PROTOCOLS FOR THE ESTABLISHMENT OF EXCEPTIONAL RESOURCE VALUE WETLANDS PURSUANT TO THE FRESHWATER WETLANDS PROTECTION ACT (N.J.S.A. 13:9B-1 ET SEQ.) BASED ON DOCUMENTATION OF STATE OR FEDERAL ENDANGERED OR THREATENED SPECIES

NOVEMBER 2023

A cooperative effort of
WATERSHED AND LAND MANAGEMENT

OFFICE OF NATURAL LANDS MANAGEMENT
DIVISION OF PARKS AND FORESTRY
and
THE ENDANGERED AND NONGAME SPECIES PROGRAM
DIVISION OF FISH AND WILDLIFE
http://www.nj.gov/dep/landuse/

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Introduction

As part of its legal mandate to implement the provisions of the Freshwater Wetlands Protection Act (Act) (N.J.S.A. 13:9B-1 et seq.), the New Jersey Department of Environmental Protection (Department) has developed the following protocols for designating freshwater wetlands of exceptional resource value based on documentation of endangered and threatened species. In developing these protocols, Department staff has conducted extensive reviews of scientific literature and field studies for each species. Criteria believed to define the presence, absence, and distribution of each species in a particular habitat type (e.g. home range, movement patterns, habitat use characteristics, predator and prey relationships, population ecology) were integrated to establish, where possible, a practical and predictable framework through which the requirements of the Act can be met.

The guidelines provided below are flexible in nature. They should be employed as an outline by which to evaluate blocks of wetland habitat for resource value classification under the Act. In addition, the Department views the wetland classification process as evolutionary, with protocols for each species being added, deleted, or modified, as experience and new scientific information warrant. To facilitate this process, each species' protocol will be dated so that new versions may be distinguished from older ones. We believe that the protocols will provide the regulated public and the environmental consultant community with a good understanding of the science and rationale behind the implementation of the resource value classification and transition area requirements of the Act.

Legal Basis

The Freshwater Wetlands Protection Act, at N.J.S.A. 13:9B-7, directs the Department to develop a system for the classification of freshwater wetlands based upon criteria that distinguish between wetlands of exceptional resource value, intermediate resource value, and ordinary resource value. Wetlands of exceptional resource value are described as those that discharge into FW-1 or FW-2 trout production waters and their tributaries. A resource value classification is also granted to a wetland that has been recently or historically documented as habitat for endangered or threatened species. Documentation of a habitat occurs provided that the habitat is suitable for breeding, resting, or feeding by the named species.

The following is an excerpt from the Act rules, N.J.A.C. 7:7A-1, that provides further explanation of a *documented habitat:*

> *1. There is recorded evidence of past use by a threatened or endangered species of flora or fauna for breeding, resting or feeding. Evidence of past use by a species may include, but is not limited to, sightings of the species, or of its sign (for example, skin, scat, shell, track, nest, herbarium records etc.), as well as identification of its call; and*

2. The Department makes the finding that the area remains suitable for use by the specific documented threatened or endangered species during the normal period(s) the species would use the habitat."

Wetlands designated as being of exceptional resource value receive additional levels of protection under the guidelines for establishing transition areas (13:9B-16), obtaining transition area waivers (13:9B-18), the issuance of wetland permits (13:9B-9) and the issuance of statewide general permits (13:9B-23). Additional details on the restrictions or requirements may be found in the Freshwater Wetlands Protection Act Rules at N.J.A.C. 7:7A-1 et.seq.

Rationale

This document is the third edition of the Department's guide for the classification of freshwater wetlands based on the documentation of endangered or threatened species. It has been divided into three sections. The first section will discuss how the Department interprets individual sightings of endangered or threatened animal species and translates them into areas of documentation using the Endangered and Nongame Species Program's (ENSP) Landscape Project Maps. The second section will consist of individual endangered or threatened animal species habitat discussions. The third section will discuss the protection applied to federally listed plant species under the Act.

In the first edition of the Act Protocols (DEP 1995), the Department largely focused on protecting only those habitats known to be occupied and suitable for use by a local population of a particular species. Suitable habitat adjacent to but outside of the estimated area of use by that population was not considered to be a documented habitat. Therefore, it was not considered to be endangered or threatened species habitat. At that time, the Department felt that this strategy was the best applied approach to (1) ensure appropriate natural resource protection, and (2) provide for consistency and predictability in the regulatory process.

