Birds of North American Online database: http://bna.birds.cornell.edu/BNA/account/Coopers_Hawk/.

3. NatureServe. 2006. "NatureServe Explorer: An Online Encyclopedia of Life." Available: http://www.natureserve.org/explorer/ [Date visited: 07/10/06].

4. Mannan, R. William and Clint W. Boal. 2000. Home range characteristics of male Cooper's hawks in an urban environment. Willson Bulletin. 112(1):21-27.

* ENSP biologist expert opinion - K. Schantz

Eastern Meadowlark - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	2
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	2
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	2
1800	URBAN	RECREATIONAL LAND	N/A	2
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, 2
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, 2
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1, 2
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	2
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	2
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	1, 2
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	2
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	2
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	2
7400	BARREN LAND	ALTERED LANDS	N/A	1
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	2

Eastern Meadowlark - Literature Citations

1. Hull, S. D. 2000 (revised 2002). Effects of management practice on grassland birds: Eastern Meadowlark. Northern Prairie Wildlife Research Center, Jamestown, ND. 35 pages.

2. Lanyon, W. E. 1995. Eastern Meadowlark (Sturnella magna). In The Birds of North America, No. 160 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Golden Winged Warbler - For an explanation of Patch Type "E", see Page 18.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	SECONDARY	1, 2, 4, 5, 6, 7
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	SECONDARY	1, 2, 4, 5, 6, 7
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	SECONDARY	1, 2, 4, 5, 6, 7
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	SECONDARY	1, 2, 4, 5, 6, 7
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	PRIMARY	1, 2, 4, 5, 6, 7
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	PRIMARY	1, 2, 4, 5, 6, 7
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	PRIMARY	1, 2, 4, 5, 6, 7
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	PRIMARY	1, 2, 4, 5, 6, 7
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	PRIMARY	1, 2, 4, 5, 6, 7
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	PRIMARY	1, 2, 4, 5, 6, 7
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	PRIMARY	1, 2, 4, 5, 6, 7
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	PRIMARY	1, 2, 4, 5, 6, 7
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	SECONDARY	1, 2, 4, 5, 6, 7
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	SECONDARY	1, 2, 4, 5, 6, 7
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	SECONDARY	1, 2, 4, 5, 6, 7
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	SECONDARY	1, 2, 4, 5, 6, 7
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	SECONDARY	1, 2, 4, 5, 6, 7
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	SECONDARY	1, 2, 4, 5, 6, 7
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	SECONDARY	1, 2, 4, 5, 6, 7
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	SECONDARY	1, 2, 4, 5, 6, 7
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	SECONDARY	1, 2, 4, 5, 6, 7
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	SECONDARY	1, 2, 4, 5, 6, 7
6240	WETLANDS	HERBACEOUS WETLANDS	SECONDARY	1, 2, 4, 5, 6, 7
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	SECONDARY	1, 2, 4, 5, 6, 7
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	SECONDARY	1, 2, 4, 5, 6, 7

Golden-winged Warbler - Multiple Dissolve Type Justification

All coniferous, deciduous, and mixed forest LULC types, except wooded wetlands, within 20 meters of core GWWA habitat will be valued by occurrence data. Wooded wetlands are included as GWWA core habitat because of the shrubby understory that is associated with these areas (Confer 1992, Confer and Pascoe unpublished, Confer et al. 2003). Although the core of GWWA habitat consists of components of scrub-shrub habitat, the forest edge is a vital component to their breeding habitat and individual territories can extend 5 – 30 meters into the forest (Confer 1992, Confer and Pascoe unpublished, Confer et al. 2003). For this reason, certain forest LULC types will be valued if they are within 20 meters of core habitat valued by the occurrence (2, 3, 4).

Golden-winged Warbler - Literature Citations

1. Confer, J. 1992. Vermivora chrysoptera: Golden-winged Warbler. In A. Poole and F. Gill (eds.), Birds of North America 20:1-15.

2. Confer, J. and S. Pascoe. Unpublished. The avian community on utility rights-of-ways and other managed shrublands in northeastern United States.

3. Confer, John L. 1992. Golden-winged Warbler. In The Birds of North America, No. 20 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

4. Confer, J. L, G. Hammerson, and D.W. Mehlman. 1992. Species management abstract (element stewardship abstract) for Golden-winged Warbler (Vermivora chrysoptera). The Nature Conservancy, Arlington, VA.

5. Confer, J., J. Larkin, and P. Allen. 2003. Effects of vegetation, interspecific competition, and brood parasitism on Golden-winged Warbler nesting success. Auk 120(1):138-144.

6. Hunter, W. C., D. A. Buehler, R. A. Canterbury, J. L. Confer, and P. B. Hamel. 2001. Conservation of disturbance-dependent birds in eastern North America. Wilson Bulletin 29(2)440-455.

7. Reed, R. 2001. Song perch characteristics of Golden-winged Warblers in a mountain wetland. Wilson Bulletin 113(2):246-248.

Grasshopper Sparrow - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	3
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	3
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	3
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, 2, 3
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, 2, 3
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1, 2, 3
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	3
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	3
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	3
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2, 3
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	3
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	3

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Grasshopper Sparrow - For an explanation of Patch Type "B", refer to Page 17.				
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	3
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	3
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	3
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	3
7400	BARREN LAND	ALTERED LANDS	N/A	3
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	3

Grasshopper Sparrow - Literature Citations

1. Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 1998 (revised 2002). Effects of management practice on grassland birds: Grasshopper Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. 28 pages.

2. Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

3. Vickery, P. D. 1996. Grasshopper Sparrow (Ammodramus savannarum). In The Birds of North America, No. 239 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Great Blue Heron - For an explanation of Patch Type "D", refer to Page 17.				
1741	URBAN	PHRAGMITES DOMINATE URBAN AREA	N/A	*
1850	WETLANDS	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	N/A	*
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4230	FOREST	PLANTATION	N/A	*
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 2
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	N/A	*
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	*

Great Blue Heron - Literature Citations

1. Butler, R. W. 1992. Great Blue Heron. In The Birds of North America, No. 25 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 10, 2006).

* ENSP biologist expert opinion - D. Jenkins

Great Blue Heron Forage - For an explanation of Patch Type "D", refer to Page 17.				
1499	URBAN	STORMWATER BASIN	N/A	1, 2
1741	URBAN	PHRAGMITES DOMINATE URBAN AREA	RIPARIAN	1, 2
1850	WETLANDS	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	RIPARIAN	*
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	RIPARIAN	*
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	RIPARIAN	*
5100	WATER	STREAMS AND CANALS	N/A	1, 2
5200	WATER	NATURAL LAKES	N/A	1, 2
5300	WATER	ARTIFICIAL LAKES	N/A	1, 2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	RIPARIAN	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	RIPARIAN	1, 2

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Great Blue Heron Forage - For an explanation of Patch Type "D", refer to Page 17.				
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	RIPARIAN	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	RIPARIAN	1, 2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	RIPARIAN	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	RIPARIAN	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	RIPARIAN	1, 2

Great Blue Heron Forage - Riparian Justification

Long-legged wading birds (e.g., herons and egrets) forage exclusively in aquatic or wetlands habitats (Sibley 2000). The primary foraging tactic of this suite of species is to stand still (or slowly wade) in the water or along the shoreline and attack prey items with a swift stab of their bill. Foraging birds nearly always enter the water from the adjacent land as opposed to landing in the water, which would create a disturbance that would undermine the stealth they use while foraging. In addition, land areas immediately adjacent to water bodies are often used as resting and roosting habitats whereas land areas of the same classification not adjacent to water bodies would not be used. Therefore, for these species, we included the above LU/LC classes only when they were included in the riparian habitat layer (1, 2).

Great Blue Heron Forage - Literature Citations

1. Butler, R. W. 1992. Great Blue Heron. In The Birds of North America, No. 25 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 10, 2006).

3. Sibley, D.A. (2000). National Audubon Society: The Sibley Guide to Birds. New York: Alfred A. Knopf.

* ENSP biologist expert opinion - D. Jenkins

Henslow's Sparrow - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	2
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	2
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	2
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, 2, 3
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, 2, 3
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	2
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2, 3
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	2

Henslow's Sparrow - Literature Citations

1. Herkert, J. R. 1998 (revised 2002). Effects of management practice on grassland birds: Henslow's Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. 17 pages.

2. Herkert, J. R., P. D. Vickery, and D. E. Kroodsma. 2002. Henslow's Sparrow (Ammodramus henslowii). In The Birds of North America, No. 672 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

3. Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

King Rail - For an explanation of Patch Type "B", refer to Page 17.				
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2

King Rail - Literature Citations

1. Poole, A. F., L. R. Bevier and C. A. Marantz. (2005). King Rail (Rallus elegans). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Laboratory of Ornithology; Retrieved from The Birds of North American Online database: http://bna.birds.cornell.edu/BNA/account/King_Rail

2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 10, 2006).

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Least Bittern - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	*
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	*
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	*
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	RIPARIAN	*
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	RIPARIAN	*
5200	WATER	NATURAL LAKES	N/A	1, 2
5300	WATER	ARTIFICIAL LAKES	N/A	1, 2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	N/A	1, 2
7300	BARREN LAND	EXTRACTIVE MINING	N/A	*

Least Bittern - Riparian Justification

Least bitterns forage in emergent marshes (Sibley 2000). The areas surrounding these water bodies can play an important role in breeding and predator evasion behaviors (Gibbs 1992). The above "upland" LU/LC classes were included only when they were within the riparian habitat layer, since otherwise these habitat classes go unused by these species. These classes were chosen to include known wetlands where Least bittern occur that would otherwise not be mapped because the wetland sizes are smaller than the minimum mapping unit of the 2002 LU/LC (i.e., 2.0 acres) (ENSP Biologist expert opinion).

Least Bittern - Literature Citations

1. Gibbs, J. P., F. A. Reid, and S. M. Melvin. 1992. Least Bittern. In The Birds of North America, No. 17 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 10, 2006).

3. Sibley, D.A. (2000). National Audubon Society: The Sibley Guide to Birds. New York: Alfred A. Knopf.

* ENSP biologist expert opinion - D. Jenkins

Long-eared Owl - For an explanation of Patch Type "B", refer to Page 17.				
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1

Long-eared Owl - Literature Citations

1. Marks, J.S. D.L. Evans, and D.W. Holt. 1994. Long-eared owl (Asio otus). In The Birds of North America, No. 133 (A. Poole and F. Gill, Eds.). Philadelphia: The Acedemy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

Migrant Loggerhead Shrike - For an explanation of Patch Type "B", refer to Page 17.				
1140	URBAN	RESIDENTIAL, RURAL, SINGLE UNIT	N/A	3
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	3
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	3
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	3
1710	URBAN	CEMETERY	N/A	3
1711	WETLANDS	CEMETERY ON WETLAND	N/A	3
1750	WETLANDS	MANAGED WETLAND IN MAINTAINED LAWN GREENSPACE	N/A	3
1800	URBAN	RECREATIONAL LAND	N/A	3
1850	WETLANDS	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	N/A	3
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, 2, 3
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, 2, 3
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1, 2, 3
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	3
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	3
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	3
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2, 3
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2, 3
4230	FOREST	PLANTATION	N/A	1, 2, 3

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Migrant Loggerhead Shrike - For an explanation of Patch Type "B", refer to Page 17.				
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	3
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	3
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2, 3
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	1, 2, 3
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	1, 2, 3
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	1, 2, 3
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	3
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	3
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 2, 3
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 2, 3
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 2, 3
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 2, 3
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2, 3
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	3
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	3
7400	BARREN LAND	ALTERED LANDS	N/A	3
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	3

Migrant Loggerhead Shrike - Literature Citations

1. Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, M. P. Nenneman, A. L. Zimmerman, and B. R. Euliss. 1998 (revised 2002). Effects of management practices on grassland birds: Loggerhead Shrike. Northern Prairie Wildlife Research Center, Jamestown, ND. 19 pages.

2. Pruitt, L. 2000. Loggerhead Shrike Status Assessment. USFWS, Bloomington, IN.

3. Yosef, . Loggerhead Shrike: Lanius ludovicianus. In A. Poole and F. Gill (eds.), Birds of North America 231:1-28.

Northern Goshawk - For an explanation of Patch Type "B", refer to Page 17.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	4
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	4
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4230	FOREST	PLANTATION	N/A	1
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	4
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	4
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	3
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	3
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	3
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	3
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	3
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	3

Northern Goshawk - Literature Citations

1. Squires, J. R., and R. T. Reynolds. 1997. Northern Goshawk (Accipiter gentilis). In The Birds of North America, No. 298 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

2. Bosakowsky, Thomas and Robert Speiser. 1994. Macrohabitat Selection by Nesting Northern Goshawks: Implications for Managing Eastern Forests. Studies in Avian Biology. 16:46-49.

3. Liguori, Sherry. 2003. Northern Goshawk (Accipiter gentilis). In Endangered and Threatened Wildlife of New Jersey (B. Beans and L. Niles, eds.). Rutgers University Press, New Brunswick, New Jersey. Pp 50 – 56.

Northern Harrier - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	2
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	1, 2
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	1, 2
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, 2
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, 2
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1, 2
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	2
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	2
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	2

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Northern Harrier - For an explanation of Patch Type "B", refer to Page 17.				
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2
4411	FOREST	PHRAGMITES DOMINATE OLD FIELD	N/A	1, 2
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	2
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	2
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	N/A	1, 2
7400	BARREN LAND	ALTERED LANDS	N/A	2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	2
7500	BARREN LAND	TRANSITIONAL AREAS	N/A	2

Northern Harrier - Literature Citations

1. Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, M. P. Nenneman, and B. R. Euliss. 1998 (revised 2002). Effects of management practices on grassland birds: Northern Harrier. Northern Prairie Wildlife Research Center, Jamestown, ND. 15 pages.

2. MacWhirter, R. B., and K. L. Bildstein. 1996. Northern Harrier (Circus cyaneus). In The Birds of North America, No. 210 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Osprey - For an explanation of Patch Type "B", refer to Page 17.				
5100	WATER	STREAMS AND CANALS	N/A	1, 2
5200	WATER	NATURAL LAKES	N/A	1, 2
5300	WATER	ARTIFICIAL LAKES	N/A	1, 2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2

Osprey - Literature Citations

1. Poole, A. F., R. Bierregaard, and M. S. Martell. 2002. Osprey (Pandion haliaetus). In The Birds of North America, No. 683 (A. Poole and F. Gill, eds.). The Birds of North America Inc., Philadelphia, PA.

2. Poole, A. F. 1989. Ospreys: a natural and unnatural history. Cambridge Univ. Press. Cambridge, U.K.

Pied-billed Grebe - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	*
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	*
5200	WATER	NATURAL LAKES	N/A	1, 2
5300	WATER	ARTIFICIAL LAKES	N/A	1, 2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	RIPARIAN	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	RIPARIAN	1 2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	RIPARIAN	*

Pied-billed Grebe - Riparian Justification

Due to the discreet nature and small size of some wetlands within the larger landscape context, the above LU/LC classes were included only when they were within the riparian habitat layer. This was done to accommodate small, unmapped pockets of emergent wetlands near areas of open water (i.e., suitable habitat) which are more likely to feature such pockets when they are associated with the riparian zone (1, 2).

Pied-billed Grebe - Literature Citations

1. Muller, M. J., and R. W. Storer. 1999. Pied-billed Grebe (Podilymbus podiceps). In The Birds of North America, No. 410 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer (Accessed: July 10, 2006).

* ENSP biologist expert opinion - D. Jenkins

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Red-headed Woodpecker - LU/LCs marked with a † are only valued by non-breeding sightings. For an explanation of Patch Type "F", refer to Page 18.				
1120	URBAN	RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY †	SECONDARY	2
1130	URBAN	RESIDENTIAL, SINGLE UNIT, LOW DENSITY †	SECONDARY	2
1140	URBAN	RESIDENTIAL, RURAL, SINGLE UNIT	SECONDARY	2
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	SECONDARY	2
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	SECONDARY	2
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	SECONDARY	2
1710	URBAN	CEMETERY	SECONDARY	2
1711	WETLANDS	CEMETERY ON WETLAND	SECONDARY	2
1750	WETLANDS	MANAGED WETLAND IN MAINTAINED LAWN GREENSPACE	SECONDARY	2
1800	URBAN	RECREATIONAL LAND	PRIMARY	2
1850	WETLANDS	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	SECONDARY	2
2100	AGRICULTURE	CROPLAND AND PASTURELAND	PRIMARY	2
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	PRIMARY	2
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	PRIMARY	2
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	PRIMARY	1, 2
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	SECONDARY	2
2400	AGRICULTURE	OTHER AGRICULTURE	SECONDARY	2
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	PRIMARY	1, 2
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	PRIMARY	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	PRIMARY	1, 2
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	PRIMARY	1, 2
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	PRIMARY	1, 2
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	PRIMARY	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	PRIMARY	1, 2
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	PRIMARY	1, 2
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	PRIMARY	1, 2
4500	FOREST	SEVERE BURNED UPLAND VEGETATION	PRIMARY	1, 2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	PRIMARY	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	PRIMARY	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	PRIMARY	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	SECONDARY	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	SECONDARY	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	SECONDARY	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	SECONDARY	1, 2
6240	WETLANDS	HERBACEOUS WETLANDS	PRIMARY	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	PRIMARY	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	PRIMARY	1, 2
7400	BARREN LAND	ALTERED LANDS	SECONDARY	1, 2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	SECONDARY	1, 2

Multiple Dissolve Type Justification - Red-headed Woodpecker

Red-headed woodpeckers use similar habitats in different ways during breeding and non-breeding seasons. Both habitat types vary from beaver wetlands to forest to pasture and recreational parks, but breeding habitat requires tree cavities for nesting and non-breeding habitat requires mast for the primary food source in the winter (Liguori 2003, Smith et al. 2000).

Preferred RHWO breeding habitat consists of deciduous woodlands in northern New Jersey and pine scrub, mixed pine, and hardwood forests in southern New Jersey (Liguori 2003, Smith et al. 2000). Because breeding territories have been located in urban areas with standing dead trees, and RHWO utilize forest edges during the breeding season (Smith et al. 2000), urban LULC types, such as rural residential (1140) and managed wetlands in recreational area (1850), were chosen to be valued provided they are adjacent to preferred breeding habitat.

Preferred RHWO wintering habitat is similar to the preferred breeding habitat. Because RHWO rely on mast and also use bird and suet feeders in the winter (Smith et al. 2000), low and medium density residential areas (1130 and 1120, respectively) will be valued provided they are adjacent to preferred habitat (1, 2).

Red-headed Woodpecker - Literature Citations

1. Liguori, S. 2003. Red-headed Woodpecker, Melanerpeserythrocephalus. In Endangered and Threatened Wildlife of New Jersey (B. Beans and L. Niles, eds.), pages 143 – 148. Rutgers University Press, New Brunswick, NJ.

2. Smith, K. G., J. H. Withgott, and P. G. Rodewald. 2000. Red-headed Woodpecker (Melanerpes erythrocephalus). In The Birds of North America, No. 518 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Red-shouldered Hawk - For an explanation of Patch Type "G", refer to Page 18.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	3
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	3
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	*
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	*
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4230	FOREST	PLANTATION	N/A	1, 2
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	*
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	*
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	*
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	*
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	*
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	*
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	*
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	*
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	*
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	*
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2

Red-shouldered Hawk - Literature Citations

1. Crocoll, S. T. (1994). Red-shouldered Hawk (Buteo lineatus). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Laboratory of Ornithology; Retrieved from The Birds of North American Online database: http://bna.birds.cornell.edu/BNA/account/Red-shouldered_Hawk.

2. Liguori, Sherry. 2003. Red-shouldered hawks (Buteo lineatus). In Endangered and Threatened Wildlife of New Jersey (B. Beans and L. Niles, eds.). Rutgers University Press, New Brunswick, New Jersey. Pp 61 – 67.

3. Bosakowsky, Thomas and Robert Speiser. 1994. Macrohabitat Selection by Nesting Northern Goshawks: Implications for Managing Eastern Forests. Studies in Avian Biology. 16:46-49.

* ENSP biologist expert opinion - K. Schantz

Savannah Sparrow - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	4
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	4
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	4
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, 2, 3
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, 2, 3
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1, 2, 3
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	4
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	4
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	4
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2, 3
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	4
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	4
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	4
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	4
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	4
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	4
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	4
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	4
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	4

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Savannah Sparrow - For an explanation of Patch Type "B", refer to Page 17.				
7100	BARREN LAND	BEACHES	N/A	4
7400	BARREN LAND	ALTERED LANDS	N/A	4
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	4

Savannah Sparrow - Literature Citations

1. Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

2. Swanson, D. A. 1998 (revised 2001). Effects of management practice on grassland birds: Savannah Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. 28 pages

3. Vickery, P. D., M. L. Hunter, Jr. and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4): 1087-1097.

4. Wheelwright, N. T. and J. D. Rising. 1993. Savannah Sparrow (Passerculus sandwichensis). In The Birds of North America, No. 45 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Sedge Wren - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	2
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	2
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	2
1850	WETLANDS	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	N/A	2
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, 2
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, 2
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1, 2
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	2
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	2
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	2
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
7400	BARREN LAND	ALTERED LANDS	N/A	2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	2

Sedge Wren - Literature Citations

1. Dechant, J. A., M. L. Sondreal, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 1998 (revised 2002). Effects of management practice on grassland birds: Sedge Wren. Northern Prairie Wildlife Research Center, Jamestown, ND. 17 pages.

2. Herkert, J. R., D. E. Kroodsma, and J. P. Gibbs. 2001. Sedge Wren (Cistothorus platensis). In The Birds of North America, No. 582 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Upland Sandpiper - For an explanation of Patch Type "C", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	3
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	3
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	3
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, 2, 3, 4
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	3
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	3
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2, 3, 4
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	3
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	3
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	3

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Upland Sandpiper - Multiple Dissolve Type Justification				
There is a minimum core size of 25 ha for certain habitat types that must be met before that habitat will be valued by UPSA occurrence area data. A minimum core size for these habitats is required because UPSAs need large contiguous patches of open habitat for survival in NJ. Minimum patch sizes varied greatly from 26 to 50 ha. Dechant et al. (2002) reported minimum area requirements of 30 ha in Illinois, 75 ha in southwest Missouri, and 50% incidence at 50 ha in Nebraska and Vickery et al. (1994) reported minimum area to be 200 ha in Maine. Mitchell et al. (2000) reported minimum areas to be at least 100 ha but found 50% incidence at 30-40 ha, but in New York, one study reported the minimum area to be 26 ha. Because of a high level of fragmentation in New Jersey, the smallest minimum patch size reported from the closest proximity was chosen (1, 2, 4).				

Upland Sandpiper - Literature Citations

1. Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 1999 (revised 2001). Effects of management practice on grassland birds: Upland Sandpiper. Northern Prairie Wildlife Research Center, Jamestown, ND. 33 pages.

2. Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

3. Houston, C. S. and D. E. Bowen, Jr. 2001. Upland Sandpiper (Bartramia longicauda). In The Birds of North America, No. 580 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

4. Vickery, P. D., M. L. Hunter, Jr. and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4): 1087-1097.

Veery - For an explanation of Patch Type "B", refer to Page 17.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2, 3
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2, 3
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2, 3
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2, 3
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2, 3
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2, 3
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	1, 2, 3
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	1, 2, 3
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2, 3
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 2, 3
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 2, 3
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 2, 3
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2, 3
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2, 3

Veery - Literature Citations

1. USFWS, February 2001. Veery Habitat Model. http://www.fws.gov/r5gomp/gom/habitatstudy/metadata/veery_model.htm.

2. Rosenberg, K., R. Hames, R. Rohrbaugh, S. Barker Swarthout, J. Lowe, and A. Dhondt. 2003. A land manager's guide to improving habitat for forest thrushes. The Cornell Lab of Ornithology.

3. Moskoff, 1995. Veery: Catharus fuscescens. In A. Poole and F. Gill (eds.), Birds of North America 142:1-16.

Vesper Sparrow - For an explanation of Patch Type "C", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	2
1462	URBAN	UPLAND RIGHTS-OF-WAY DEVELOPED	N/A	2
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	2
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1, 2, 3
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, 2, 3
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1, 2, 3
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	2
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	2
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1, 2, 3
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	2
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	2
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	2

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Vesper Sparrow - For an explanation of Patch Type "C", refer to Page 17.				
7400	BARREN LAND	ALTERED LANDS	N/A	2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	2

Vesper Sparrow - Multiple Dissolve Type Justification

There is a minimum core size of 5 ha for certain habitat types that must be met before that habitat will be valued by VESP occurrence area data. A minimum core size for these habitats is required because vesper sparrows need large contiguous patches of early-successional habitat for survival in NJ. Jones and Cornerly (2002) reported that VESPs used open areas in Ohio ranging from 5 – 15 ha. In Maine, VESPs reached 50% incidence at 20 ha (Vickery et al 1994). Other minimum patch sizes included 10 ha in Illinois and a range of 10-100 ha in Missouri (Mitchell et al. 2000). Furthermore, other studies have shown individual VESPs to have average territory sizes of 3 ha (see Dechant et al. 2002). Because of a high level of fragmentation in New Jersey, the smallest minimum patch size reported from the closest proximity was chosen (1, 2, 3, 4).

Vesper Sparrow - Literature Citations

1. Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 1999 (revised 2001). Effects of management practice on grassland birds: Vesper Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. 40 pages.

2. Jones, S. L. and J. E. Cornely. 2002. Vesper Sparrow (Pooecetes gramineus). In The Birds of North America, No. 624 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

3. Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

4. Vickery, P. D., M. L. Hunter, Jr. and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4): 1087-1097.

Winter Wren - For an explanation of Patch Type "B", refer to Page 17.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2

Winter Wren - Literature Citations

1. Hejl, S. J., J. A. Holmes, and D. E. Kroodsma. 2002. Winter Wren (Troglodytes troglodytes). In The Birds of North America, No. 632 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

2. Gould, D. Farr, B. Beck, J. Beck, and R. Bonar. 1999. Winter Wren Reproductive Habitat: Habitat suitability index model, Version 5. Foothills Model Forest. http://www.fmf.ca/HS/HS_report14.pdf.

Worm-eating Warbler - For an explanation of Patch Type "B", refer to Page 17.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	1
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	1
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Worm-eating Warbler - For an explanation of Patch Type "B", refer to Page 17.				
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1

Worm-eating Warbler - Literature Citations

1. Hanners, L. A. and S. R. Patton. 1998. Worm-eating Warbler (Helmitheros vermivorus). In The Birds of North America, No. 623 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Yellow-crowned Night-heron - For an explanation of Patch Type "D", refer to Page 17.				
1120	URBAN	RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	N/A	1, 2
1130	URBAN	RESIDENTIAL, SINGLE UNIT, LOW DENSITY	N/A	1, 2
1140	URBAN	RESIDENTIAL, RURAL, SINGLE UNIT	N/A	1, 2
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4230	FOREST	PLANTATION	N/A	*
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	RIPARIAN	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	RIPARIAN	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	RIPARIAN	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	RIPARIAN	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2

Yellow-crowned Night-heron - Literature Citations

1. Watts, B. D. 1995. Yellow-crowned Night-Heron (Nyctanassa violacea). In The Birds of North America, No. 161 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, D.C.

2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 10, 2006).

* ENSP biologist expert opinion - D. Jenkins

Yellow-crowned Night-heron Forage - For an explanation of Patch Type "D", refer to Page 17.				
1741	URBAN	PHRAGMITES DOMINATE URBAN AREA	RIPARIAN	1, 2
1850	WETLANDS	MANAAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	RIPARIAN	*
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	RIPARIAN	*
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	RIPARIAN	*
5100	WATER	STREAMS AND CANALS	N/A	1, 2
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	RIPARIAN	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	RIPARIAN	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	RIPARIAN	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	RIPARIAN	1, 2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	RIPARIAN	*
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	RIPARIAN	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	RIPARIAN	1, 2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	1, 2

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE

Yellow-crowned Night-heron Forage - Riparian Justification

Long-legged wading birds (e.g., herons and egrets) forage exclusively in aquatic or wetlands habitats (Sibley 2000). The primary foraging tactic of this suite of species is to stand still (or slowly wade) in the water or along the shoreline and attack prey items with a swift stab of their bill. Foraging birds nearly always enter the water from the adjacent land as opposed to landing in the water, which would create a disturbance that would undermine the stealth they use while foraging. In addition, land areas immediately adjacent to water bodies are often used as resting and roosting habitats whereas land areas of the same classification not adjacent to water bodies would not be used. Therefore, for these species, we included the above LU/LC classes only when they were included in the riparian habitat layer.

Yellow-crowned Night-heron Forage - Literature Citations

1. Davis, W. E., Jr. 1993. Black-crowned Night-Heron (Nycticorax nycticorax). In The Birds of North America, No. 74 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

2. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 10, 2006).

3. Sibley, D.A. (2000). National Audubon Society: The Sibley Guide to Birds. New York: Alfred A. Knopf.

* ENSP biologist expert opinion - D. Jenkins

Reptiles

Bog Turtle - For an explanation of Patch Type "B", refer to Page 17.

1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	*
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 2
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	*

Bog Turtle - Mapping Methodology Justification

The Bog Turtle, *Glyptemys muhlenbergii*, is a Federally Threatened, State Endangered habitat specialist that occupies wetlands with certain vegetative, soil, and hydrological characteristics. The life history of the bog turtle is somewhat unique in that it spends the majority of the year within the wetland complex and often does not venture for long periods of time into the adjacent uplands. Therefore, identifying wetlands that support bog turtles is critical in maintaining the integrity of the populations in the state.

In 2001, the USFWS released the Bog Turtle Northern Population Recovery Plan. The primary threats to the species survival include habitat alterations and loss and, notably, illegal collection for the wildlife trade. The unique nature of bog turtle habitat combined with the continued threat of illegal collecting influenced the methodology used to value habitat for the bog turtle in Landscape Project V. 3.

Leading up to adoption of the Recovery Plan the ENSP completed a series of habitat evaluations throughout the state in wetlands that bog turtles were known to occupy. First-hand observations and data collected in the field during subsequent mark/recapture, live-trapping, and/or radio-telemetry studies allowed biologists to delineate core habitat boundaries for the bog turtles at each site. These hand-digitized polygons were integrated into a GIS database and are referred to as Bog Turtle Colonies.

When developing a method to value habitat for Bog Turtle in Landscape Project V. 3 using the 2002 LU/LC it was intuitive that wetlands would play a large role in identifying and mapping critical habitat. Based upon the literature and first-hand experience by biologists, the above Level III LU/LC patches were initially selected to be valuable to this species.

An additional 200 meters is generated around the Bog Turtle Colony polygons to account for turtle movements not identified during fieldwork as well as habitat that is valuable to the colony, but was not identified by the biologists. This new polygon is called a Species Occurrence Area (SOA) and is described for the bog turtle in Appendix II. All of the above Wetland LU/LC classes from Table 1 are dissolved into patches of suitable bog turtle habitat. Patches which intersect the SOA are then valued for bog turtle.

Due to the discreet nature and small size of some bog turtle wetlands within the larger landscape context, an analysis of this preliminary mapping methodology revealed that habitat associated with entire bog turtle colonies was not being valued. Known wetlands where bog turtles occur were mapped as non-Wetland land cover types because the wetland sizes are smaller than the minimum mapping unit of the 2002 LU/LC (i.e., 2.0 acres). In other cases, bog turtle colonies exist in non-contiguous wetlands and are therefore isolated (e.g., a small "island" wetland surrounded by uplands) to a point where all the remaining wetlands comprise the entirety of the bog turtle colony. Because illegal collection is still a major threat to this species, the ENSP and the USFWS were concerned that such mapping would reveal exact location information that could be mis-used by collectors.

To address the issue of habitat not being identified and the cases where core bog turtle colonies were the only wetlands identified two approaches were taken to map this species. 1) In addition to any of the Wetland Level III LU/LC classes initially chosen, biologists hand-selected Level III LU/LC patches within the boundaries of core bog turtle colony polygons to ensure known wetlands were valued in cases where the habitat was mapped as a non-Wetland type. 2) In addition to any of the Wetland Level III LU/LC classes initially chosen, biologists hand-selected Level III LU/LC patches within, or adjacent to the SOA to mask the precise location of the bog turtle colony. In both cases, the use of this methodology can include non-Wetlands LU/LC types that are known to not actually be providing habitat to the population of bog turtles represented by the SOA.

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Bog Turtle - Literature Citations				
1. Chase, J.D., K.R. Dixon, J.E. Gates, D. Jacobs, and G.J. Taylor. 1989. Habitat Characteristics, Population Size, and Home Range of the Bog Turtle, Clemmys muhlenbergii, in Maryland. Journal of Herpetology 23(4): 356-362.				
2. Morrow, J.L., J.H. Howard, S.A. Smith, and D.K. Poppel. 2001. Home Range and Movements of the Bog Turtle in Maryland. Journal of Herpetology 35(1): 68-73.				
* ENSP biologist expert opinion - B. Zarate				

Eastern Box Turtle - For an explanation of Patch Type "E", refer to Pages 18.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	SECONDARY	2, 4
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	SECONDARY	2, 4
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	SECONDARY	2, 4
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	PRIMARY	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	PRIMARY	1, 2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	PRIMARY	1, 2
6240	WETLANDS	HERBACEOUS WETLANDS	PRIMARY	1, 2

Eastern Box Turtle - Multiple Dissolve Type Justification

The eastern box turtle, Terrapene c. carolina, is New Jersey's most terrestrial turtle. As such, it relies on a variety of habitat types to successfully complete its life cycle. There is a preference for ecotone areas and valued LU/LC types attempt to reflect the diverse habitats the species is known to occur in and those the literature suggests are valuable.

Analyzing the state's current distribution of precise records for box turtle determined a large percentage are from wetland areas, although woodlands are well recognized as being a preferred habitat type. In order to capture the state's existing records and include the upland covers that the species routinely occupies, various wetland types tangent to scrub/shrub and hardwood forests were chosen as the species core and adjacent cover types (1, 3, 5).

Eastern Box Turtle - Literature Citations

1. Delia R.J. Kaye, Kevin M. Walsh, and Christopher M. Ross, "Seasonal movements and habitat preferences for the spotted turtle and eastern box turtle in Massachusetts" (September 24, 2001). Road Ecology Center. Paper Kaye2001a. http://repositories.cdlib.org/jmie/roadeco/Kaye2001a

2. Ernst, C. H., R. W. Barbour, and J. E. Lovich. 1994. Turtles of the United States and Canada. Smithsonian Institution Press, Washington, D.C., USA.

3. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 12, 2006)

4. Reagan, D.P. 1974. Habitat Selection in the Three-Toed Box Turtle, Terrapene Carolina triunguis.Copeia. 2: 512-527.

5. Stickel, L. F. 1950 Populations and home range relationships of the box turtle, Terrapene c. carolina (Linnaeus). Ecol. Monogr. 20: 351-378.

Northern Copperhead Snake - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	3, 4
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	3, 4
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4230	FOREST	PLANTATION	N/A	1, 2
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1, 2
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	4
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	4
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	4
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	4
4500	FOREST	SEVERE BURNED UPLAND VEGETATION	N/A	4
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	3
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	3
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 3
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 3
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 3
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 3
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	3
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	3

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Northern Copperhead Snake - For an explanation of Patch Type "B", refer to Page 17.				
7200	BARREN LAND	BARE EXPOSED ROCK, ROCK SLIDES, ETC.	N/A	1, 2

Literature Citations - Northern Copperhead Snake

1. Reinert, Howard K. 1984. Habitat Variation within Sympatric Snake Populations. Ecology 65(5): 1673-1682.

2. Reinert, Howard K. 1984. Habitat Separation between Sympatric Snake Populations. Ecology 65(2): 478-486.

3. University of Massachusetts-Amherst. 2006. "Natural Resources and Environmental Conservation: Snakes of Massachusetts, Copperheads." Available: http://www.umass.edu/umext/snake/copper.html [Date visited: 06/28/06].

4. Mitchell, Joseph C. 1994. Northern Copperhead (Agkistrodon contortrix mokasen). In The Reptiles of Virginia (S. Fansler, ed.). Smithsonian Institution Press, Washington and London. Pp. 285 – 291.

Timber Rattlesnake - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	*
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	*
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
4230	FOREST	PLANTATION	N/A	*
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1, 2
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	*
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	*
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	*
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	*
4500	FOREST	SEVERE BURNED UPLAND VEGETATION	N/A	5
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	*
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	*
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	2
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	*
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	2
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	*
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	2
7200	BARREN LAND	BARE EXPOSED ROCK, ROCK SLIDES, ETC.	N/A	1

Literature Citations - Timber Rattlesnake

1. Brown, William S. 1993. Biology, Status, and Management of the Timber Rattlesnake (Crotalus Horridus): A Guide for Conservation (Joseph T. Collins ed.). Museum of Natural History – Dyche Hall, The University of Kansas, Lawrence, Kansas. Pp. 10-15.

2. Reinert, Howard K. and Robert T. Zappalorti. 1988. Timber Rattlesnakes (Crotalus horridus) of the Pine Barrens: Their Movement Patterns and Habitat Preference. Copeia (4): 964-978.

3. Reinert, Howard K. 1984. Habitat Variation within Sympatric Snake Populations. Ecology 65(5): 1673-1682.

4. Reinert, Howard K. 1984. Habitat Separation between Sympatric Snake Populations. Ecology 65(2): 478-486.

5. Reinert, Howard K. 2006. Personal communications. The College of New Jersey. [07/26/06]

* ENSP biologist expert opinion - K. Schantz

Wood Turtle - For an explanation of Patch Type "E", refer to Page 18.				
1419	WATER	BRIDGE OVER WATER	RIPARIAN	1, 3, 4, 5
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	PRIMARY/RIPARIAN	1, 2
1711	WETLANDS	CEMETERY ON WETLAND	RIPARIAN	1, 3, 4, 5
1750	WETLANDS	MANAGED WETLAND IN MAINTAINED LAWN GREENSPACE	RIPARIAN	1, 3, 4, 5
1850	WETLANDS	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	RIPARIAN	1, 3, 4, 5
2100	AGRICULTURE	CROPLAND AND PASTURELAND	RIPARIAN	1, 3, 4, 5
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	PRIMARY/RIPARIAN	1, 2
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	PRIMARY/RIPARIAN	1, 2
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	RIPARIAN	1, 3, 4, 5
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	RIPARIAN	1, 3, 4, 5
2400	AGRICULTURE	OTHER AGRICULTURE	RIPARIAN	1, 3, 4, 5
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	SECONDARY/RIPARIAN	1, 2

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Wood Turtle - For an explanation of Patch Type "E", refer to Page 18.				
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	SECONDARY/RIPARIAN	1, 2
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	RIPARIAN	1, 3, 4, 5
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	RIPARIAN	1, 3, 4, 5
4230	FOREST	PLANTATION	RIPARIAN	1, 3, 4, 5
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	RIPARIAN	1, 3, 4, 5
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	RIPARIAN	1, 3, 4, 5
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	RIPARIAN	1, 3, 4, 5
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	RIPARIAN	1, 3, 4, 5
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	RIPARIAN	1, 3, 4, 5
4411	FOREST	PHRAGMITES DOMINATE OLD FIELD	RIPARIAN	1, 3, 4, 5
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	RIPARIAN	1, 3, 4, 5
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	RIPARIAN	1, 3, 4, 5
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	SECONDARY/RIPARIAN	1, 2
4500	FOREST	SEVERE BURNED UPLAND VEGETATION	RIPARIAN	1, 3, 4, 5
5100	WATER	STREAMS AND CANALS	RIPARIAN	1, 3, 4, 5
5200	WATER	NATURAL LAKES	RIPARIAN	1, 3, 4, 5
5300	WATER	ARTIFICIAL LAKES	RIPARIAN	1, 3, 4, 5
6120	WETLANDS	FRESHWATER TIDAL MARSHES	RIPARIAN	1, 3, 4, 5
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	PRIMARY/RIPARIAN	1, 2
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	SECONDARY/RIPARIAN	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	PRIMARY/RIPARIAN	1, 2
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	RIPARIAN	1, 3, 4, 5
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	PRIMARY/RIPARIAN	1, 2
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	SECONDARY/RIPARIAN	1, 2
6240	WETLANDS	HERBACEOUS WETLANDS	PRIMARY/RIPARIAN	1, 2
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	RIPARIAN	1, 3, 4, 5
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	SECONDARY/RIPARIAN	1, 2
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	SECONDARY/RIPARIAN	1, 2
7100	BARREN LAND	BEACHES	RIPARIAN	1, 3, 4, 5
7200	BARREN LAND	BARE EXPOSED ROCK, ROCK SLIDES, ETC.	RIPARIAN	1, 3, 4, 5
7300	BARREN LAND	EXTRACTIVE MINING	RIPARIAN	1, 3, 4, 5
7400	BARREN LAND	ALTERED LANDS	RIPARIAN	1, 3, 4, 5
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	RIPARIAN	1, 3, 4, 5
7500	BARREN LAND	TRANSITIONAL AREAS	RIPARIAN	1, 3, 4, 5
7600	BARREN LAND	UNDIFFERENTIATED BARREN LANDS	RIPARIAN	1, 3, 4, 5

Wood Turtle - Multiple Dissolve Type Justification

Behind the eastern box turtle, the wood turtle (Glyptemys insculpta) is New Jersey's second most terrestrial turtle. After the spring breeding period, females disperse to nesting areas and both sexes frequently move great distances away from the streams during the summer months.

The LU/LC choices made for wood turtle represent the habitat types most described in the literature along with areas of documented occurrence in New Jersey. With many of the occurrences in wetlands and ongoing research using radio telemetry and mark-recapture documenting strong habitat use in wetland areas adjacent to streams, non-upland areas were chosen as primary habitats (1, 3, 4, 5).

Riparian Justification - As a stream-dependent species, wood turtles also value riparian habitats immediately adjacent to their valued primary or secondary habitats provided they intersect with the SOA. These riparian habitats include all non-urban LU/LC types. This habitat is critical as basking and resting areas, and also as dispersal corridors to other preferred habitat types (1, 2).

Wood Turtle - Literature Citations

1. Compton, B. W., J. M. Rhymer, and M. McCollouh. 2002. Habitat selection by wood turtles (Clemmys insculpta): An application of paired logistic regression. Ecology 83: 833-843.

2. Harding, J. H. and T. J. Bloomer. 1979. The wood turtle, Clemmys insculpta...a natural history. Bulletin of the New York Herpetological Society 15: 9-26.

3. Kaufmann, J. H. 1992. Habitat use by wood turtles in Central Pennsylvania. Journal of Herpetolpgy 26: 315-321.

4. Kaufmann, J. H. 1995. Home ranges and movements of wood turtles, *Clemmys insculpta*, in Central Pennsylvania. Copeia 1995:22-27.

5. Tuttle, S. E. and D. M. Carroll. 2003. Home range and seasonal movements of the wood turtle (Glyptemys insculpta) in southern New Hampshire. Chelonian Conservation and Biology 4: 656-663.

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Amphibians				
Blue-spotted Salamander - For an explanation of Patch Type "E", refer to Page 18.				
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	SECONDARY	*
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	SECONDARY	4, 5
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	SECONDARY	4, 5
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	PRIMARY	5
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	PRIMARY	5
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	SECONDARY	5
6240	WETLANDS	HERBACEOUS WETLANDS	PRIMARY	5

Blue-spotted Salamander - Multiple Dissolve Type Justification

The spotted salamander (Ambystoma maculatum), marbled salamander (Ambystoma opacum), Jefferson salamander (Ambystoma jeffersonianum) and blue spotted salamander (Ambystoma laterale) are all obligate vernal pool breeders in New Jersey. Much of each species' distribution is within 300m of a breeding habitat, although individuals will disperse outside of this range.

A large percentage of the vernal habitats occur within one of the wetland types selected as a core habitat for the species, most importantly deciduous wooded wetlands. An upland component comprised of one of the adjacent LU/LC types is critical in providing habitat for the species outside of the breeding period.

In some cases, up to three of the four Ambystomids listed will use the same vernal pool for breeding and therefore upland, adjacent habitats are similar (1, 2, 3, 4).

Blue-spotted Salamander - Literature Citations

1. Faccio, S. D. 2003. Postbreeding emigration and habitat use by Jefferson and spotted salamanders in Vermont. Journal of Herpetology 37:479-489.

2. Madison, D. M. 1997. The emigration of radio-implanted spotted salamanders, Ambystoma maculatum. Journal of Herpetology 31:542-551.

3. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 12, 2006)

4. Petranka, J.W. 1998. *Salamanders of the United States and Canada*. Smithsonian Institution Press, Washington D.C., USA.

5. Regosin, J.V., B.S. Windmiller, R.N. Homan, and J.M. Reed. 2005. Variation in Terrestrial Habitat Use By Four Pool-Breeding Amphibian Species. Journal of Wildlife Management 69 (4): 1481-1493.

* ENSP biologist expert opinion - B. Zarate

Four-toed Salamander - For an explanation of Patch Type "E", refer to Page 18.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	*
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	*
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	*

Four-toed Salamander - Literature Citations

1. Petranka, J.W. 1998. *Salamanders of the United States and Canada*. Smithsonian Institution Press, Washington D.C., USA.