Due to the changes in New Jersey's landscape over the last ten to fifteen years during the decades of the 80's and 90's and the evolution of landscape-based habitat protection theories, the Department had to reconsider its protection strategy defined in 1995. The rapid suburbanization of the landscape has led to the loss and degradation of critical wildlife habitat and the fragmentation and isolation of the habitats that remain. Many rare species populations require large contiguous blocks of habitat to survive longterm. Small patches of fields, forests and wetlands interspersed with development provide habitat for some common species but do not necessarily provide the necessary habitat for the long-term protection of most many of our endangered and threatened animal species. Examples of these conditions include the loss of 40 percent of the remaining critical migratory bird stopover habitat on the lower third of the Cape May Peninsula and approximately 50 percent loss of New Jersey's bog turtle habitat during the last three decades. Recent studies conducted to assess the status of the state-listed raptors in southern New Jersey have raised questions about the long-term stability of their

populations (Sutton and Dowdell 2001). As a result, the Department conducted a re-assessment of its regulatory efforts under the Act to see if the above objectives were being met and determined that a change in approach was necessary.

To this end, the Department sought to establish a population-driven parameter of habitat protection which would best ensure the continued, long-term existence of a particular documented species, or population, in an identified wetland habitat. As a solution, the Department decided in July 2002 to replace the former species sighting-specific areas of documentation with species population/habitat complex Landscape Maps to improve upon both the predictability and quality of habitat protection provided under the Act. The second version of the Department's protocols incorporated changes made to the Landscape methodology that attempted to further identify those specific habitats in need of protection for each species. The present version of the Landscape Maps (Version 3.3) continues the evolution of the habitat patch protection strategy by revising the maps based on 2012 Land Use/Land Cover mapping and up-dating some of the species models/ habitat relationships to more accurately reflect current science incorporating statewide these species- based patch methodology. originally applied only in the Highlands region. Some of the species-specific habitat discussions have been up-dated to incorporate the results of more recent scientific work. Others have been added to reflect changes made to the list of state endangered and nongame species adopted in February 2012. A summary of the species protocols developed to date is provided in Tables 1-5. Each species' protocol occurring in the second section of this document provides a discussion on the following topics:

a. The species' distribution in New Jersey;

b. A summary of the habitat types and characteristics used by the species for feeding, resting and breeding;

c. A summary of survey methodologies used to identify the presence or absence of the species;

d. A Fish and Wildlife contact person for additional information on the species and their habitats;

e. Primary authors and date of protocol draft; and

f. A literature cited section.

For additional information on the development of these protocols, please contact Larry Torok of the Land Use Regulation Program at (609) 633-6755 or Pat Woerner of the Endangered and Nongame Species Program at (908)638-4127.

Cautions

The Department notes that the Landscape Project maps represent an approximation of the location and extent of documented endangered or threatened species habitat. Because the maps are rooted in the Department's aerial photograph-based land-use/land-cover data, they do not replace the need for an individual case site assessment of the wetlands on any particular property. The Department will also use other sources of information relating to the presence or absence of endangered or threatened species. These sources include but are not limited to, new valid sightings, received from the applicant or members of the interested public that have not yet been incorporated into the Landscape mapping, and the results of surveys of listed species conducted or sponsored by the Department.

Additionally, because the wetland classification process is an evolutionary process, it must be emphasized that the protocols provided are subject to change, deletion, or addition as new information or experience dictate. The absence of a protocol for a particular endangered or threatened species does not prevent wetland habitats being used by such species from being designated as exceptional resource value on a case by case basis. For example, species such as Queen snakes (*Regina septemvittata)*, peregrine falcons (*Falco peregrinus*) or freshwater mussel species may rely on freshwater wetland habitats for their continued survival in certain circumstances. To obtain a legal determination of a wetland classification and subsequent regulatory restrictions, it is recommended that a formal Letter of Interpretation be obtained from the Department. In addition, the protection standards provided below are largely designed for regulatory purposes and may not be entirely ideal for wildlife habitat conservation purposes. The Department cautions against applying these standards universally in instances where long-term land use and conservation goals are desired. Finally, we note that the survey guidelines provided are examples of what other researchers have used to capture or document the presence of specific endangered or threatened species, often for research purposes. Protocols for presence/absence survey efforts specific to New Jersey may vary from these examples and the Department recommends that surveyors coordinate species survey methodologies with Program staff prior to conducting such surveys.

Literature Cited

Department of Environmental Protection. 1995. Protocols for the establishment of exceptional resource value wetlands pursuant to the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.) based on documentation of state of federal endangered or threatened species. NJDEP, Landuse Regulation Program, Office of Natural Lands Management, and Endangered and Nongame Species Program. Trenton, New Jersey. pp. 152.

Sutton, C. and J. Dowdell. 2001. Woodland raptor surveys in the Bellplain State Forest Region and elsewhere in Cape May, Cumberland, and Atlantic Counties, New Jersey. Spring 2001. pp. 7 plus appendices.

TABLE ONE: STATE ENDANGERED HERPTILE PROTOCOLS

Species	**Listed Status**	**Area of Documentation**	**Suitable Wetland Habitats**
Blue-spotted salamander	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	0.5-3m deep pond surrounded by forest with a dense litter base. Adjacent upland forest.
Tiger salamander	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	1-3m deep pond with >1 side forested with additional forested corridors. Few or no predators. Adjacent upland forest.
Bog Turtle	NJ(E) US(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Emergent or scrub-shrub wetlands within wetland complex association with sighting.
Timber Rattlesnake	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	North-All mapped wetland habitats for foraging. South-Forested riparian habitat. Forested wetland w/dense surface vegetation and litter. Favors sandy soils, upland foraging habitat. Occasional upland denning sites.
Southern gray treefrog	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Mixed forest ponds, open bog areas, gravel pits, floodplain wetlands. Forested adj. Uplands important.

TABLE TWO: STATE THREATENED HERPTILE PROTOCOLS

Species	**Listed Status**	**Area of documentation**	**Suitable Wetland Habitats**
Wood turtle	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Mosaics of forested, scrub-shrub, emergent wetlands, upland forest, old fields and agricultural lands.
Pine Barrens treefrog	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Typical habitat: ponds 0.1 <> 2 m. deep or with 75% of area 0.1<>2 m. deep. Aver shrub ht. 1.6 m, pH 3.8<>4.6, open canopies.
Mud Salamander	NJ(T)	Wetlands associated with locale of sighting.	

TABLE THREE: STATE ENDANGERED BIRD SPECIES PROTOCOLS

Species	**Listed Status**	**Area of documentation**	**Suitable Wetland Habitats**
Henslow's sparrow	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Seasonally saturated emergent wetlands, sparse shrub cover, 1-2m high.
Short – eared owl	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Seasonally saturated emergent scrub/shrub habitats
American bittern	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Emergent marsh habitats featuring cattails and sedges.
Red – shouldered hawk	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Hardwood, softwood, or mixed swamp featuring mature, closed overstory, variable to dense understory, near streams or open water.
Northern harrier	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Open field, meadow, emergent marsh, or wet agricultural areas.
Sedge wren	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Seasonally saturated marsh, meadows, or wet fields. Sedges, rushes, and grass dominate. Sparse 1-2m. shrub layer.
Bald eagle (breeding)	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	All wetlands contiguous with a 1 km radius of a nest site will be assessed as they relate to maintaining a suitable nest environment.

TABLE THREE: STATE ENDANGERED BIRD SPECIES PROTOCOLS(cont.)

Golden-winged Warbler	NJ (E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	open scrubby areas or wetlands as well as brushy, early successional habitat.

TABLE FOUR: STATE THREATENED BIRD PROTOCOLS

Species	**Listed Status**	**Area of Documentation:**	**Suitable Wetland Habitats**
Long – eared owl	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Linear forest, hedgerows, or smallish stands of moderate age forest. Emergent or scrub-shrub wetland field habitats.
Bobolink	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Open field or meadow. Dominated by grasses or forb species. Sparse saplings and fence posts used for perches.
Cattle Egret	NJ (T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Freshwater or brackish, fringe marshes featuring emergent vegetation (e.g. grasses, sedges, rushes).
Black rail	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Freshwater or brackish, fringe marshes featuring emergent vegetation (e.g. grasses, sedges, rushes).
Yellow-crowned night heron	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Freshwater or brackish, fringe marshes featuring emergent vegetation (e.g. grasses, sedges, rushes).
Black-crowned night heron	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Freshwater or brackish, fringe marshes featuring emergent vegetation (e.g. grasses, sedges, rushes).
Red – headed woodpecker	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Floodplain, or flooded wetlands typified by dead trees, open understories, and mast.
Osprey	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Forested, scrub-shrub, or emergent wetlands w/in proximity to nest structure.
Barred owl	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Hard, soft, or mixed forest stands featuring closed canopies and open to variable density understories.