* ENSP biologist expert opinion - B. Zarate

Jefferson Salamander - For an explanation of Patch Type "E", refer to Page 18.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	SECONDARY	4, 5
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	SECONDARY	4, 5
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	SECONDARY	5
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	SECONDARY	5
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	SECONDARY	5
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	SECONDARY	5
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	PRIMARY	5
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	PRIMARY	5
6240	WETLANDS	HERBACEOUS WETLANDS	PRIMARY	5

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE

Jefferson Salamander - Multiple Dissolve Type Justification

The spotted salamander (Ambystoma maculatum), marbled salamander (Ambystoma opacum), Jefferson salamander (Ambystoma jeffersonianum) and blue spotted salamander (Ambystoma laterale) are all obligate vernal pool breeders in New Jersey. Much of each species' distribution is within 300m of a breeding habitat, although individuals will disperse outside of this range.

A large percentage of the vernal habitats occur within one of the wetland types selected as a core habitat for the species, most importantly deciduous wooded wetlands. An upland component comprised of one of the adjacent LU/LC types is critical in providing habitat for the species outside of the breeding period.

In some cases, up to three of the four Ambystomids listed will use the same vernal pool for breeding and therefore upland, adjacent habitats are similar (1, 2, 3, 4).

Jefferson Salamander - Literature Citations

1. Faccio, S. D. 2003. Postbreeding emigration and habitat use by Jefferson and spotted salamanders in Vermont. Journal of Herpetology 37:479-489.

2. Madison, D. M. 1997. The emigration of radio-implanted spotted salamanders, Ambystoma maculatum. Journal of Herpetology 31:542-551.

3. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 12, 2006)

4. Petranka, J.W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington D.C., USA.

5. Regosin, J.V., B.S. Windmiller, R.N. Homan, and J.M. Reed. 2005. Variation in Terrestrial Habitat Use By Four Pool-Breeding Amphibian Species. Journal of Wildlife Management 69 (4): 1481-1493.

Longtail Salamander - For an explanation of Patch Type "B", refer to Page 17.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1, 2
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1, 2
5100	WATER	STREAMS AND CANALS	N/A	1, 2
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	*
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	*
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	*

Longtail Salamander - Literature Citations

1. Anderson and Martino. 1966. The Life History of Eurycea l. longicauda Associated with Ponds The American Midland Naturalist. 75(2): 257-279.

2. Petranka, J.W. 1998. *Salamanders of the United States and Canada*. Smithsonian Institution Press, Washington D.C., USA.

* ENSP biologist expert opinion - B. Zarate

Marbled Salamander - For an explanation of Patch Type "E", refer to Page 18.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	SECONDARY	4
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	SECONDARY	4
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	SECONDARY	*
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	SECONDARY	*
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	SECONDARY	*
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	SECONDARY	*
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	PRIMARY	*
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	PRIMARY	*
6240	WETLANDS	HERBACEOUS WETLANDS	PRIMARY	*

Marbled Salamander - Multiple Dissolve Type Justification

The spotted salamander (Ambystoma maculatum), marbled salamander (Ambystoma opacum), Jefferson salamander (Ambystoma jeffersonianum) and blue spotted salamander (Ambystoma laterale) are all obligate vernal pool breeders in New Jersey. Much of each species' distribution is within 300m of a breeding habitat, although individuals will disperse outside of this range.

A large percentage of the vernal habitats occur within one of the wetland types selected as a core habitat for the species, most importantly deciduous wooded wetlands. An upland component comprised of one of the adjacent LU/LC types is critical in providing habitat for the species outside of the breeding period.

In some cases, up to three of the four Ambystomids listed will use the same vernal pool for breeding and therefore upland, adjacent habitats are similar (1, 2, 3, 4).

Marbled Salamander - Literature Citations

1. Faccio, S. D. 2003. Postbreeding emigration and habitat use by Jefferson and spotted salamanders in Vermont. Journal of Herpetology 37:479-489.

2. Madison, D. M. 1997. The emigration of radio-implanted spotted salamanders, Ambystoma maculatum. Journal of Herpetology 31:542-551.

3. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 12, 2006)

4. Petranka, J.W. 1998. *Salamanders of the United States and Canada*. Smithsonian Institution Press, Washington D.C., USA.

* ENSP biologist expert opinion - B. Zarate

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Spotted Salamander - For an explanation of Patch Type "E", refer to Page 18.				
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	SECONDARY	2, 5, 6
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	SECONDARY	2, 5, 6
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	SECONDARY	5
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	SECONDARY	5
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	SECONDARY	5
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	SECONDARY	5
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	PRIMARY	2, 5
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	PRIMARY	5
6240	WETLANDS	HERBACEOUS WETLANDS	PRIMARY	5

Spotted Salamander - Multiple Dissolve Type Justification

The spotted salamander (Ambystoma maculatum), marbled salamander (Ambystoma opacum), Jefferson salamander (Ambystoma jeffersonianum) and blue spotted salamander (Ambystoma laterale) are all obligate vernal pool breeders in New Jersey. Much of each species' distribution is within 300m of a breeding habitat, although individuals will disperse outside of this range.

A large percentage of the vernal habitats occur within one of the wetland types selected as a core habitat for the species, most importantly deciduous wooded wetlands. An upland component comprised of one of the adjacent LU/LC types is critical in providing habitat for the species outside of the breeding period.

In some cases, up to three of the four Ambystomids listed will use the same vernal pool for breeding and therefore upland, adjacent habitats are similar (1, 3, 4, 5).

Spotted Salamander - Literature Citations

1. Faccio, S. D. 2003. Postbreeding emigration and habitat use by Jefferson and spotted salamanders in Vermont. Journal of Herpetology 37:479-489.

2. Homan, R.N., B.S. Windmiller, and J.M. Reed. 2004. Critical Thresholds Associated with Habitat Loss for Two Vernal Pool-Breeding Amphibians. Ecological Applications 14 (5): 1547-1553.

3. Madison, D. M. 1997. The emigration of radio-implanted spotted salamanders, Ambystoma maculatum. Journal of Herpetology 31:542-551.

4. NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.7. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: July 12, 2006)

5. Petranka, J.W. 1998. *Salamanders of the United States and Canada*. Smithsonian Institution Press, Washington D.C., USA.

6. Regosin, J.V., B.S. Windmiller, R.N. Homan, and J.M. Reed. 2005. Variation in Terrestrial Habitat Use By Four Pool-Breeding Amphibian Species. Journal of Wildlife Management 69 (4): 1481-1493.

Butterflies				
A Silver-bordered Fritillary - For an explanation of Patch Type "B", refer to Page 17.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	1, 5
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1, 5
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1, 5
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1, 2, 3, 4, 5

A Silver-bordered Fritillary - Literature Citations

1. Glassberg, J. 1999. Butterflies through binoculars, the east. Oxford University Press, New York, NY.

2. Iftner, D.C., J.A. Shuey and J.V. Calhoun. 1992. Butterflies and Skippers of Ohio. Ohio Biological Survey Bulletin. New Series, Vol. 9, no. 1.

3. Opler, P.A. and V. Malikul. 1998. A guide to eastern butterflies. Houghton Mifflin Company, New York, NY.

4. Scott, J.A. 1986. The butterflies of north America, a natural history and field guide. Stanford University Press, Stanford, CA.

5. Gochfeld, M. and J. Burger. 1997. Butterflies of New Jersey: A Guide to their status, distribution, conservation, and appreciation. New Brunswick: Rutgers University Press.

Arogos Skipper - For an explanation of Patch Type "B", refer to Page 17.				
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	1, 2, 3, 4
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	3
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	3
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	3
7300	BARREN LAND	EXTRACTIVE MINING	N/A	*
7400	BARREN LAND	ALTERED LANDS	N/A	*
7600	BARREN LAND	UNDIFFERENTIATED BARREN LANDS	N/A	1, 2, 3, 4

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Arogos Skipper - Literature Citations				
1. Glassberg, J. 1999. Butterflies through binoculars, the east. Oxford University Press, New York, NY.				
2. Opler, P.A. and V. Malikul. 1998. A guide to eastern butterflies. Houghton Mifflin Company, New York, NY.				
3. Schweitzer, D.F. 1992. Element ecology and life history. In: The comprehensive report of Atrytone arogos arogos. NatureServe: An online encyclopedia of life [web application]. 2001. Version 1.5 . Arlington, Virginia, USA: Association for Biodiversity Information. Available: http://www.natureserve.org/. (Accessed: September 19, 2001).				
4. Gochfeld, M. and J. Burger. 1997. Butterflies of New Jersey: A Guide to their status, distribution, conservation, and appreciation. New Brunswick: Rutgers University Press.				
* ENSP biologist expert opinion - D. Golden				

Dragonflies & Damselflies				
Arrowhead Spiketail, Brook Snaketail, Brush-tipped Emerald, Harpoon Clubtail, Maine Snaketail, Midland Clubtail, New England Bluet, Rapids Clubtail, Sable Clubtail, Ski-tailed Emerald, Spatterdock Darner, Tiger Spiketail, Williamson's Emerald, Zebra Clubtail - For an explanation of Patch Type "A", refer to Page 17.				
1419	WATER	BRIDGE OVER WATER	N/A	*
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	*
1711	WETLANDS	CEMETERY ON WETLAND	N/A	*
1750	WETLANDS	MANAGED WETLAND IN MAINTAINED LAWN GREENSPACE	N/A	*
1850	WETLANDS	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	N/A	*
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	*
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	*
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	*
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	*
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	*
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	*
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	*
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	*
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	*
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	*
4230	FOREST	PLANTATION	N/A	*
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	*
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	*
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	*
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	*
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	*
4411	FOREST	PHRAGMITES DOMINATE OLD FIELD	N/A	*
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	*
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	*
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	*
4500	FOREST	SEVERE BURNED UPLAND VEGETATION	N/A	*
5100	WATER	STREAMS AND CANALS	N/A	*
5200	WATER	NATURAL LAKES	N/A	*
5300	WATER	ARTIFICIAL LAKES	N/A	*
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	*
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	*
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	*
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	*
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	*
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	*
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	*
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	*
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	N/A	*
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	*
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	*
7100	BARREN LAND	BEACHES	N/A	*
7200	BARREN LAND	BARE EXPOSED ROCK, ROCK SLIDES, ETC.	N/A	*
7300	BARREN LAND	EXTRACTIVE MINING	N/A	*
7400	BARREN LAND	ALTERED LANDS	N/A	*
7430	WETLANDS	DISTURBED WETLANDS (MODIFIED)	N/A	*
7500	BARREN LAND	TRANSITIONAL AREAS	N/A	*

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Arrowhead Spiketail, Brook Snaketail, Brush-tipped Emerald, Harpoon Clubtail, Maine Snaketail, Midland Clubtail, New England Bluet, Rapids Clubtail, Sable Clubtail, Ski-tailed Emerald, Spatterdock Darner, Tiger Spiketail, Williamson's Emerald, Zebra Clubtail - For an explanation of Patch Type "A", refer to Page 17.				
7600	BARREN LAND	UNDIFFERENTIATED BARREN LANDS	N/A	*

Arrowhead Spiketail, Brook Snaketail, Brush-tipped Emerald, Harpoon Clubtail, Kennedy's Emerald, Maine Snaketail, Midland Clubtail, New England Bluet, Rapids Clubtail, Sable Clubtail, Ski-tailed Emerald, Spatterdock Darner, Tiger Spiketail, Williamson's Emerald, Zebra Clubtail - Literature Citations

* ENSP biologist expert opinion - D. Golden

Freshwater Mussels

Brook Floater, Creeper, Dwarf Wedgemussel, Eastern Lampmussel, Triangle Floater, Yellow Lampmussel - For an explanation of Patch Type "I", refer to Page 18.				
N/A	N/A	NJDEP 2002 STREAMS LAYER	N/A	*

Brook Floater, Creeper, Dwarf Wedgemussel, Eastern Lampmussel, Eastern Pondmussel, Triangle Floater, Yellow Lampmussel - Literature Citations

* ENSP biologist expert opinion - J. Bowers-Altman

Habitat-specific Suitability Requirements (Rank 1).

For certain general habitat types, habitat-specific suitability requirements must be met in order for a patch of habitat to be considered suitable (rank 1). The following tables detail the level 3 LU/LC classes that make up the general habitat types subject to the suitability requirements.

Emergent Wetland - All emergent wetland patches are considered suitable regardless of size. Therefore, all emergent wetland patches received a minimum rank of 1.				
1461	WETLANDS	WETLAND RIGHTS-OF-WAY	N/A	1-8
1741	URBAN	PHRAGMITES DOMINATE URBAN AREA	N/A	1-8
2140	WETLANDS	AGRICULTURAL WETLANDS (MODIFIED)	N/A	1-8
2150	WETLANDS	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT BUILT-UP)	N/A	1-8
6120	WETLANDS	FRESHWATER TIDAL MARSHES	N/A	1-8
6240	WETLANDS	HERBACEOUS WETLANDS	N/A	1-8
6241	WETLANDS	PHRAGMITES DOMINATE INTERIOR WETLANDS	N/A	1-8

Emergent Wetland - Suitability Justification

Emergent wetland types play a critical role in any ecosystem. Aside from the beneficial functions they provide for people, this unique habitat type is crucial to the existence of several wetland dependent species. Sizes ranging from less than 1 acre to several acres are of equal importance because of their role as habitat for wetland dependent species that vary in their mobility. Species like the American Bittern and Black Rails occupy habitat up to 4 hectares while salamanders, such as the Blue Spotted Salamander, frequently do not travel more than 300 meters from their breeding sites (Eddleman et al. 1994, Gibbs et al. 1992, Semlitsch and Bodie 2003).

For species that are habitat specialists and/or with limited dispersal capabilities, the presence of corridors can provide an effective means to enhance dispersal, thus reducing the effects of isolation and fragmentation on a population (Chase et al. 1989, Collinge 1996, Beier & Noss 1998, Simberloff & Cox 1987, Haddad 1999). Bog turtles almost exclusively inhabit emergent wetland types and value wetland connectivity to support gene flow and travel corridor as individual sites degrade or improve in condition in time. A several hundred acre wetland can sustain multiple viable colonies and occurrences of the species that value them (Chase et al. 1989) (1-8).

Emergent Wetland - Literature Citations

1. Beier, P. and R. F. Noss. 1998. Do habitat corridors provide connectivity? Conservation Biology 12(6):2352-1252.

2. Chase et al. 1989. Habitat Characteristics, Population Size, and Home Range of the Bog Turtle, Clemmys muhlenbergii, in Maryland. Journal of Herpetology 23(4): 356-362.

3. Collinge, S. 1996. Ecological consequences of habitat fragmentation: implications for landscape architecture and planning. Landscape and Urban Planning 36:59-77.

4. Eddleman, W. R., R. E. Flores, and M. L. Legare. 1994. Black Rail (Laterallus jamaicensis). In The Birds of North America, No. 123 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

5. Gibbs, J. P., S. Melvin, and F. A. Reid. 1992. American Bittern. In The Birds of North America, No. 18 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

6. Haddad, N. 2000. Corridor length and patch colonization by a butterfly, Junonia coenia. Conservation Biology 14(3):738-745.

7. Semlitsch, R. D., and J. R. Bodie. 2003. Biological Criteria for Buffer Zones around Wetlands and Riparian Habitats for Amphibians and Reptiles. Conservation Biology 17(5): 1219-1228

8. Simberloff, D., and J. Cox. 1987. Consequence and costs of conservation corridors. Conservation Biology 1:63-71.

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Forested Wetland - All forested wetland patches are considered suitable regardless of size. Therefore, all forested wetland patches receive a minimum rank of 1.				
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1, 2, 3, 4
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1, 2, 3, 4
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1, 2, 3, 4
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1, 2, 3, 4
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1, 2, 3, 4
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1, 2, 3, 4
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1, 2, 3, 4
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1, 2, 3, 4

Forested Wetland - Suitability Justification

Core habitat types for ambystomid breeding salamanders and core and travel corridor for wood turtle.

Canada warblers use a wide range of deciduous, coniferous and mixed wetland forests with a well-developed understory (Conway 1999). They inhabit lowland and upland habitats, including swamps, streamside thickets, brushy ravines, moist forests, and regenerating timber cuts with well-developed shrub layer and structurally complex forest floor. They are area sensitive in “settled” areas but not in forest-dominated regions (Lambert and Faccio 2005) (1, 2, 3, 4).

Forested Wetland - Literature Citations

1. Compton, B. W., J. M. Rhymer, and M. McCollouh. 2002. Habitat selection by wood turtles (Clemmys insculpta): An application of paired logistic regression. Ecology 83: 833-843.

2. Conway, C. J. 1999. Canada Warbler (Wilsonia canadensis). In The Birds of North America, No. 421 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

3. Faccio, S. D. 2003. Postbreeding emigration and habitat use by Jefferson and spotted salamanders in Vermont. Journal of Herpetology 37:479-489.

4. Lambert, D. J. and S. D. Faccio. 2005. Canada warbler population status, habitat use, and stewardship guidelines for northeastern forests. Vermont Institute of Natural Science, Woodstock, VT.

Forest 10 Hectares Core - All forest patches that have a core area of 10 hectares or greater are considered suitable. Core area is defined as interior forest grater than 90 meters from the forest edge.				
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	1-23
1804	URBAN	ATHLETIC FIELDS (SCHOOLS)	N/A	1-23
4110	FOREST	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	N/A	1-23
4120	FOREST	DECIDUOUS FOREST (>50% CROWN CLOSURE)	N/A	1-23
4210	FOREST	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	N/A	1-23
4220	FOREST	CONIFEROUS FOREST (>50% CROWN CLOSURE)	N/A	1-23
4230	FOREST	PLANTATION	N/A	1-23
4311	FOREST	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	N/A	1-23
4312	FOREST	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	N/A	1-23
4321	FOREST	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	N/A	1-23
4322	FOREST	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	N/A	1-23
4420	FOREST	DECIDUOUS BRUSH/SHRUBLAND	N/A	1-23
4430	FOREST	CONIFEROUS BRUSH/SHRUBLAND	N/A	1-23
4440	FOREST	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	N/A	1-23
4500	FOREST	SEVERE BURNED UPLAND VEGETATION	N/A	1-23
6210	WETLANDS	DECIDUOUS WOODED WETLANDS	N/A	1-23
6220	WETLANDS	CONIFEROUS WOODED WETLANDS	N/A	1-23
6231	WETLANDS	DECIDUOUS SCRUB/SHRUB WETLANDS	N/A	1-23
6232	WETLANDS	CONIFEROUS SCRUB/SHRUB WETLANDS	N/A	1-23
6233	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	N/A	1-23
6234	WETLANDS	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	N/A	1-23
6251	WETLANDS	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	N/A	1-23
6252	WETLANDS	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	N/A	1-23

Forest 10 Hectares Core - Suitability Justification

Endangered and rare species tend to have specific habitat requirements for foraging, nesting and cover (i.e., habitat "specialists"), making them more vulnerable to changes in the landscape. As it is, loss of habitat is the primary cause of the decline in species, affecting 85% of the species of plants, mammals, birds, herptiles, fish, and invertebrates, followed by the increase of non-native species (see Wilcove et al. 1998). When their habitats are lost or degraded because of fragmentation, individuals of the species are also lost because they cannot utilize habitats other than those for which they are specialized for (With and Crist 1995, Collinge 1996).

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE

Forest 10 Hectares Core - Suitability Justification (Cont.)

Many endangered and threatened species in New Jersey only inhabit large tracts of forest (> 10 ha). Barred owls are restricted to forested areas, ranging from swamps and riparian areas to upland regions. They prefer large, unfragmented tracts of mature and old-growth forests, typically of mixed deciduous-coniferous composition. In New Jersey, barred owls are found in old-growth hardwood, cedar swamps, and upland oak-pine forests (Mazur and James 2000) and have a mean home range of 339.47 ha (Nichols and Warner 1972, Fuller 1979, Elody and Sloan 1985). Red-shouldered hawk habitat varies from bottomland hardwood, riparian areas, and flooded deciduous swamps to upland mixed deciduous-coniferous forest. They prefer extensive forest stands (mean home range 224 ha) consisting of mature to old-growth canopy trees with variable amounts of understory with a mean home range of 224 ha (Crocoll 1994). Northern goshawks prefer large, contiguous tracts of mature forests and forested wetlands to breed (Squires and Reynolds 1997, Bosakowski and Speiser 1994), while non-breeding habitats may also include young forests, scrub-shrub habitats and ecotones between forest and open fields and agricultural lands (Squires and Reynolds 1997, Bosakowski and Speiser 1994). Bobcat home range sizes are highly variable, both geographically and intrasexually in the same geographic area particularly if suitable habitat components have a patchy distribution (Lovallo 1999). The home range size of males is generally larger than that of females, but range from 6.40 -33 km2 for females and 15.34 - 326 km2 for males (Connor et al. 1999, Litvaitis et al. 1986, Lovallo and Anderson 1996, Lovallo 2000). In New Jersey, the annual home range of a male in 2002 was 121 km2 with a core of 19 km2 and the home range of a female in 2003 was 90 km2 with a core of 11.7 km2, as estimated by kernel home range method. Timber rattlesnakes have variable sizes in home ranges, but the range is from 16 – 207 ha (Brown 1993a, Brown 1993b).
The minimum 10 ha for suitable habitat was chosen because many of the bird species of special or regional concern are forest-interior birds, that is, birds that nest within the interior core of a forest patch (area of forest > 90 m from an edge) (Faaborg et al. 1995). The minimum core required to provide suitable breeding habitat for area-sensitive species are 10 ha of forest core (Franklin 1993, Faaborg et al. 1995, Dawson et al. 1993, Collinge 1996, Dawson et al. 1998, Hamel 2000). Area-sensitive birds tend not to occur in forests that lack core habitat (McCollin 1998) (1-23).

Forest 10 Hectares Core - Literature Citations

1. Bosakowski, Thomas and Robert Speiser. 1994. Macrohabitat Selection by Nesting Northern Goshawks: Implications for Managing Eastern Forests. Studies in Avian Biology. 16:46-49.

2. Brown, William S. 1993a. Timber Rattlesnake: Ecology. In Biology, Status, and Management of the Timber Rattlesnake (Crotalus Horridus): A Guide for Conservation (Joseph T. Collins ed.). Museum of Natural History – Dyche Hall, The University of Kansas, Lawrence, Kansas. Pp. 15-24.

3. Brown, William S. 1993b. Timber Rattlesnake: Land Protection. In Biology, Status, and Management of the Timber Rattlesnake (Crotalus Horridus): A Guide for Conservation (Joseph T. Collins ed.). Museum of Natural History – Dyche Hall, The University of Kansas, Lawrence, Kansas. Pp. 39-40.

4. Collinge, S. 1996. Ecological consequences of habitat fragmentation: implications for landscape architecture and planning. Landscape and Urban Planning 36:59-77.

5. Conner, M., B. Plowman, B.D. Leopold, C. Lovell. 1999. Influence of time-in-residence on home range and habitat use of bobcats. Journal of Wildlife Management 63(1):261-269.

6. Crocoll, S. T. (1994). Red-shouldered Hawk (Buteo lineatus). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Laboratory of Ornithology; Retrieved from The Birds of North American Online database: http://bna.birds.cornell.edu/BNA/account/Red-shouldered_Hawk/

7. Dawson, D. K., L. J. Darr, C. S. Robbins. 1993. Predicting the distribution of breeding forest birds in a fragmented landscape. Trans. 58th North American Wildl. and Nat. Resour. Conf. Pgs.35-43.

8. Dawson, D. K., C. S. Robbins, and L. J. Darr. 1998. Effects of urbanization on the distribution of area-sensitive forest birds in Prince George's County, Maryland. Pages 207-213 in G. D. Therres (ed.), Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond. Maryland Department of Natural Resources, Annapolis, MD.

9. Elody, B.J. and N.F. Sloan. 1985. Movements and habitat use of barred owls in the Huron Mountains of Marquette County, Michigan, as determined by radiotelemetry. Jack-pine Warbler 63(1):3-8.

10. Faaborg, J., M. Brittingham, T. Donovan, et al. 1995. Habitat fragmentation in the temperate zone. Pages 357-380 in Martin, T. E. and D. M. Finch (eds.) Ecology and Management of Neotropical migratory birds: A synthesis and review of critical issues. Oxford University Press, New York.

11. Franklin, J. 1993. Preserving biodiversity: Species, ecosystems, or landscapes? Ecological Applications 3(2):202-205.

12. Fuller, M.R. 1979. Spatiotemporal ecology of four sympatric raptor species. Ph.D. Dissertation. University of Minnesota, St. Paul. 396 pp.

13. Hamel, P. B. 2000. Cerulean Warbler (Dendroica cerulean). In The Birds of North America, No. 511 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

14. Litvaitis, J.A., J.A. Sherburne, J.A. Bissonette. 1986. Bobcat habitat use and home range size in relation to prey density. Journal of Wildlife Management 50(1):110-117.

15. Lovallo, M.J., E.M. Anderson. 1996. Bobcat (Lynx rufus) home range size and habitat use in northwest Wisconsin. American Midland Naturalist 135(2): 241-252.

16. Lovallo, J.M. 1999. Multivariate models of bobcat habitat selection for Pennsylvania Landscape. Ph.D. dissertation. The Pennsylvania State University, University Park. 146pp.

17. Lovallo, M.J. 2000. Bobcat home range size and intraspecific social relationships. Pennsylvania Game Commission Bureau of Wildlife Management Research Division Project Annual Job Report: Bobcat Research/Management 06630.

18. Mazur, K. M., and P. C. James. 2000. Barred Owl (Strix varia). In The Birds of North America, No. 508 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

19. McCollin, D. 1998. Forest edges and habitat selection in birds: a functional approach. Ecography 21:247-260.

20. Nichols, T.H. and D.W. Warner. 1972. Barred owl habitat use as determined by radiotelemetry. J. Wildlife Manage. 36(2):213-224.

21. Squires, J. R., and R. T. Reynolds. 1997. Northern Goshawk (Accipiter gentilis). In The Birds of North America, No. 298 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

22. Wilcove, D. S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. Bioscience 48(8):607-622.

23. With, K. and T. Crist. 1995. Critical thresholds in species' responses to landscape structure. Ecology 46(8):2446-2459.

Grassland 18 Hectares - All grassland patches that are greater than 18 hectares in size are considered suitable.				
1463	URBAN	UPLAND RIGHTS-OF-WAY UNDEVELOPED	N/A	1-10
2100	AGRICULTURE	CROPLAND AND PASTURELAND	N/A	1-10
2200	AGRICULTURE	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	N/A	1-10
2300	AGRICULTURE	CONFINED FEEDING OPERATIONS	N/A	1-10
2400	AGRICULTURE	OTHER AGRICULTURE	N/A	1-10

Appendix III. (Cont.)

LU02	TYPE02	LABEL02	DISSOLVE TYPE	LITERATURE
Grassland 18 Hectares - All grassland patches that are greater than 18 hectares in size are considered suitable.				
4410	FOREST	OLD FIELD (< 25% BRUSH COVERED)	N/A	1-10

Grassland 18 Hectares - Suitability Justification

Endangered and rare species tend to have specific habitat requirements for foraging, nesting and cover (i.e., habitat "specialists"), making them more vulnerable to changes in the landscape. As it is, loss of habitat is the primary cause of the decline in species, affecting 85% of the species of plants, mammals, birds, herptiles, fish, and invertebrates, followed by the increase of non-native species (see Wilcove et al. 1998). When their habitats are lost or degraded because of fragmentation, individuals of the species are also lost because they cannot utilize habitats other than that which they are specialized for (With & Crist 1995, Collinge 1996).

The minimum core required to provide suitable breeding habitat for area-sensitive grassland species is 18 ha. of grassland core. (Franklin 1993, Faaborg et al. 1995, Vickery et al. 1994, Collinge 1996, Mitchell et al. 2000, Dechant et al. 2002, Smallwood and Bird 2002). Area-sensitive birds tend not to occur in grasslands that lack core habitat (Forman et al. 2002) (1-10).

Grassland 18 Hectares - Literature Citations

1. Collinge, S. 1996. Ecological consequences of habitat fragmentation: implications for landscape architecture and planning. Landscape and Urban Planning 36:59-77.

2. Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, B. D. Parkin, and B. R. Euliss. 1999 (revised 2002). Effects of management practice on grassland birds: Upland Sandpiper. Northern Prairie Wildlife Research Center, Jamestown, ND. 34 pages.

3. Faaborg, J., M. Brittingham, T. Donovan, et al. 1995. Habitat fragmentation in the temperate zone. Pages 357-380 in Martin, T. E. and D. M. Finch (eds.) Ecology and Management of Neotropical migratory birds: A synthesis and review of critical issues. Oxford University Press, New York.

4. Forman, R., B. Reinaking, and A. Hersperger. 2002. Road traffic and nearby grassland bird patterns in a suburbanizing landscape. Environmental Management 29(6):782-800.

5. Franklin, J. 1993. Preserving biodiversity: Species, ecosystems, or landscapes? Ecological Applications 3(2):202-205.

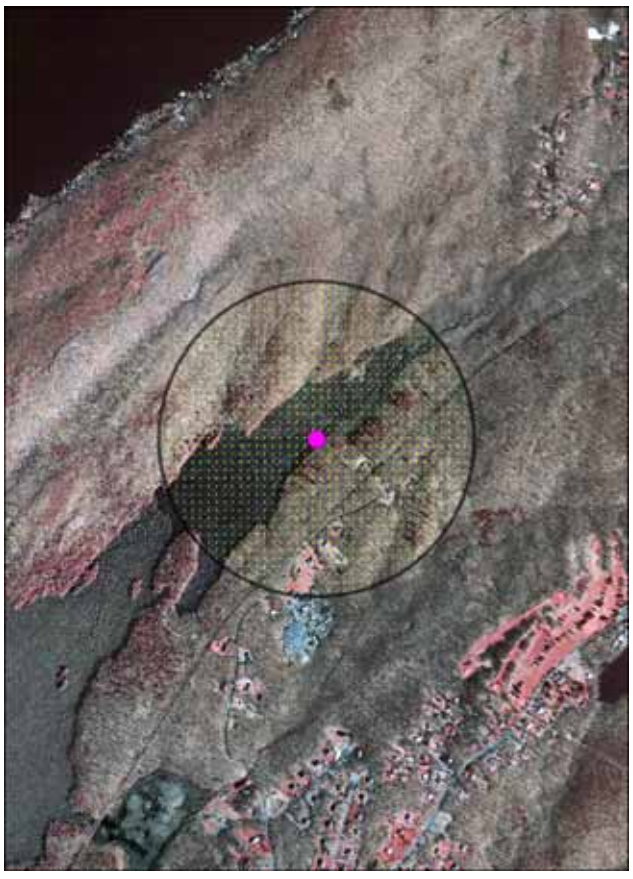
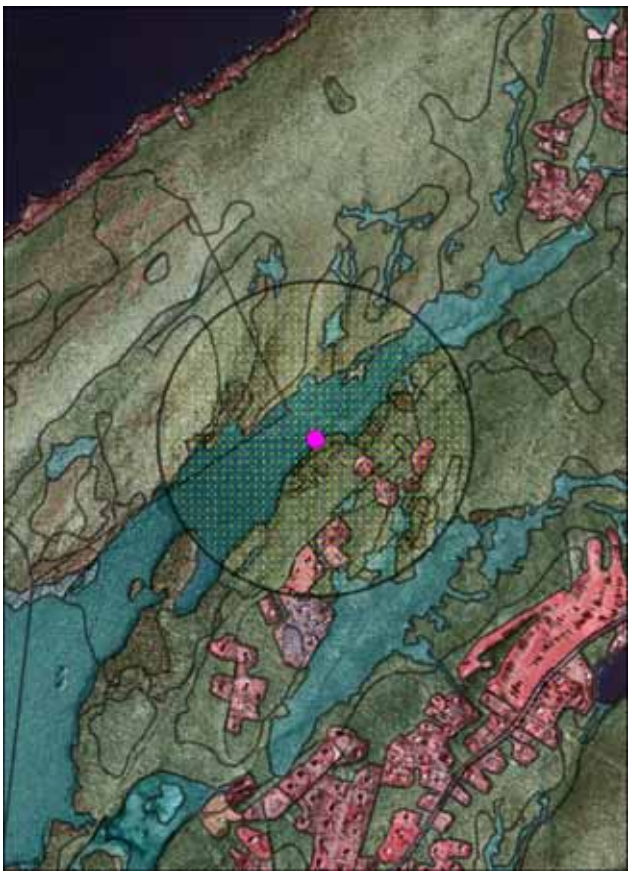
6. Mitchell, L. R., C. R. Smith and R. A. Malecki, R. A. 2000. Ecology of grassland breeding birds in the northeastern US – a literature review with recommendations for management. USGS, BRD, NY Cooperative Fish and Wildlife Research Unit, DNR, Cornell University, Ithaca, NY 14853-3011. September 2000.

7. Smallwood, J. A., and D. M. Bird. 2002. American Kestrel (Falco sparverius). In The Birds of North America, No. 602 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA

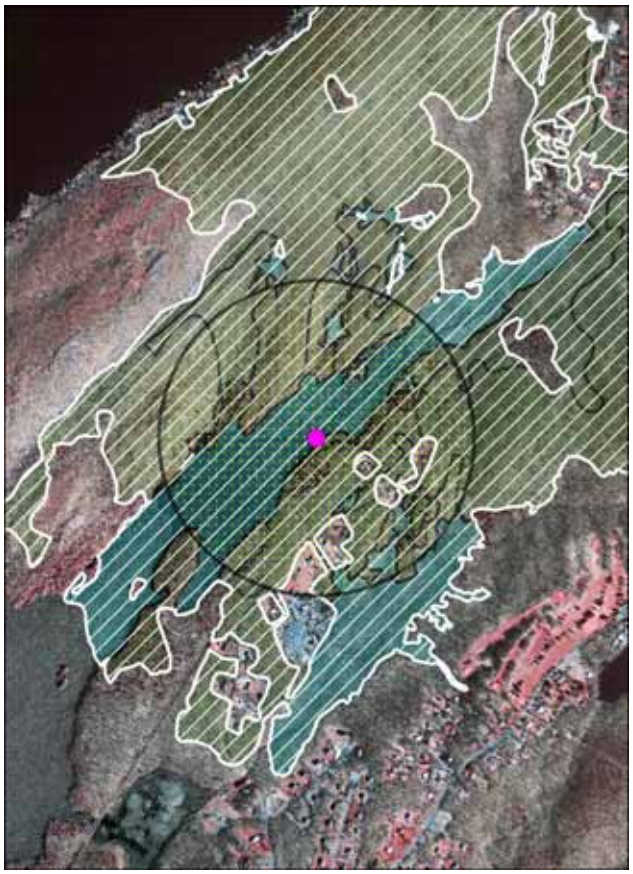
8. Vickery, P., M. Hunter, and S. Melvin. 1994. Effects of habitat area on the distribution of grassland birds in Maine. Conservation Biology 8(4):1087-1097.

9. Wilcove, D. S., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. Bioscience 48(8):607-622.

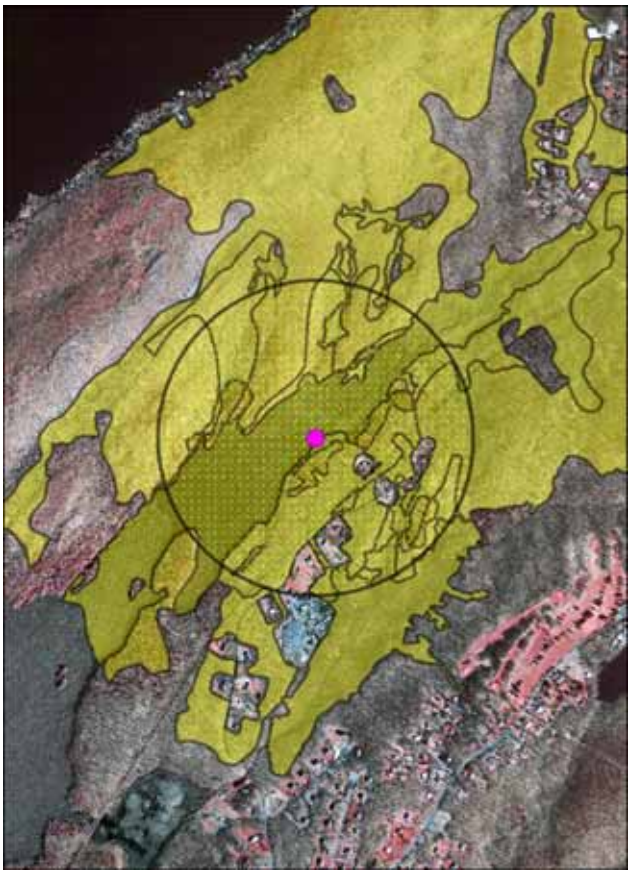
10. With, K. and T. Crist. 1995. Critical thresholds in species' responses to landscape structure. Ecology 46(8):2446-2459.

Use for all patch-type description illustrations throughout Appendix IV	Patch Type "A" – Example
	LU/LC level 3 classes are not dissolved/combined into patches for these species. Species occurrence areas value any non-urban LU/LC polygons with which they intersect.
A1: Species occurrence point and area overlaying 2002 aerial photography	A2: All DEP 2002 LU/LC level 3 class polygons
	

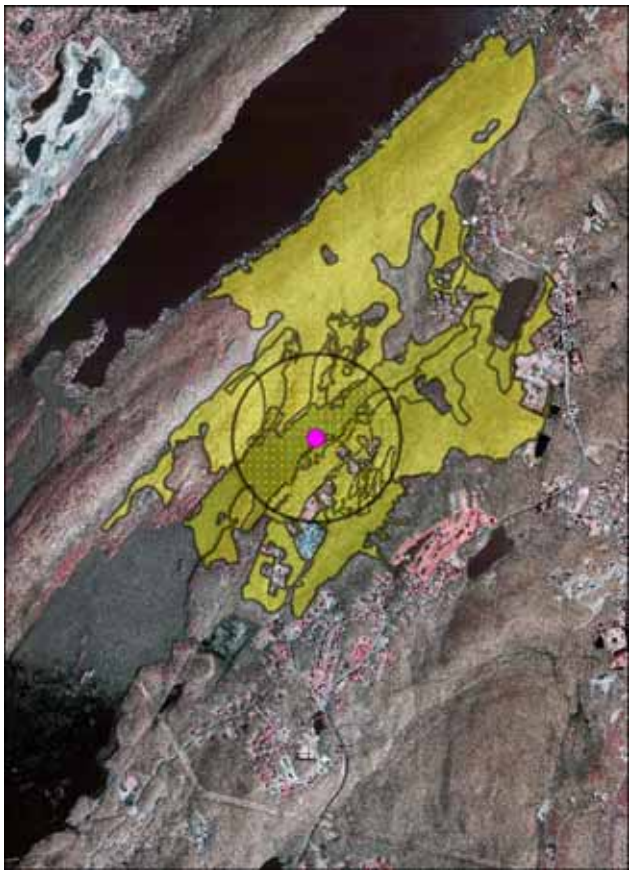
A3: Non-urban level 3 classes that can be valued as habitat for the species



A4: Non-urban level 3 classes that intersect the species occurrence area are valued for the species



A5: Extent of valued area for the species occurrence



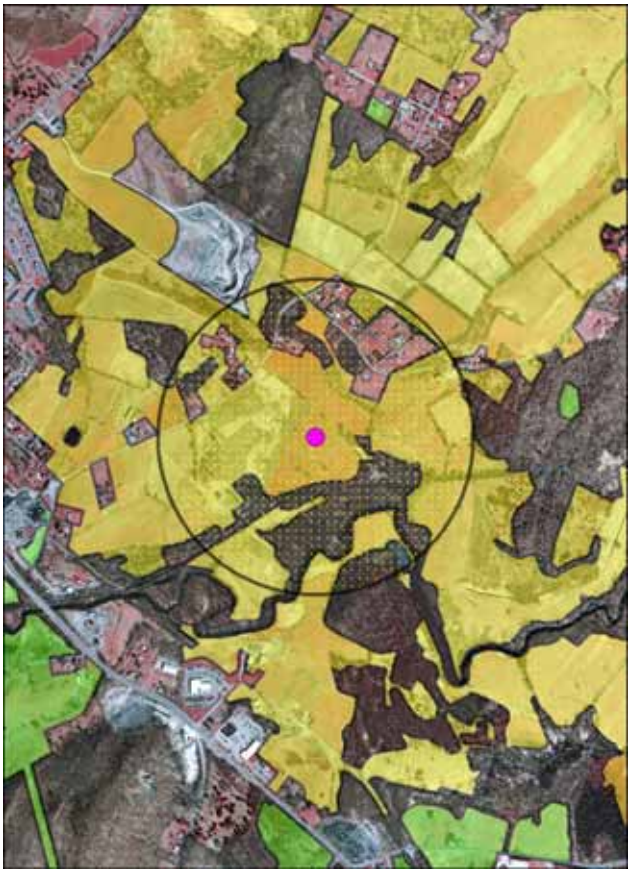
Patch Type "B" – Example

For each species, lists of LU/LC level 3 classes are chosen. These are dissolved/combined into species-specific patches of habitat. Species occurrence areas are overlaid on the habitat patches and they value any patch with which they intersect.

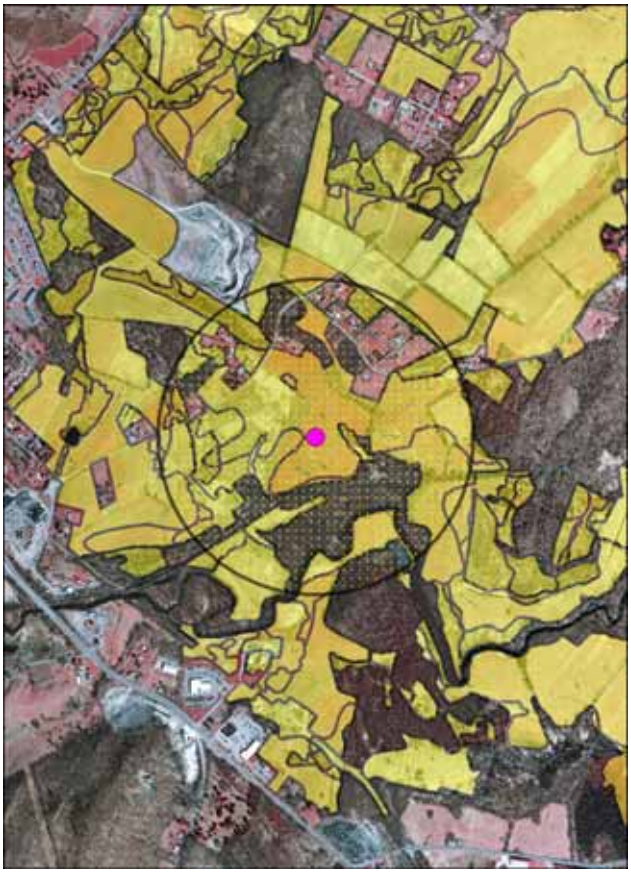
Appendix IV. (Cont.)