TABLE FIVE: STATE ENDANGERED MAMMAL PROTOCOLS

Species	**Listed Status**	**Area of Documentation**	**Suitable Wetland Habitats**
Indiana Bat	NJ(E) US(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Forested hardwood wetland complexes, often in associated with floodplains, streams and waterbodies.

TABLE SIX: STATE LISTED INVERTEBRATES

Species	**Listed Status**	**Area of Documentation**	**Suitable Wetland Habitats**
Gray Petaltail	NJ(E)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Mucky seepage areas in mature forests or mossy, wooded fens.
Banner Clubtail	NJ (T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Tea-colored, acidic streams with sandy substrates and large accumulations of organic debris.
Brook Snaketail	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Clear, sand bottomed streams or rivers with intermittent rapids and wood riparian habitat adjacent.
Superb Jewelwing	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Clean, fast moving streams with dense surrounding forest and abundant aquatic vegetation.
Kennedy's Emerald	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Cold water limestone fens and bogs.
Robust Baskettail	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Flood plain swamps, marshes adjacent to rivers or streams or woodland ponds.
Harpoon Clubtail	NJ(T)	Refer to Appendix II and V in the Landscape Ver. 3.3 document.	Stream segments with fine, sand substrates.

TABLE SEVEN: FEDERALLY LISTED PLANT PROTOCOLS

Species	**Listed Status**	**Area of Documentation**	**Suitable Wetland Habitats**
Endangered			
Small-whorled Pogonia (*Isotria medeoloides*)	US(E) NJ(E)	Case by case basis	Braided stream, secondary growth hard or softwood forests with Loam soils.
Threatened			
Sensitive Joint-Vetch (*Aeschynomene virginica*)	US(T) NJ(E)	Case by case basis	Across a gradient of freshwater to brackish emergent tidal river marshes.
Swamp Pink (*Helonias bullata*)	US(T) NJ(E)	Case by case basis	Mucky soils, dense canopy or understory, sphagnum hummock bogs. Habitats infrequently flooded.
Knieskern's beaked rush (*Rhynchospora knieskernii*)	US(T) NJ(E)	Case by case basis	Early successional or disturbed communites with dense soils and vegetative communities of grasses and other rushes.

SECTION I.

LANDSCAPE PROJECT MAPPING - PROTOCOL FOR IDENTIFYING AND DELINEATING CRITICAL WILDLIFE HABITAT

INTRODUCTION

Since the advent of the Landscape Mapping Project and the release of Version 1.0 in July 2002, the Division of Land Use Regulation has used the mapping to establish whether or not a particular wetland habitat could be a "documented" habitat for endangered or threatened species for the purposes of implementing the resource value classification and permitting standards provided in the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et. seq.). Over the past decade, refinements to the mapping protocols and incorporation of additional species location information have resulted in Versions 2.0, 2.1 and 3.0 and Version 3.3. Version 3.3 follows in the footsteps of it's predecessors by incorporating the best features of previous mapping projects and supplementing them with updated landscape information and species sightings data. Version 3.3 also reflects changes made to the endangered species list at N.J.A.C. 7:25-4.13 and the nongame wildlife list at N.J.A.C. 7:25-4.17 involving status changes for many species. In addition to reflecting the updated status of many wildlife species, the new maps include species not represented in previous statewide versions of the Landscape Project, including freshwater mussels, marine mammals and marine turtles.

MAPPING CRITERIA DISCUSSION

The Landscape Maps generally depict "patches" of habitat that are valued as habitat for endangered, threatened and other priority wildlife species based upon the intersection of the habitat (derived from the Department's land use/land cover (LU/LC) data layer) with location data known as "species occurrence information" for any such species. Location data for endangered, threatened or priority wildlife are stored in the Natural Heritage Database. The Natural Heritage Database includes a continuously updated inventory on the location and status of endangered, threatened and other priority wildlife. Version 3.3 of the Landscape Project applies to the entire state a single standard method that was developed under peer-review and previously applied only in the Highlands Region (in Landscape Project Version 3.0). Thus, for the first time, a more precise species-based habitat method built on species-specific habitat associations is available throughout New Jersey. In addition to providing access to a list of species that occur in an area of interest defined by a user, Version 3.3 provides more detailed information that was not available

in previous versions, including the type of occurrence, or feature label (e.g., colony, den, nest, foraging, etc.), and the last recorded date of occurrence. Other notable differences between version 3.3 and Versions 2.1 and/or 3.0 include:

The segregation of the state into six landscape eco-regions; Skylands, Piedmont Plains, Pinelands, Atlantic Coastal, Delaware Bay and Marine;
The inclusion of a separate layer identifying freshwater mussel habitat;
Integration of previously species-specific layers for the wood turtle, peregrine falcon and bald eagle foraging habitat into the species based habitat patch data layers;
Up-dated habitat mapping based on aerial photo-based 2007 Land Use Land Cover mapping; and
Incorporation of a Riparian Corridor mapping protocol that identifies those streams and riparian habitats that are essential to imperiled and special concern aquatic, semi-aquatic, and floodplain wildlife and that often serve as travel corridors for many wildlife species throughout New Jersey.

Additional details on the habitat mapping methodology and the integration of species sightings data applied in the Landscape Project Version 3.3 mapping are available in the support documentation developed for the mapping in "New Jersey Division of Fish and Wildlife. 20126. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program. pp. 24." This document is available online at (**web address**?) or from the NJDEP, DFW, Endangered and Nongame species program at the address provided below.

ADDITIONAL INFORMATION REGARDING THE LANDSCAPE PROJECT AND LANDSCAPE MAPS

Landscape Project maps are available in ArcGIS 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 10.x. These software products allow the user full functionality for viewing and manipulating Landscape Project data. Non-GIS users can view the maps using the DEP's interactive mapping application listed below or 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/).
- **Upon request to:**

    New Jersey's Landscape Project
    Department of Environmental Protection
    Division of Fish and Wildlife
    Endangered and Nongame Species Program
    Mail Code 501-03
    P.O. Box 420
    Trenton, NJ 08625-0420
    Phone: (609) 292-9400
    Fax: (609) 984-1414

Persons interested in having the Department make a determination as to whether a particular property or site is within an identified Landscape Project layer, and to find out for which endangered and/or threatened wildlife species the property or site is valued or to find out additional details on the sighting of a particular species identified, should contact the New Jersey Natural Heritage Program and submit a data request. Instructions for submitting a data request can be found at http://www.nj.gov/dep/parksandforests/natural/heritage/index.html or obtained by contacting the New Jersey Natural Heritage Program at the address below. (Note: There is a small fee associated with the data request.)

The New Jersey Natural Heritage Program
Office of Natural Lands Management
Division of Parks and Forestry

Department of Environmental Protection

P.O. Box 404, Trenton, New Jersey 08625

Phone: (609) 984-1339

Fax: (609) 984-1427

HOW TO USE THE MAPS FOR ESTIMATING FRESHWATER WETLAND RESOURCE VALUE CLASSIFICATIONS

As noted above, the Department will be replacing Landscape Mapping Version 2.1 and Version 3.01 with the statewide Verison 3.3. In an effort to facilitate the use of these data in estimating the resource value classification for a particular property, we offer the following application guidance for each version.

VERSION 3.3

(a) Turn the Landscape Project region map layer so that all 5 project map regions are visible.
(b) Identify the location of the property in question.
(c) Determine which Landscape Project map region (e.g. Piedmont, Pinelands, Skylands) the property in question occurs in.
(d) Activate the appropriate region map layer.
(e) Use the identify tool to determine the habitat rank of every habitat patch occurring on the property in question. Habitat ranks are found under the RANK category.
(f) For any habitat patches showing a landscape rank of 3, 4, or 5, use the identity tool in the GIS application to determine whether or not any endangered or threatened species habitats are present within any habitat coverage identified on your property. The listing may also instruct you to refer to the separate "freshwater mussel habitat" layer.
(g) Compare the characteristics of the onsite wetlands with the habitat discussions provided under the species descriptions below to see if the onsite wetlands may provide suitable habitat to one or more endangered or threatened species. If the onsite wetlands appear suitable for any of the "documented" species the wetlands may receive an exceptional resource value classification

Please note that a formal freshwater wetland resource value classification can only be received from the NJDEP, Division of Land Use Regulation through the issuance of either a wetland Letter of Interpretation or a Freshwater Wetland Permit.

SECTION 2

SPECIES SPECIFIC HABITAT DISCUSSIONS: STATE AND FEDERAL ANIMAL SPECIES

Blue-Spotted Salamander (*Ambystoma laterale*)

Status: State endangered.