B1: Species occurrence point and area overlaying 2002 aerial photography	B2: All DEP 2002 LULC level 3 class polygons
	
B3: Select set of level 3 classes that can be valued as habitat for the species	B4: Select set of level 3 classes dissolved/combined into contiguous patches
	

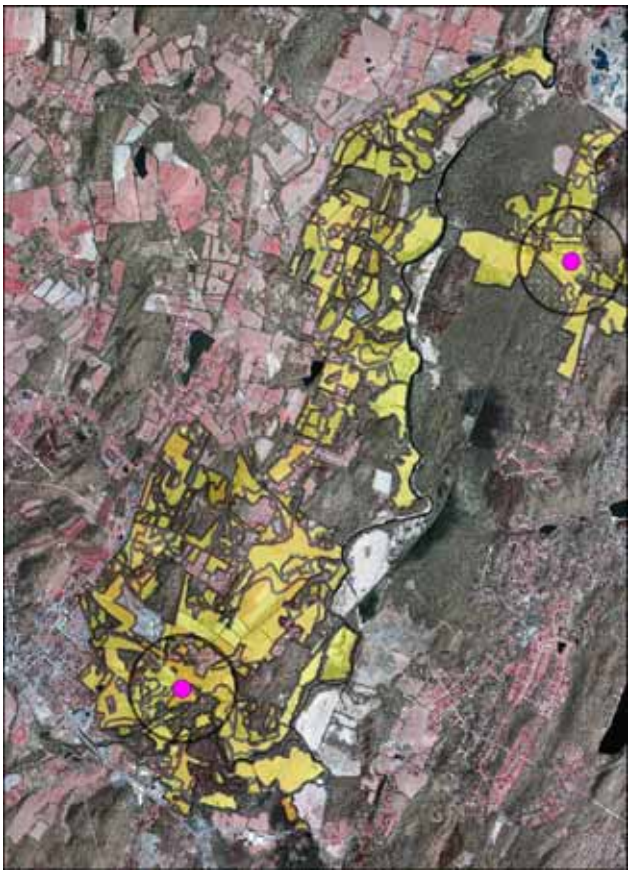
B5: Contiguous patches that intersect the species occurrence area



B6: Individual LULC level 3 class polygons that make up the selected contiguous patches are valued for the species



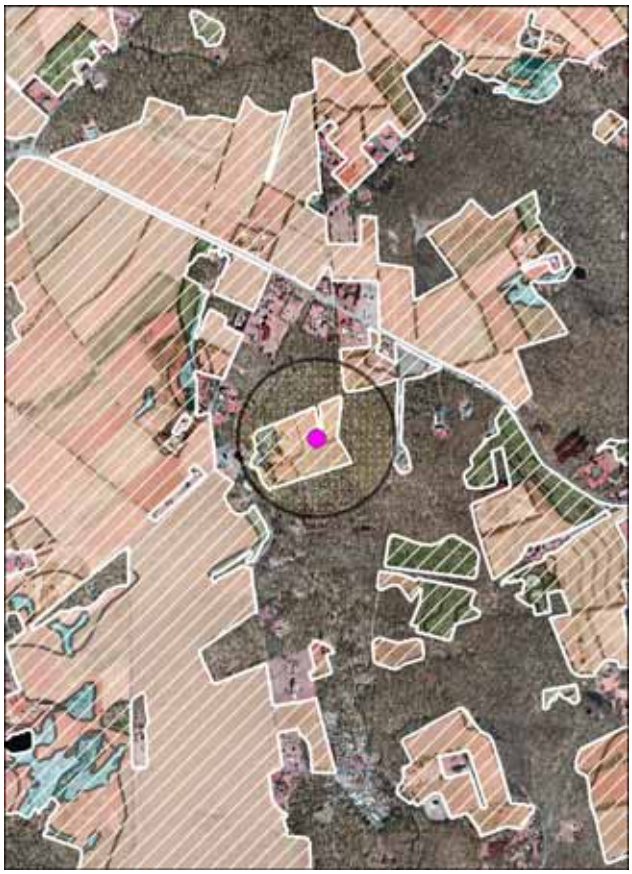
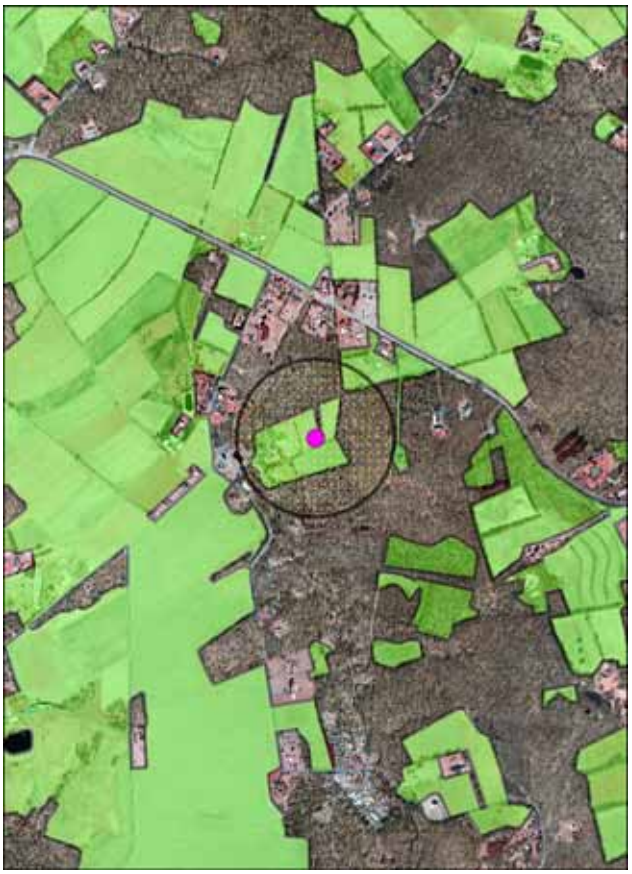
B7: Extent of valued area for the species occurrence



Patch Type "C" – Example

Species in this group have a minimum patch size requirement. They follow the same protocol as defined in Patch Type B. However, a patch must meet a size requirement before an occurrence area can value that patch.

Appendix IV. (Cont.)

C1: Species occurrence point and area overlaying 2002 aerial photography	C2: All DEP 2002 LU/LC level 3 class polygons
	
C3: Select set of level 3 classes that can be valued as habitat for the species	C4: Select set of level 3 classes dissolved/combined into contiguous patches
	

C5: Patches that do not meet the size requirement for the species

C6: Contiguous patches that intersect the species occurrence area

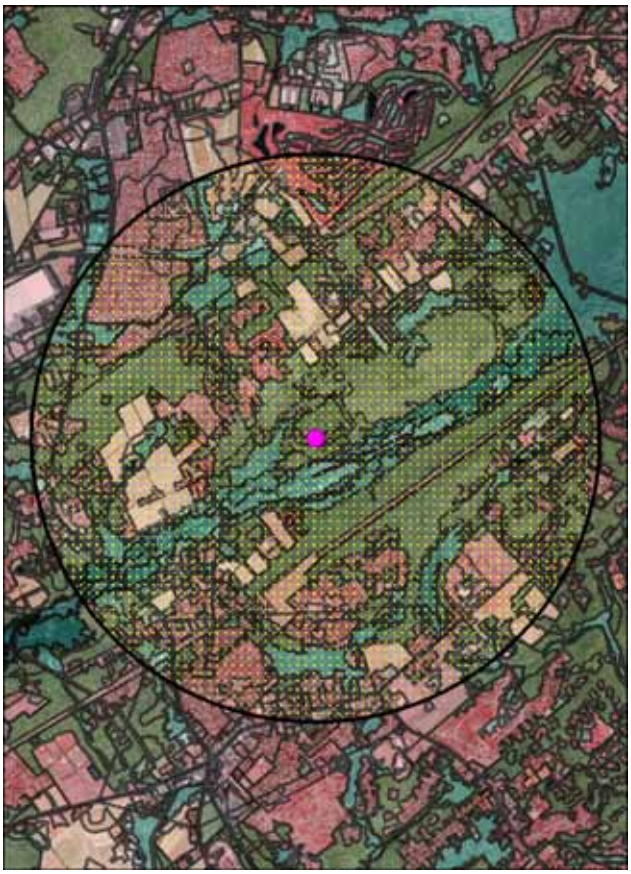
C7: Individual LU/LC level 3 class polygons that make up the selected contiguous patches are valued for the species. Also the extent of the valued area for the species occurrence

Patch Type "D" – Example (nesting)

This type relates to our colonial water birds. Nesting occurrences in this group receive two types of occurrence areas; a nesting occurrence area and a foraging occurrence area. Lists of level 3 LU/LC classes are chosen for each type of occurrence area. Similar to Patch Type A, LU/LC level 3 classes are not dissolved/combined into patches. Species occurrence areas are overlaid and value any chosen LU/LC polygons with which they intersect.

Appendix IV. (Cont.)

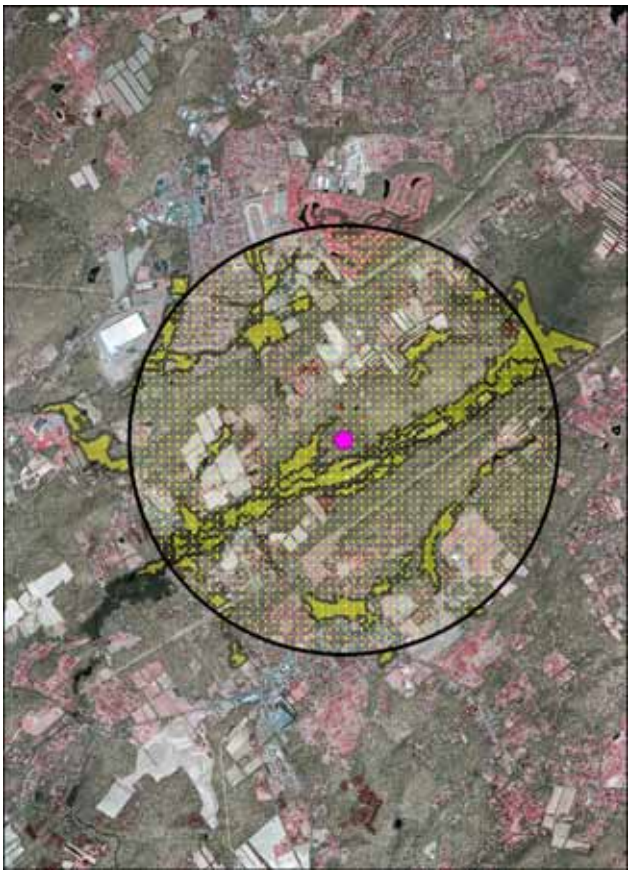
D1 (nesting): Species occurrence point and area overlaying 2002 aerial photography	D2 (nesting): All DEP 2002 LU/LC level 3 class polygons
	
D3 (nesting): Select set of level 3 classes that can be valued as habitat for the species	D4 (nesting): Patches that intersect the species occurrence area are valued for the species
	

D5 (nesting): Extent of valued area for the species occurrence	**Patch Type "D" – Example (foraging)**
	This type relates to our colonial water birds. Nesting occurrences in this group receive two types of occurrence areas; a nesting occurrence area and a foraging occurrence area. Lists of level 3 LU/LC classes are chosen for each type of occurrence area. Similar to Patch Type A, LU/LC level 3 classes are not dissolved/combined into patches. Species occurrence areas are overlaid and value any chosen LU/LC polygons with which they intersect.
D1 (foraging): Species occurrence point and area overlaying 2002 aerial photography	D2 (foraging): All DEP 2002 LU/LC level 3 class polygons
	

D3 (foraging): Select set of level 3 classes that can be valued as habitat for the species

D4 (foraging): Patches that intersect the species occurrence area are valued for the species

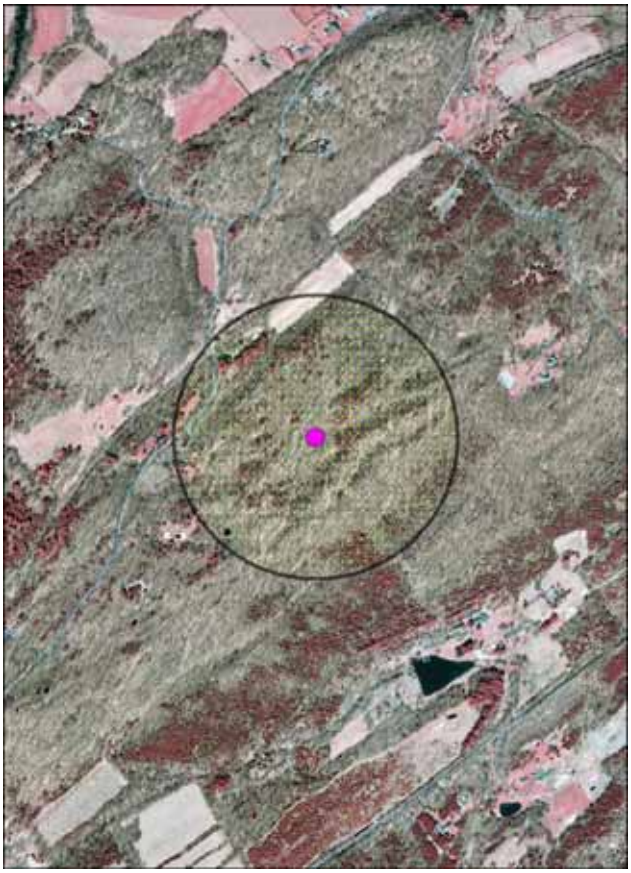
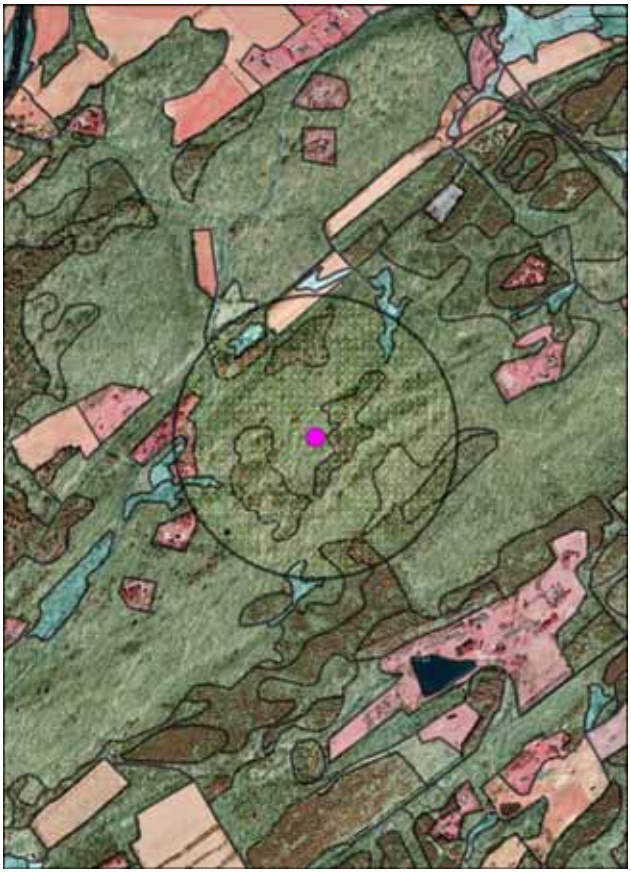
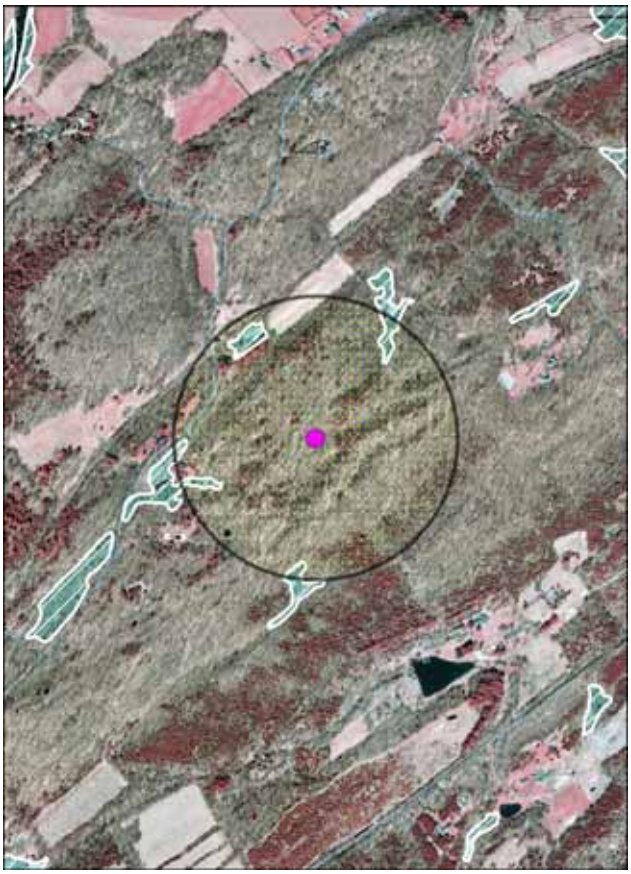
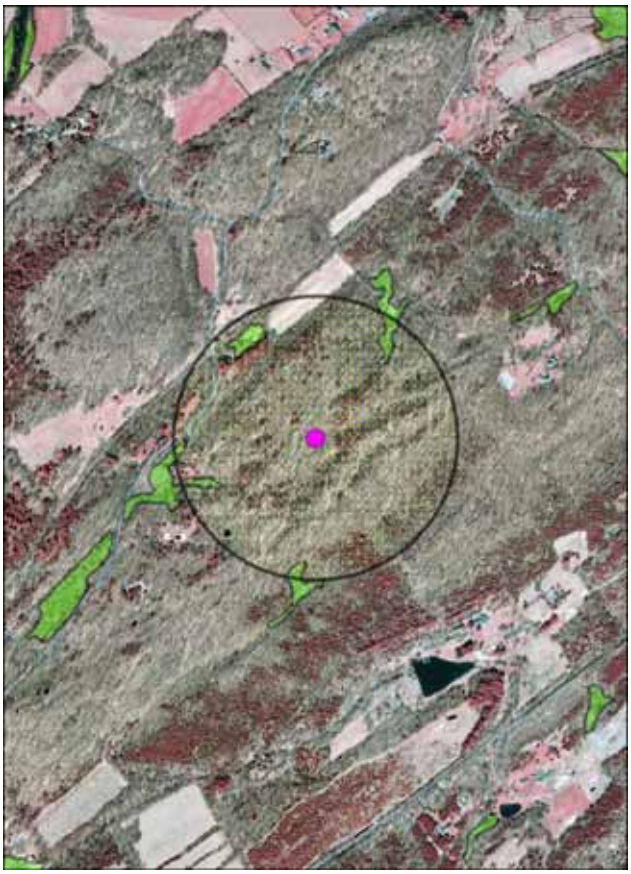
D5 (foraging): Extent of valued area for the species occurrence



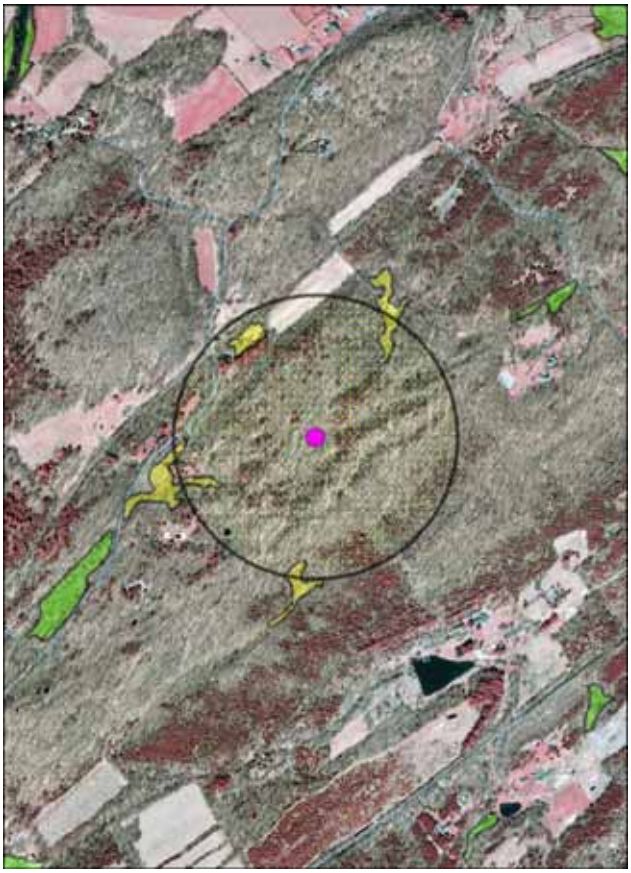
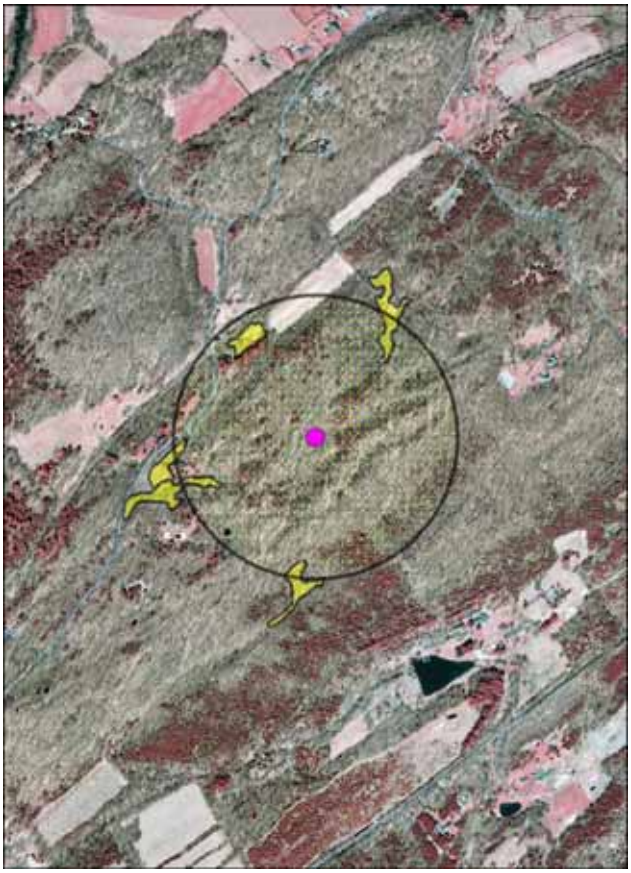
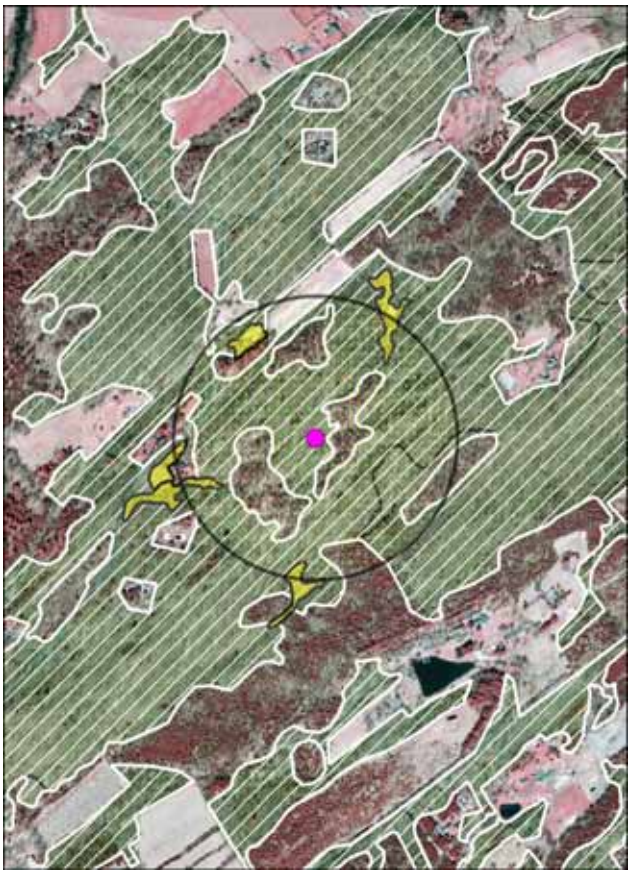
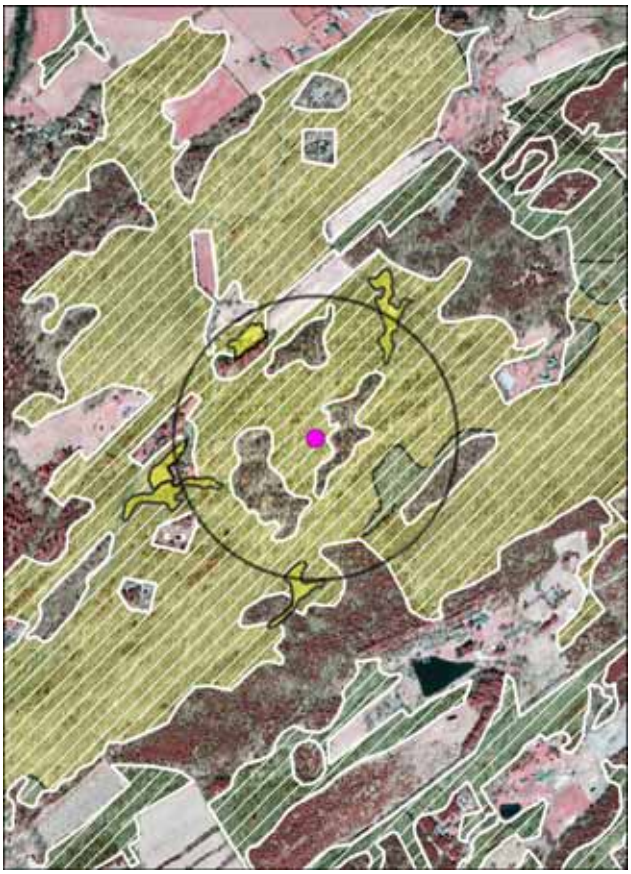
Patch Type "E" – Example

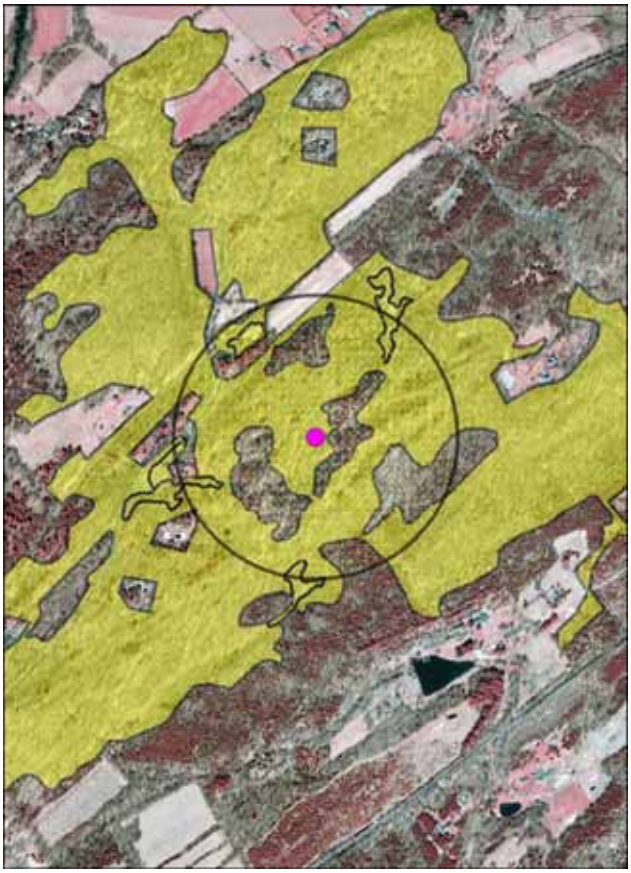
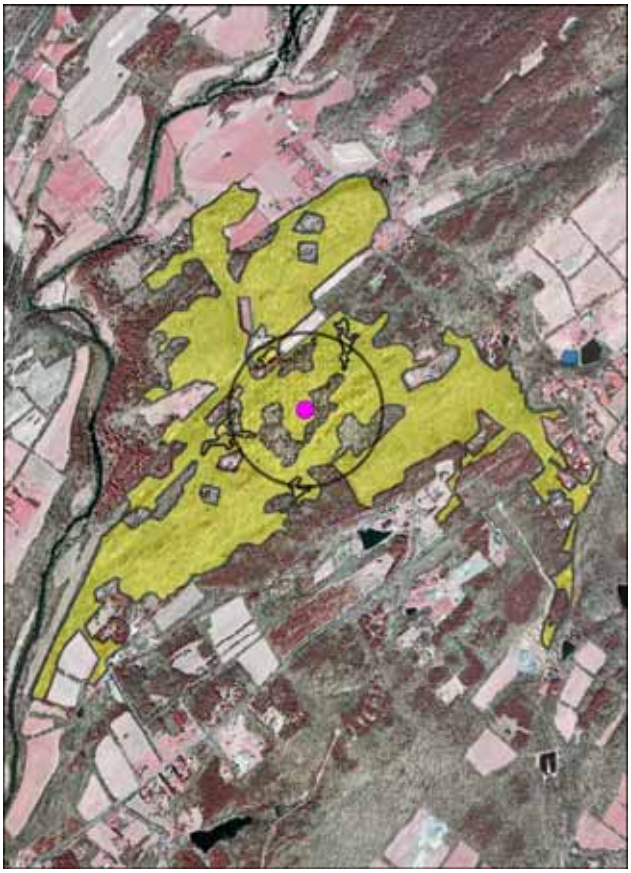
Species in this type follow the protocol described in Patch Type B. However, there is a second step. After the patches have been created for the species, second lists of LU/LC level 3 classes are identified. If these LU/LC level 3 polygons are adjacent to, or within, a specified distance (species-specific) they are dissolved and become part of the valued area.

Appendix IV. (Cont.)

E1: Species occurrence point and area overlaying 2002 aerial photography	E2: All DEP 2002 LU/LC level 3 class polygons
	
E3: Select set of primary level 3 classes that can be valued as habitat for the species	**E4: Select set of primary level 3 classes dissolved/combined into contiguous patches**
	

Appendix IV. (Cont.)

E5: Contiguous patches that intersect the species occurrence area	E6: Individual LU/LC level 3 class polygons that make up the selected contiguous patches are valued for the species
	
E7: Select set of secondary level 3 classes that can be valued as habitat for the species	**E8: Select set of secondary level 3 classes valued if adjacent to already valued patches**
	

E9: Individual LU/LC level 3 class polygons are valued for the species	E10: Extent of valued area for the species occurrence
	
Patch Type "F" – Example	F1: Species occurrence point and area overlaying 2002 aerial photography
Red-headed woodpecker has its own patch type because it follows the protocol described in Patch Type E, but has different requirements based on whether it is a breeding or non-breeding occurrence.	

Appendix IV. (Cont.)

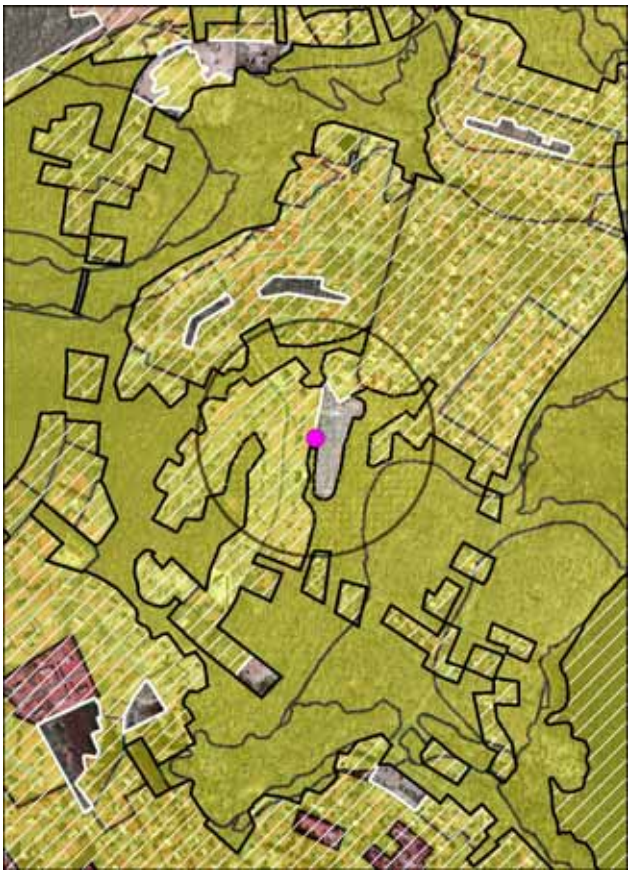
F2: All DEP 2002 LU/LC level 3 class polygons	F3: Select set of primary level 3 classes that can be valued as habitat for the species
	
F4: Select set of primary level 3 classes dissolved/combined into contiguous patches	**F5: Contiguous patches that intersect the species occurrence area**
	

Appendix IV. (Cont.)

F6: Individual LU/LC level 3 class polygons that make up the selected contiguous patches are valued for the species

F7: Select set of secondary level 3 classes that can be valued as habitat for the species

F8: Select set of secondary level 3 classes valued if adjacent to already valued patches



F9: Individual LU/LC level 3 class polygons valued for the species (non-breeding)

F10: Extent of valued area for the species occurrence (non-breeding)

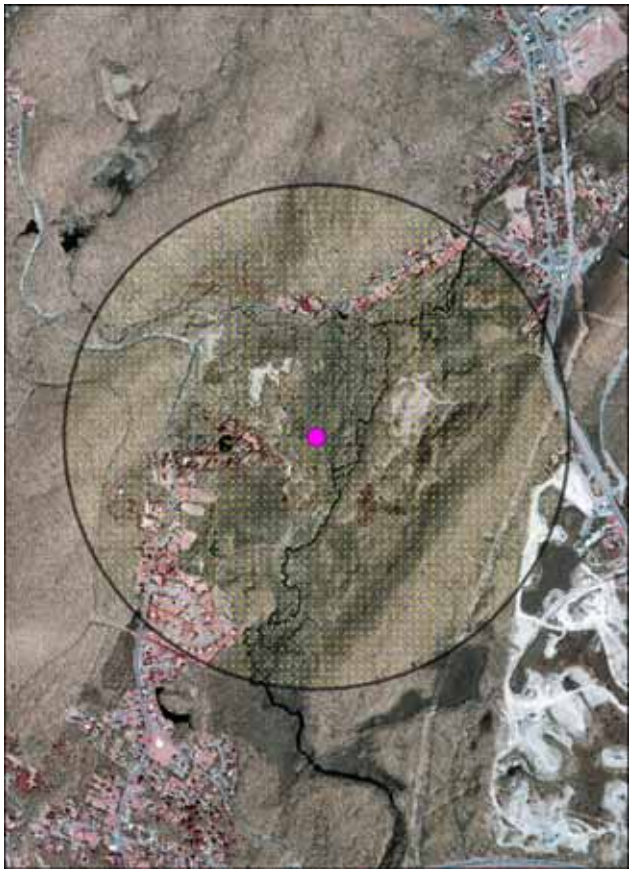
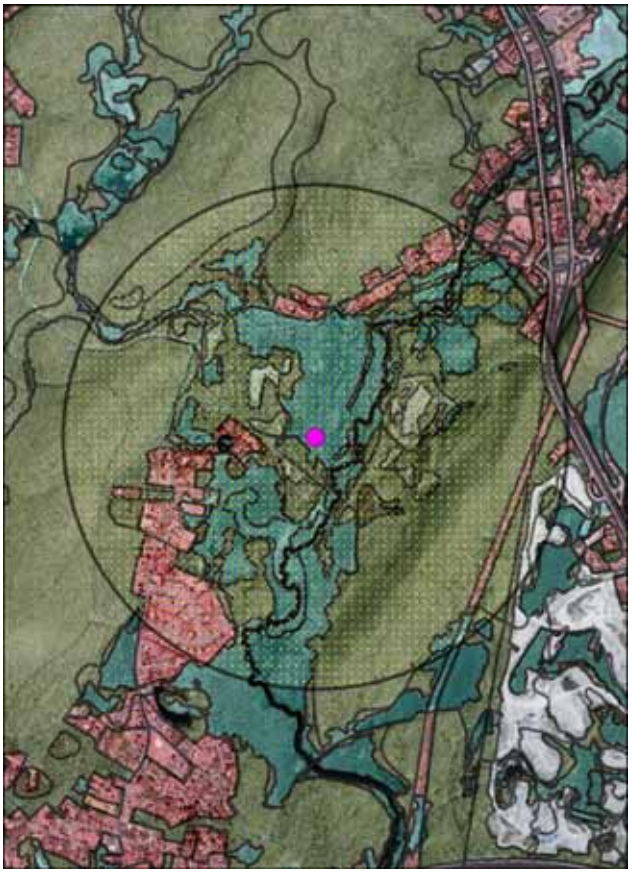
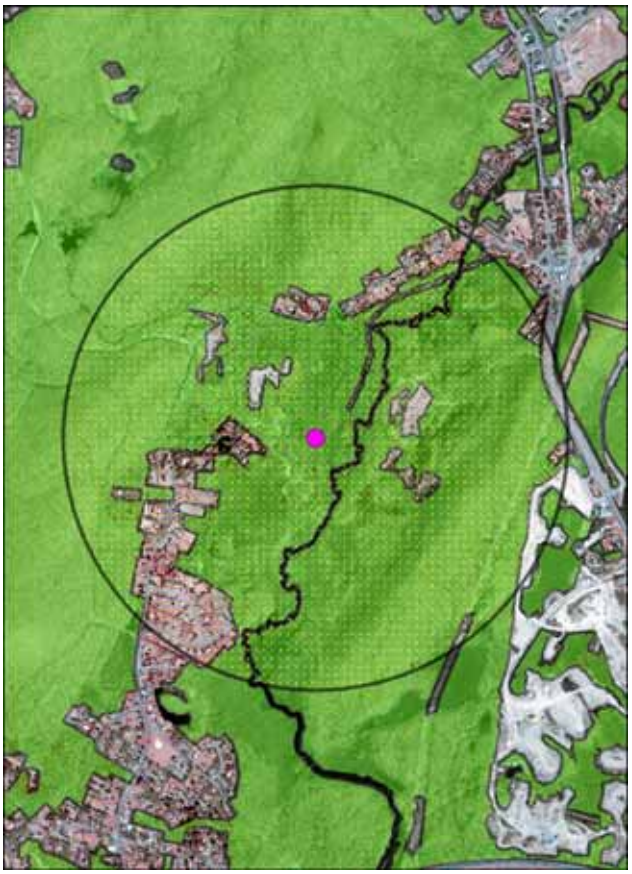
F11: Individual LU/LC level 3 class polygons valued for the species (breeding)

F12: Extent of valued area for the species occurrence (breeding)

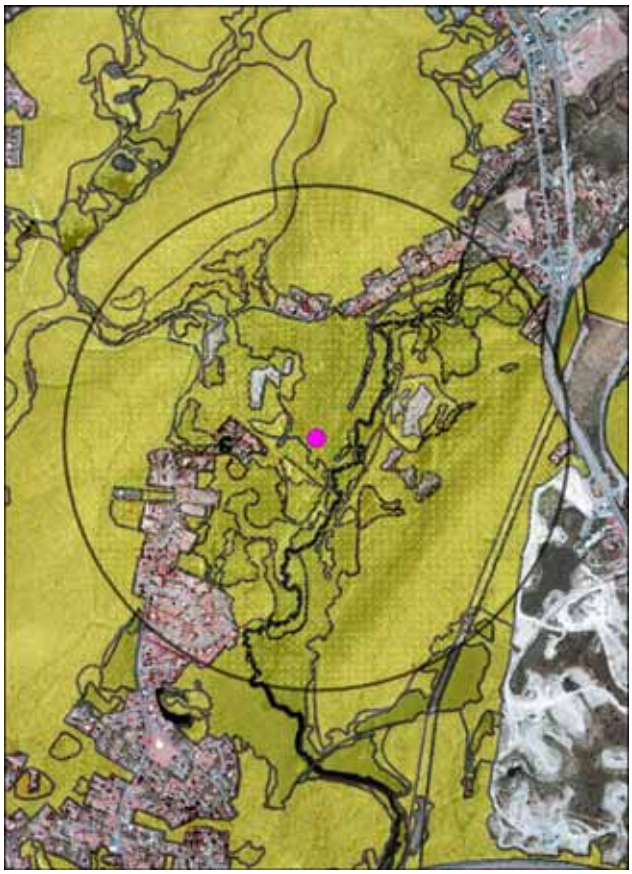
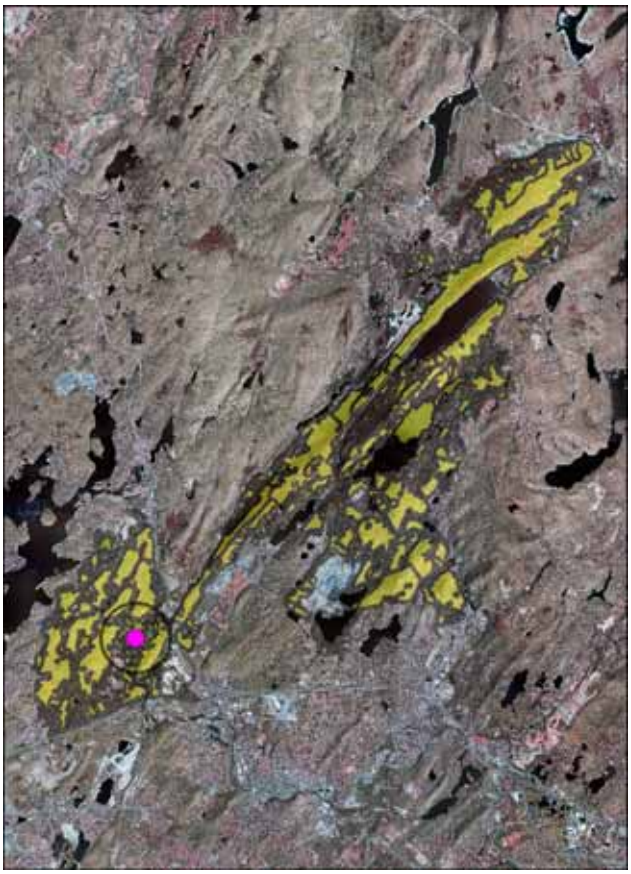
Patch Type "G" – Example

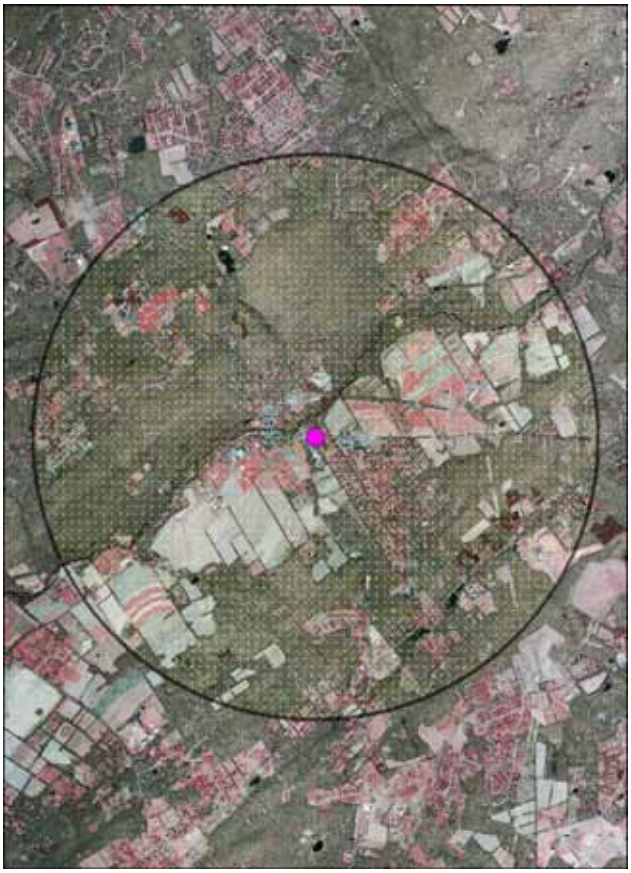
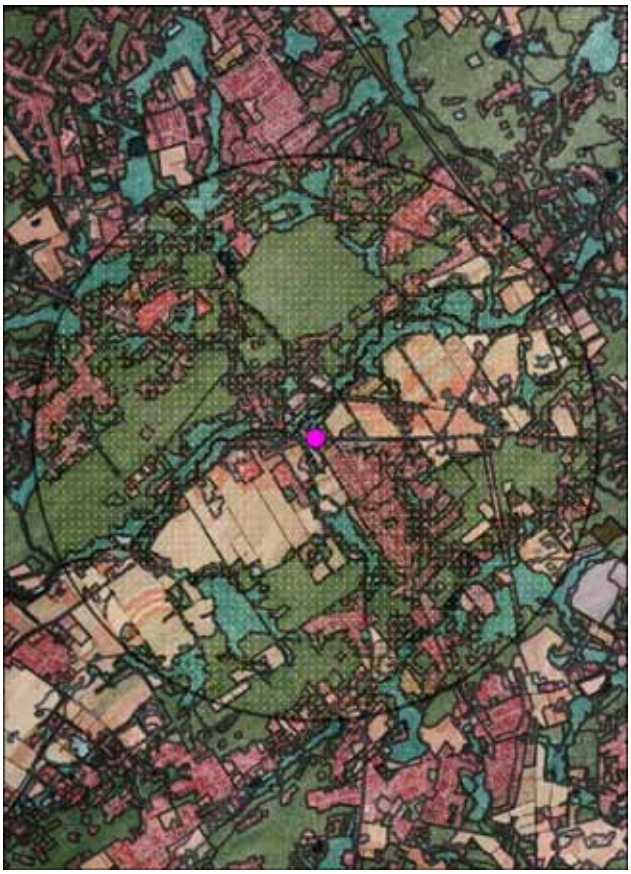
Species in this group have a minimum "core area" size requirement. They follow the same protocol as defined for Patch Type B. However, a patch must meet the core requirement before a species occurrence area can value it. Core areas are determined by buffering patches inward from the perimeter by 90 meters and erasing the buffered area from each patch. If the remaining area is 10 hectares or greater, then the original patch is coded as core.

Appendix IV. (Cont.)

G1: Species occurrence point and area overlaying 2002 aerial photography	G2: All DEP 2002 LU/LC level 3 class polygons
	
G3: Select set of level 3 classes that can be valued as habitat the species	G4: Select set of level 3 classes dissolved/combined into contiguous patches
	

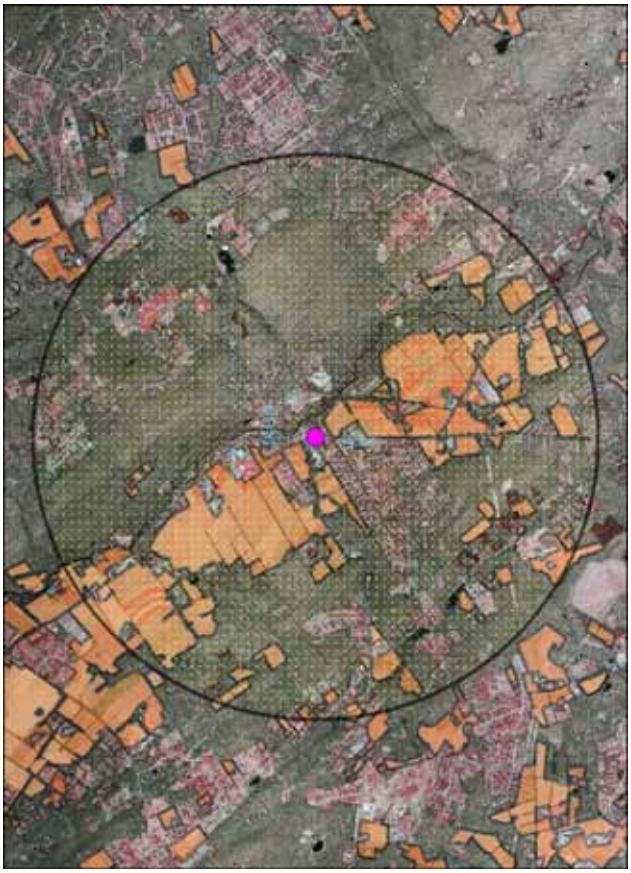
Appendix IV. (Cont.)

G5: Patches that do not meet the 10 hectares core requirement	G6: Contiguous patches that intersect the species occurrence area
	
G7: Individual LU/LC level 3 class polygons that make up the selected contiguous patches are valued for the species	G8: Extent of valued area for the species occurrence
	

Patch Type "H" – Example	H1: Species occurrence point and area overlaying 2002 aerial photography
Bobcat also has its own patch type. A select set of LU/LC classes are chosen along with LU/LC class 2100 (cropland and patureland). Acreage for LU/LC class 2100 patches are calculated and contiguous patches that are three hectares or less are retained. These patches are then combined with other selected LU/LC classifications and contiguous patches are formed. The minimum core requirement is then applied so that a patch must meet or exceed 10 hectares core area before a bobcat occurrence area can value that patch.	
H2: All DEP 2002 LU/LC level 3 class polygons	H3: Select set of level 3 classes that can be valued as habitat for the species
	

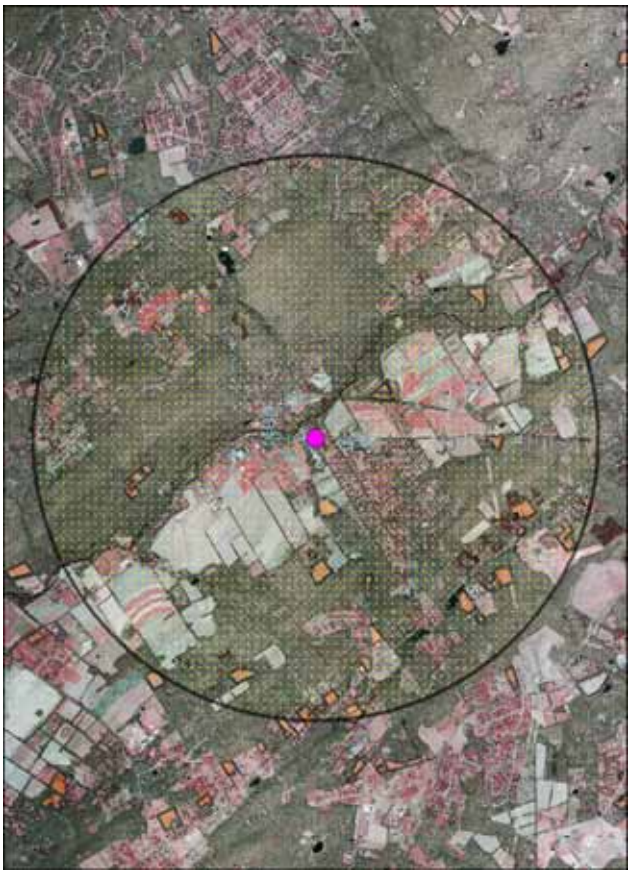
Appendix IV. (Cont.)

H4: Selection of LU/LC class 2100 (cropland and pastureland) patches

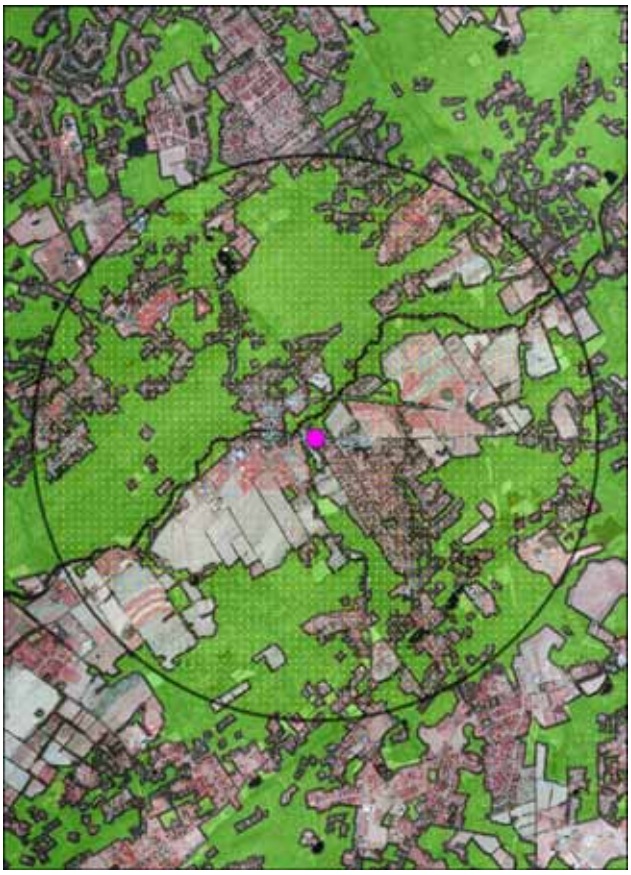


H5: Patches of LU/LC class 2100 (cropland and pastureland) that do not meet the size requirement

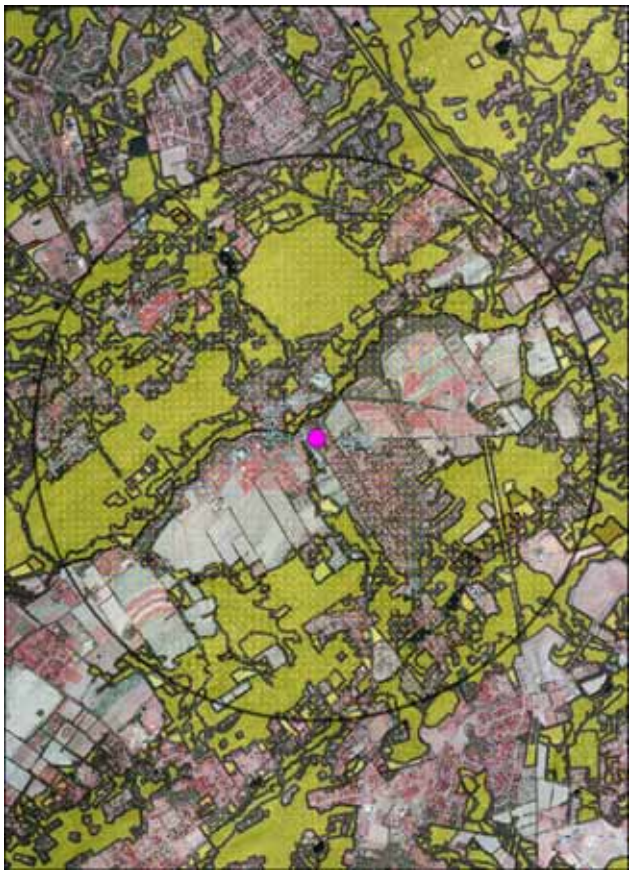
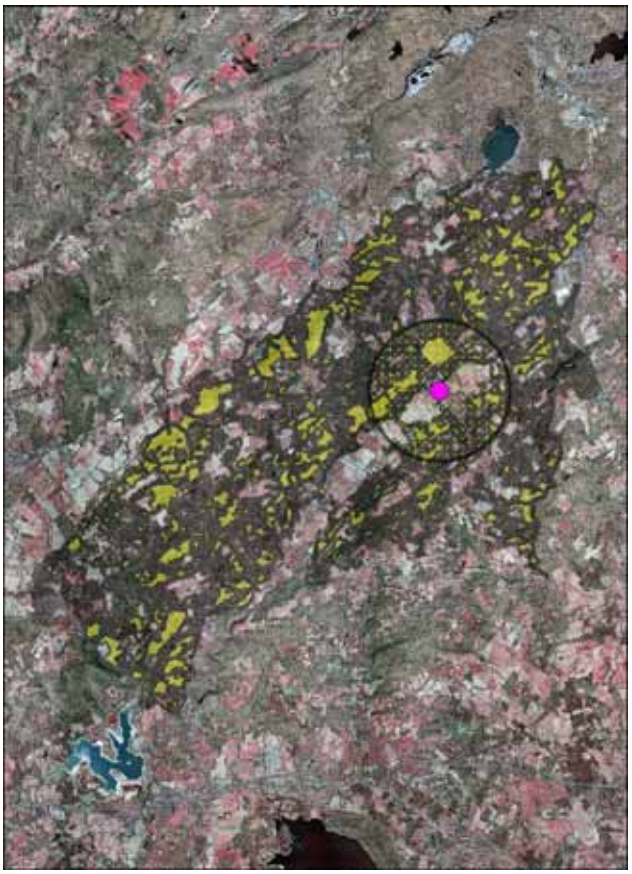
H6: Patches of LU/LC class 2100 (cropland and pastureland) that do meet the size requirement

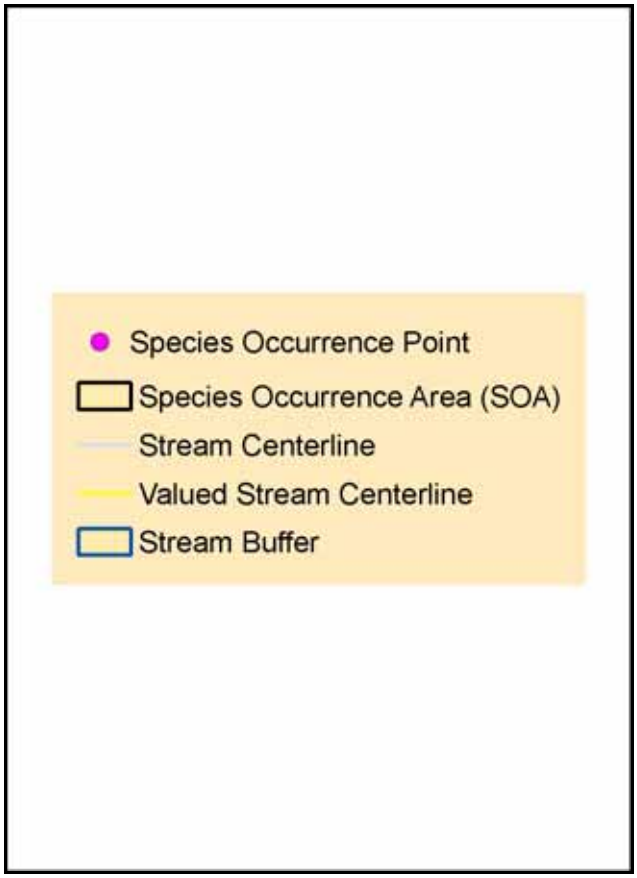


H7: LU/LC class 2100 (cropland and pastureland) patches that meet the size requirement and other selected LU/LC areas are dissolved/ combined into contiguous patches



Appendix IV. (Cont.)

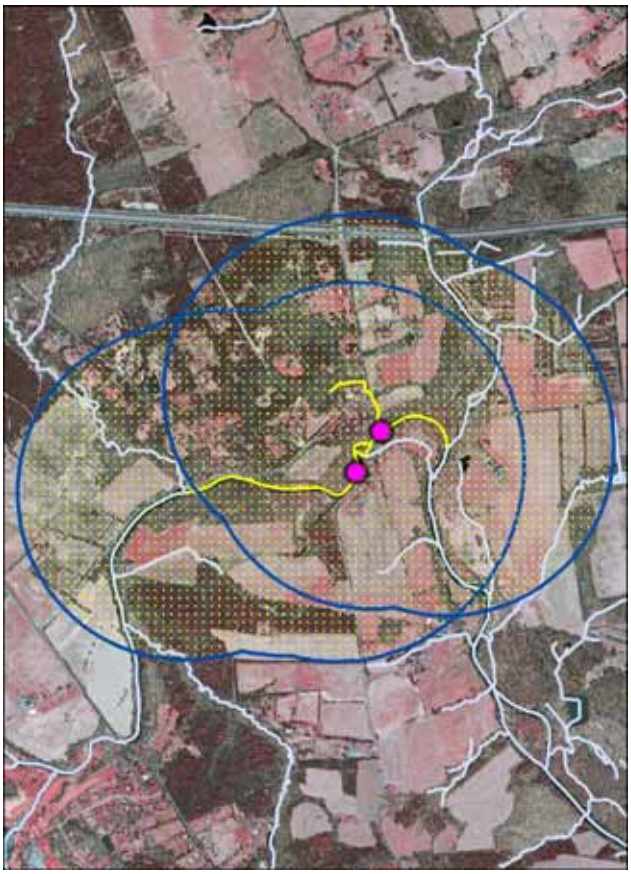
H8: Patches that do not meet the 10 hectares core requirement	H9: Contiguous patches that intersect the species occurrence area
	
H10: Individual LU/LC level 3 class polygons that make up the selected contiguous patches are valued for the species	H11: Extent of valued area for the species occurrence
	

Legend – for description of patch type “I” only	Patch Type "I" – Example
	Freshwater mussel occurrence areas are used to value stream and water body centerlines. They do not value water body polygons in the 2002 LU/LC.
I1: Species occurrence points and areas overlaying 2002 aerial photography	I2: DEP 2002 stream centerlines
	

I3: DEP 2002 stream centerlines that intersect species occurrence areas are valued for the species

I4: Stream centerlines that are valued by species occurrence areas are buffered by 0.75 kilometers

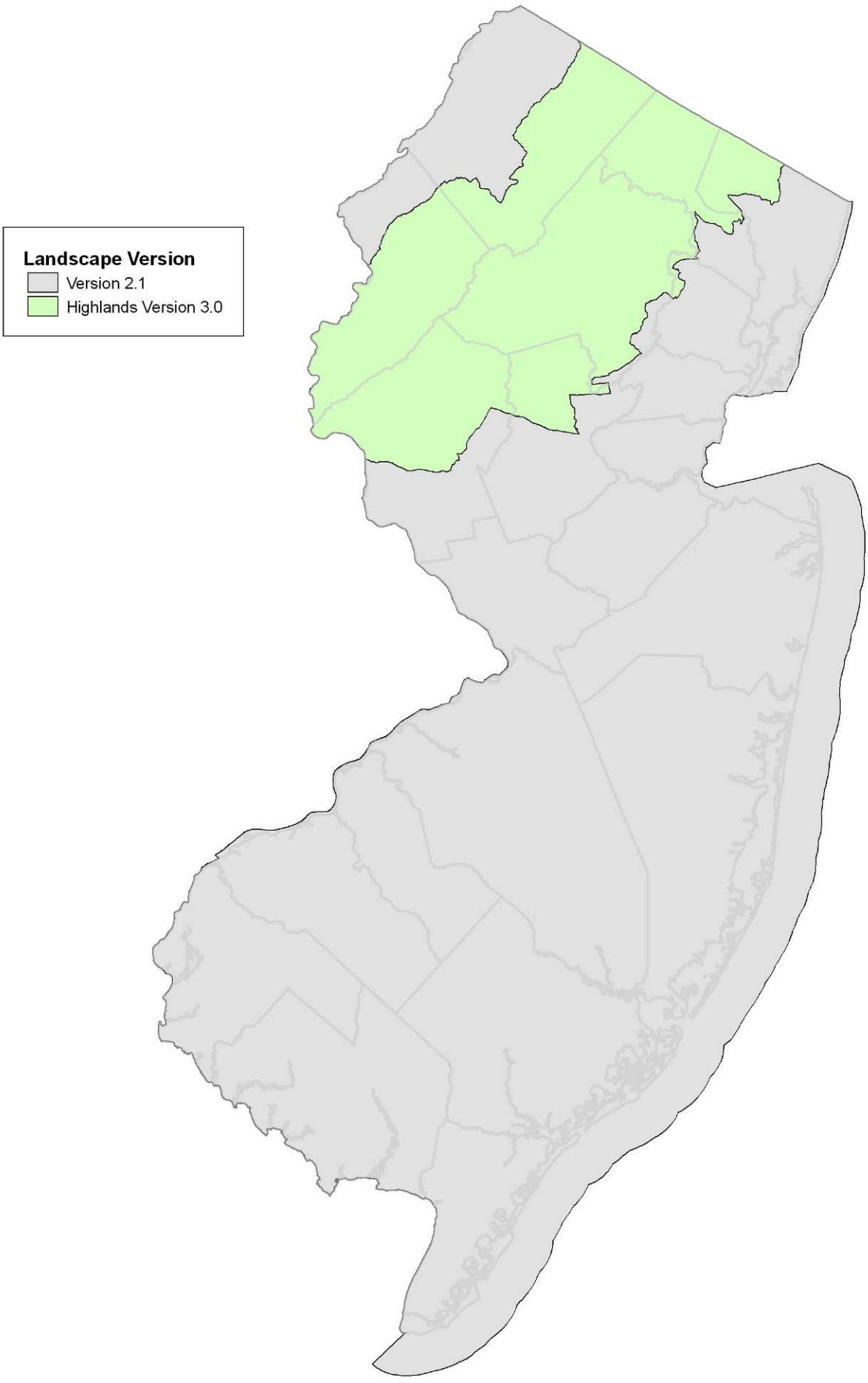
I5: Stream segments between overlapping stream buffers are valued (Note: Only in cases where stream buffers of separate occurrences of the same species meet ,are stream segments valued between the original valued streams)



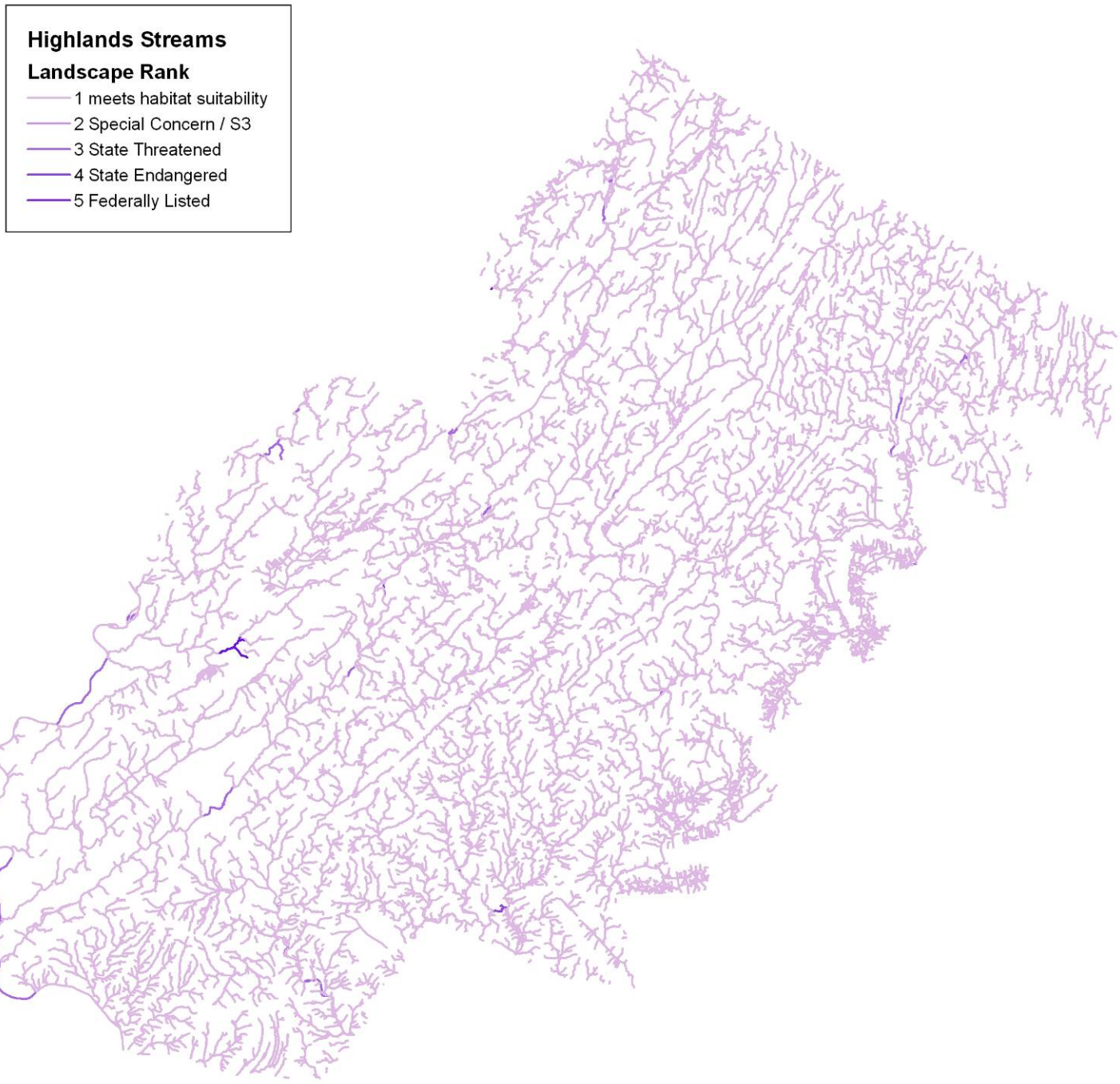
I6: Extent of valued area for the species occurrences

Appendix V. Map Gallery.

Landscape Project Version

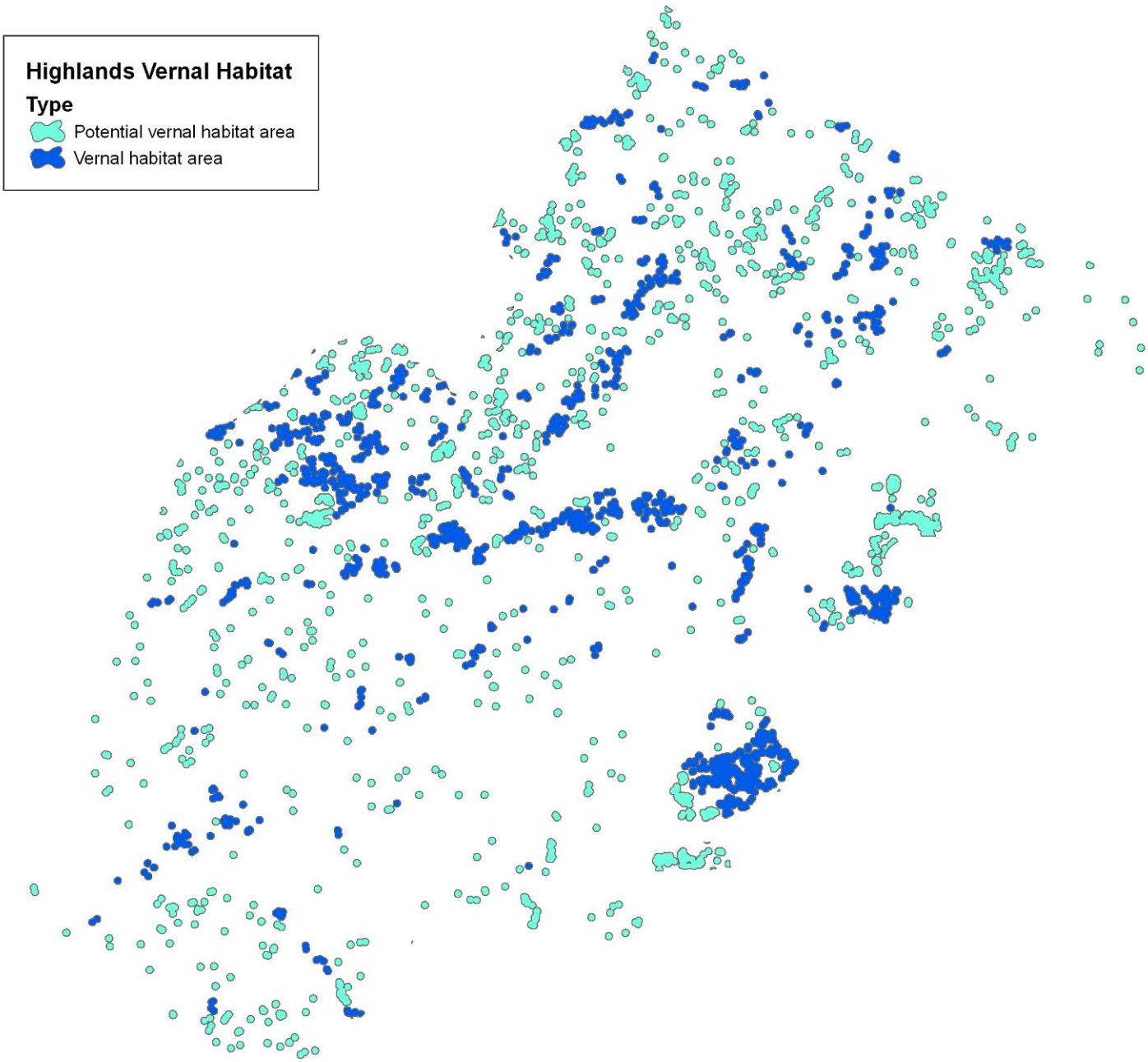


Highlands Streams



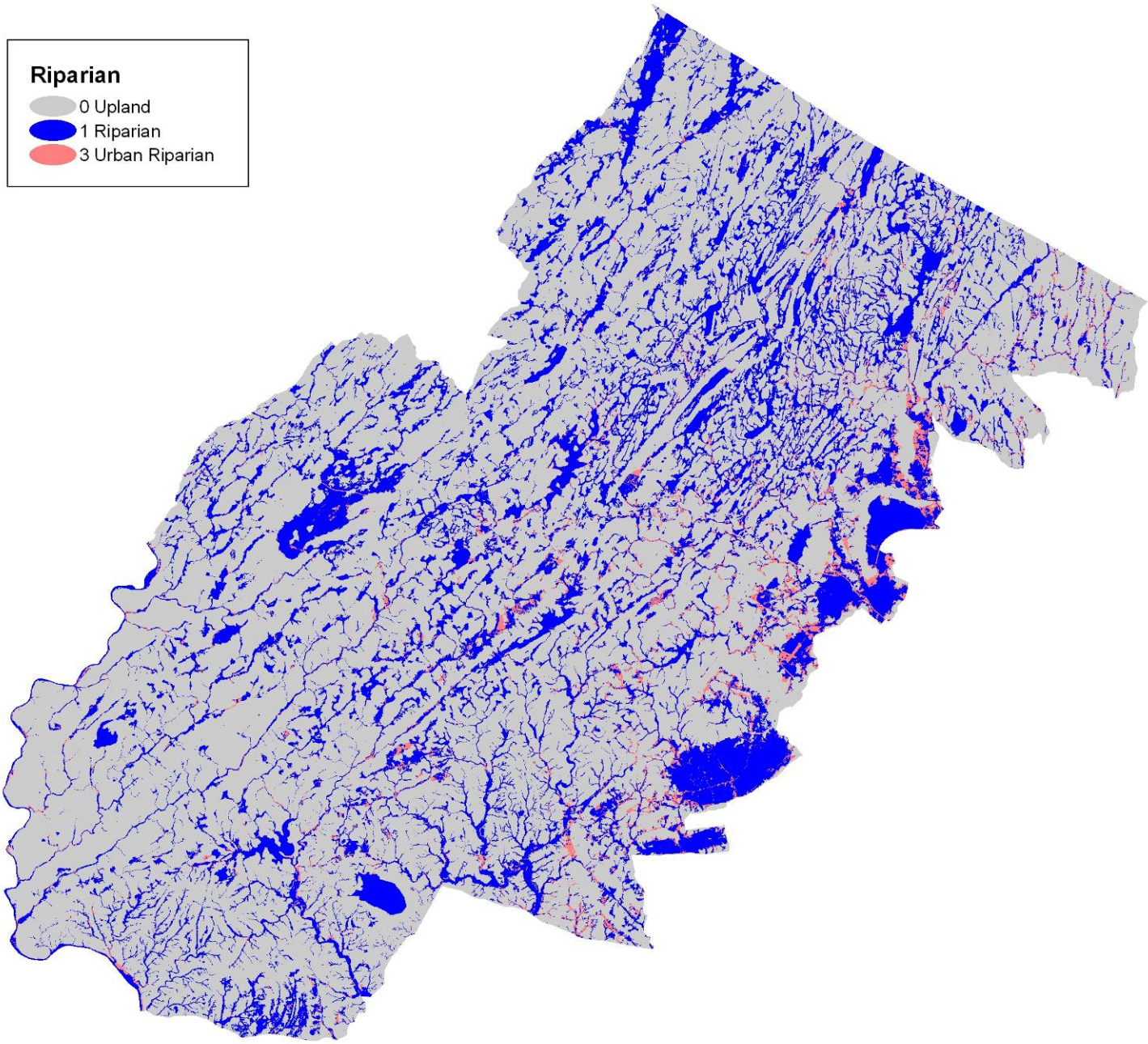
Highlands Region Extended

Highlands Vernal Habitat



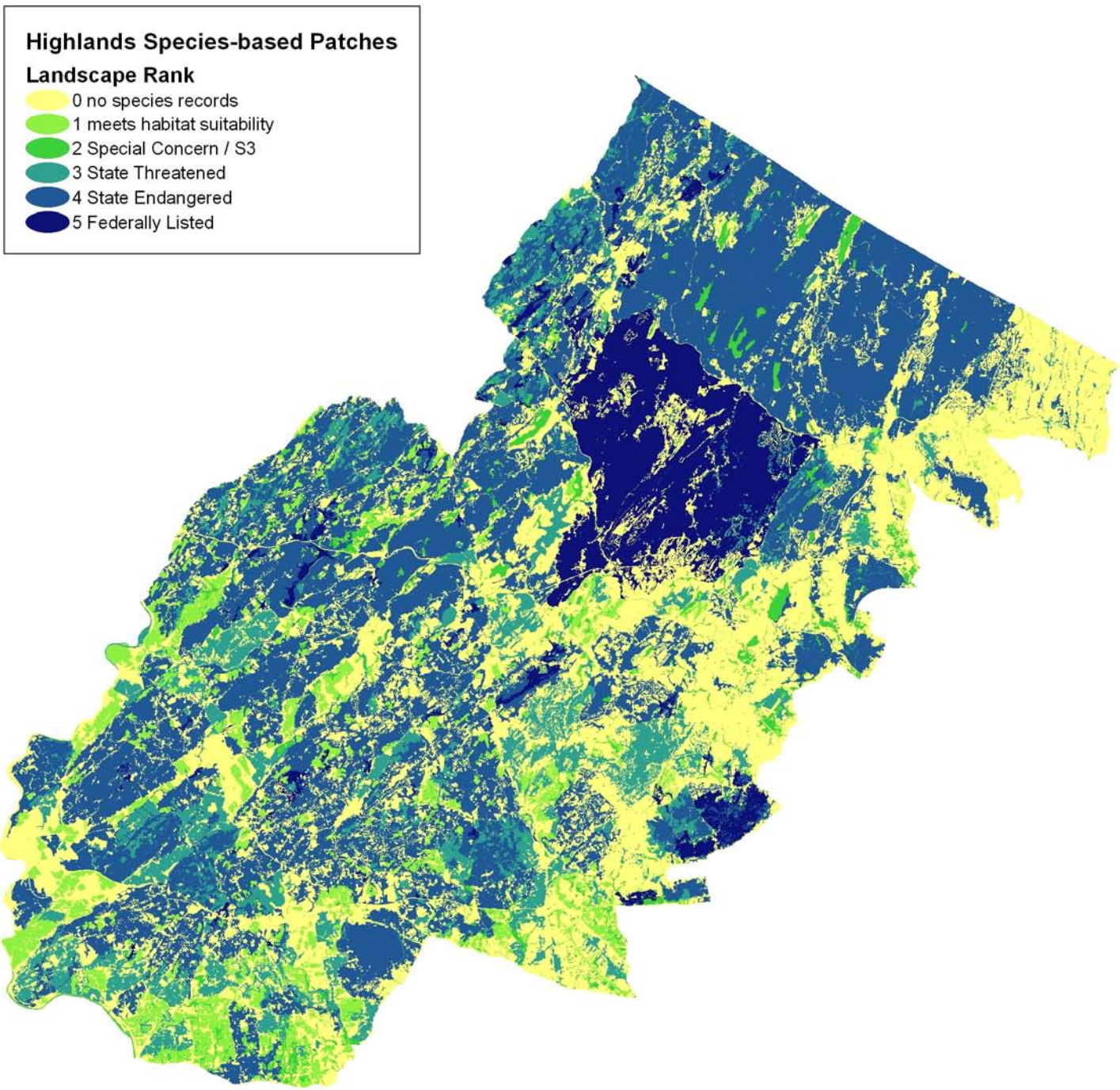
Highlands Region Extended

Highlands Riparian Corridor



Highlands Region Extended

Highlands Species-based Patches



Highlands Region Extended

Appendix VI. GIS Data Sources.

NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA). 2001. *NJDEP 1995/97 Land use/Land cover Update (Final).*

Online Linkage: http://www.state.nj.us/dep/gis/lulc95shp.html

New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). 2006. *NJDEP 2002 Land use/Land cover Update for Highlands Study Area (Final).*

Online Linkage: http://www.state.nj.us/dep/gis/lulc02cshp.html

New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). 2006. *NJDEP 2002 Streams Update for New Jersey (Final).*

Online Linkage: http://www.state.nj.us/dep/gis/hydro02shp.html

New Jersey Department of Environmental Protection (NJDEP), Division of Fish and Wildlife (DFW), Endangered and Nongame Species Program (ENSP) and Rutgers University Center for Remote Sensing and Spatial Analysis (CRSSA). 2006. *Potential Vernal Pools.*

Online Linkage: http://www.dbcrssa.rutgers.edu/ims/vernal/index.html

New Jersey Department of Environmental Protection (NJDEP), Division of Fish and Wildlife (DFW), Endangered and Nongame Species Program (ENSP). 2006. *Species Occurrence Areas, Version 2.*

Online Linkage: Unpublished.

New Jersey Department of Environmental Protection (NJDEP). *New Jersey Integrated Terrain Unit Maps (ITUM) Flood Prone Areas*

Online Linkage: http://www.epa.gov/region2/gis/atlas/fld_itum.htm

New Jersey Department of Transportation (DOT), Geographic Information Systems. 2004. *NJDOT Major Roadways 2004.*

Online Linkage: http://www.state.nj.us/transportation/gis/map.shtm

United State Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). 2005. *Soil Survey Geographic (SSURGO) database for New Jersey.*

Online Linkage: http://soildatamart.nrcs.usda.gov

Appendix VII. Literature Reviewed.

Ambuel, B., and S.A. Temple. 1983. Area-dependent changes in the bird communities and vegetation ofsouthern Wisconsin forests. Ecology 64:1057-1068.

Anthony, R.G. and F.B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. J. Wildl. Manage. 53(1):148-159.

Askins, A., J.F. Lynch, R. Greenberg. 1990. Population declines in migratory birds in eastern North America. Ch.1, pp. 1-57; In: D.M. Power, Ed., Current Ornithology Vol. 7. Plenum Press, New York.

Bellis, E.D. 1965. Home range and movement of the wood frog in a northern bog. Ecol. 46(1):90-98.

Bervin, K.A. and T.A. Grudzien. 1990. Dispersal in the wood frog (Rana sylvatica): Implications for genetic population structure.

Blake, J.G., and J.R. Karr. 1987. Breeding birds of isolated woodlots: Area and habitat relationships. Ecology 68:1724-1734.

Brittingham, M.C., and S.A. Temple. 1983. Have cowbirds caused forest songbirds to decline? BioScience 33:31-35.

Brown, W.S. 1993. Biology, status, and management of the timber rattlesnake (*Crotalus horridus*): a guide for conservation. Society for the Study of Amphibians and Reptiles. Herp. Cir. No. 22. 78pp.

Burke, D.M. and E. Nol. 1998. Influence of food abundance, nest-site habitat, and forest fragmentation on breeding ovenbirds. Auk 115(1):96-104.

Calhoun, A.J.K. and P. deMaynadier. 2004. Forestry habitat management guidelines for vernal pool wildlife. MCA Technical Paper No. 6, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

Clark, K. NINJA data base. NJ Division of Fish, Game and Wildlife.

Copeyon, C.K. 1997. Endangered and threatened wildlife and plants; final rule to list the northern population of the bog turtle as threatened and the southern population as threatened due to similarity of appearance. Federal Register 62(213): 59605-59622.

Craighead, J.J. and F.C. Craighead, Jr. 1956. Hawks, owls and wildlife. Stackpole Publ. Co., Harrisburg,PA.

Crocoll, S. and J.W. Parker. 1989. The breeding biology of broad-winged and red-shouldered hawks inwestern New York. J. Raptor Res. 23:125-139.

Darr, L.J., D.K. Dawson, C.S. Robbins. Unpublished Manuscript. Land-use planning to conserve habitat for breeding forest birds in fragmented landscape.

Dawson, D. K., L. J. Darr, and C. S. Robbins. 1993. Predicting the distribution of breeding forest birds in a fragmented landscape. Trans. North Amer. Will. Nat. Rescuer. Con. 58:35-43.

DeCalesta, D. S. 1994. Effect of white-tailed deer on songbirds within managed forests in Pennsylvania. J. Wildl. Manage. 58(4):711-718.

Douglas, M.E., and B.L. Monroe. 1981. A comparative study of topographical orientation in *Ambystoma* (Amphibia: Caudata). Copeia 1981(2):463-466.

Appendix VII. (Cont.)

Elody, B.J. and N.F. Sloan. 1985. Movements and habitat use of barred owls in the Huron Mountains of Marquette County, Michigan, as determined by radiotelemetry. Jack-pine Warbler 63(1):3-8.

Ernst, C.H. 1986. Environmental temperatures and activities in the wood turtle, *Clemmys insculpta*. J.Herpetol. 20(2):222-229.

Flather, C.H., and J.R. Sauer. 1996. Using landscape ecology to test hypotheses about large-scale abundance patterns in migratory birds. Ecology 77(1):28-35.

Freda, J. and P.J. Morin. 1984. Adult home range of the Pine Barrens treefrog (*Hyla andersoni*) and the physical, chemical, and ecological characteristics of its preferred breeding ponds. Unpublished report submitted to the Endangered and Nongame Species Program. 42pp.

Frenzel, R. 1983. Nest-site spacing of bald eagles. In Anthony, R.G., F.B. Isaacs, and R.W. Frenzel,eds. *Proceedings of a workshop on habitat management for nesting and roosting bald eagles in the western United States.* Corvallis: Coop. Wildl. Res. Unit, Oregon State Univ.

Friesen, L.E., P.F.J. Eagles, and R.J. Mackay. 1995. Effects of residential development on forest-dwelling neotropical migrant songbirds. Cons. Biol. 9(6):1408-1414.

Fuller, M.R. 1979. Spatiotemporal ecology of four sympatric raptor species. Ph.D. Dissertation. University of Minnesota, St. Paul. 396 pp.

Gordon, R.E. 1968. Terrestrial activity of the spotted salamander, *Ambystoma maculatum.* Copeia 1968(4):879-880

Hoover, J.P., M.C. Brittingham, and L. J. Goodrich. 1995. Effects of forest patch size on nesting success of wood thrushes. Auk 112(1):146-155.

Johnson, E. and P.J. Morin. 1985. 1985 blue-spotted salamander (*Ambystoma laterale*) project report. Unpublished report, NJDEP, DFGW, ENSP. 10pp.

Kiser, J.D. and C.L. Elliott. 1996. Foraging habitat, food habits, and roost tree characteristics of the Indiana bat (Myotis sodalis) during autumn in Jackson County, Kentucky. Final Report, Nongame Program, Kentucky Department of Fish and Wildlife Resources, Frankfort. 65pp.

Kleeberger, S.R. and J.K. Werner. 1983. Post-breeding migration and summer movement of Ambystoma maculatum. J. Herpetol. 17(2):176-177

Klemens, M.W. 1993. Standardized bog turtle site-quality analysis. Amer. Mus. Nat. His., New York, NY 7pp.

Lovich, J.E. 1990. Spring movement patterns of two radio-tagged make spotted turtles. Brimleyana 16:67-71.

Martin, W.H. 1992. Phenology of the timber rattlesnake (*Crotalus horridus*) in an unglaciated section of the Appalachian Mountains. In Campbell, J.A. and E.D. Brodie, Jr. (Eds.) Biology of the Pitvipers. Selva, Tyler, Texas. pp. 259-277.

Nichols, T.H. and D.W. Warner. 1972. Barred owl habitat use as determined by radiotelemetry. J. Wildl. Manage. 36(2):213-224.

Peterson, A. 1986. Habitat suitability index models: Bald eagle (breeding season). U.S. Fish Wildl. Serv. Biol. Rep. 82(10.126). 25 pp.

Appendix VII. (Cont.)

Petranka, J.W. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington, D.C..

Quinn, N.W.S. and D.P. Tate. 1991. Seasonal movements and habitat of wood turtles (*Clemmys insculpta*) in Algonquin Park, Canada. J. Herpetol. 25(2):217-220.

Reap, P.A. and R.T. Zappalorti. 1983. Notes on the diploid and triploid species of the *Ambystoma jeffersonianum* complex in New Jersey. Unpublished rept. to the Endangered and Nongame Species Program: 18pp.

Reinert, H.A. and R.T. Zappalorti. 1986. Habitat utilization by the timber rattlesnake, *Crotalus horridus*, in southern New Jersey with notes on hibernation. Final Report, Endangered and Nongame Species Program, Trenton, New Jersey. 172pp.

Rich, A.C., D.S. Dobkin, and L.J. Niles. 1994. Defining forest fragmentation by corridor width: The influence of narrow forest-dividing corridors on forest-nesting birds in southern New Jersey. Conservation Biology 8(4):1109-1121.

Ritke, M.E., J.G. Babb, and M.K. Ritke. 1991. Breeding-site specificity in the gray treefrog (*Hyla chrysoscelis*). J. Herpetol. 25(1):123-125.

Robbins, C.S., D.K. Dawson, and B.A. Dowell. 1989. Habitat area requirements of breeding forest birds of the Middle Atlantic States. Wildl. Monogr. No. 103:1-34.

Roberts, W. and V. Lewin. 1979. Habitat utilization and population densities of the amphibians of northeastern Alberta. Can. Field-Nat. 93(2):144-154

Robinson, S.K., F.R. Thompson III, T.M. Donovan, D.R. Whitehead, and J. Faaborg. 1995. Regional forest fragmentation and the nesting success of migratory birds. Science 267:1987-1990.

Semlitsch, R.D. 1981. Terrestrial activity and summer home range of the mole salamander (*Ambystoma talpoideum*). Canad. J. Zoology 59:315-322.

Semlitsch, R.D. and J.R. Bodie. 2003. Biological criteria for buffer zones around wetlands and riparian habitats for amphibians and reptiles. Conservation Biology 17(5):1219-1228.

Shaffer, B.H. and P.C. Trenham. 2005. Amphibian upland habitat use and its consequences for population viability. Ecological Applications 15(4), 2005. pp. 1158-1168.

Stewart, R.E. 1949. Ecology of a nesting red-shouldered hawk population. Wilson Bull. 61:26-35.

Stihler, C. 1998. Indian bat radio telemetry study. West Virginia Nongame & Natural Heritage News. Summer, 1998. p. 5.

Strang, C.A. 1983. Spatial and temporal activity patterns in two terrestrial turtles. J. Herpetol. 17(1):43-47.

Wacasey, J. W. 1961. An ecological study of two sympatric species of salamanders, *Ambystoma maculatum and Ambystoma jeffersonianum* in southern Michigan. Ph.D. diss., Michigan State University, East Lansing. 117 pp.

Whitcomb. R.F., C.S. Robbins, J.F. Lynch, B.L. Whitcomb, K. Klimkiewicz, and D. Bystrak. 1981. Effects of forest fragmentation on avifauna of the eastern deciduous forest. Pages 125-205 in: R.L. Burgess and D.M. Sharpe, eds.,Forest Island Dynamics in Man-dominated Landscapes. Springer-Verlag, New York, NY.

Appendix VII. (Cont.)

Williams, P.K. 1973. Seasonal movements and population dynamics of four sympatric mole salamanders, genus Ambystoma. Ph.D. thesis, Indiana University, Bloomington, IN

Wilson, R.E. 1976. An ecological study of *Ambystoma maculatum and Ambystoma jeffersonianum.* Ph.D. diss., Cornell University, Ithaca. 116pp.

Appendix VIII. Literature Cited.

Anderson, J.R., E.E. Hardy, J.T. Roach, and R.E. Witmer. 1976. A land use and land cover classification system for use with remote sensor data. U.S. Geological Survey Professional Paper 964. 28 p.

Hasse, J, and R. Lathrop. 2001. Measuring urban growth in New Jersey. A report on recent land development patterns utilizing the 1986-1995 NJ DEP Land Use/Land Cover Dataset. Center for Remote Sensing and Spatial Analysis. Rutgers University.

Lathrop, R.G., P. Montesano, J. Tesauro, and B. Zarate. 2005. *Statewide mapping and assessment of vernal pools: A New Jersey case study*. Journal of Environmental Management 76: 230-238.