New Jersey Distribution:

This species' range is restricted to the prehistoric glacial lake basins occurring in Somerset, Morris, Essex, Warren and Sussex Counties. Former Glacial Lake Passaic, which occupies portions of Morris, Somerset and Essex counties (i.e. Great Swamp, Troy Meadows, Great Piece Meadows), appears to be a stronghold for the species. Great Meadows in Warren County and wetlands within Vernon Valley in Sussex County support localized populations.

NOTE: Hybridization between the Pleistocene blue-spotted salamander and the Jefferson's salamander (special concern) has created a convoluted complex of hybrids that can only be accurately identified to the parent species through DNA analysis (Uzzell 1964). The hybrids were once assigned unique nomenclature, such as Tremblay's salamander (*A. tremblayii*: two-thirds Jefferson and one-third blue-spotted) and silvery salamander (*A. platineum*: two-thirds blue-spotted and one-third Jefferson), but currently are no longer recognized as valid taxa. Instead, hybrids are grouped as *A. jeffersonianum-laterale* complex (Bogart and Klemens 1997). Since 1998, the NJ Division of Fish and Wildlife and the Wildlife Conservation Society have been mapping the various genetic patterns throughout the range of the blue-spotted and Jefferson salamanders in New Jersey. To date, the results demonstrate that blue-spotted salamanders and their associated hybrids are restricted to the aforementioned locations. Jefferson and Jefferson-like hybrids are the dominant members of the *A. jeffersonianum-laterale* complex in the limestone sections of the Ridge and Valley Highlands. Little range or habitat overlap between Jefferson and blue-spotted salamanders has been documented. Therefore, active hybridization of the two species is not thought to be occurring.

Habitat:

The blue-spotted salamander requires both aquatic and terrestrial habitats.

Breeding habitat: Breeding ponds occur primarily in swamps and marshes associated with bottomland floodplains. While woodland ponds (vernal pools) are the preferred breeding habitat, and the species is considered to be an "oblilgate" vernal habitat breeder, the species has also been documented as breeding in drainage ditches (R.T. Zappalorti, pers. comm) and standing water in depressions within forested wetlands (Johnson 1988). Ponds are typically less than 10 meters (40 feet) in diameter, less than one meter (3 feet) in depth, feature muddy substrates such as leaf litter and fallen twigs, and are often ephemeral (Johnson and Morin 1985).

Terrestrial habitat: Individuals may be found under logs and other forest debris near the surface or in subterranean burrows in the upland and/or wetland surrounding the breeding pond (Anderson 1976; Zappalorti 1980; Johnson 1988). Dispersal ranges for salamanders of the genus *Ambystoma* is known to be extensive (see Appendix II, Table 1). Deciduous or mixed

deciduous-conifer forests with sandy or loamy soils have been favored (Petranks, 1998). Dominant plant species included pin oak (*Quercus palustris*), black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), red maple (*Acer rubrum*), black willow (*Salix nigra*) and gray birch (*Betula populifolia*) (Zappalorti 1980; Sciascia 1984). Soil types in the vicinity of capture sites included various types of sandy loams and 0-3% slopes (Zappalorti and Johnson 1988). Blue-spotted salamanders have also been found in refuse dumps amidst suitable habitat under asphalt shingles, broken bottles, and other natural and man-made debris (Stein 1990).

Survey Methodologies:

Blue-spotted salamanders typically migrate to breeding ponds during heavy rains in March, but migrations in New Jersey may occur any time from late February to late April, if conditions warrant. During the breeding period, which typically lasts no more than 2-3 weeks (Petranka, 1998), adults can be readily observed in ponds at night with the aid of a flashlight or headlamp. Drift fence/pitfall trap arrays can be also used to intercept migrating individuals, and minnow traps have been used successfully to capture salamanders in breeding ponds (Anderson and Giacosie 1967; E. Johnson, pers. comm.). Following the breeding period, egg masses can be observed attached to the breeding pool substrate, sticks and twigs or related structures. Larval surveys may also be performed for up to three months following hatching, though larval identification between cohabitant Ambystoma species can be difficult.

Regulatory Guidelines:

1. Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Any pond meeting the criteria described in the habitat discussion above that is surrounded by sufficient upland/wetland habitat within the 1000 foot area of documentation. Surrounding habitat should be forested and feature one or more of the species described previously. Forested wetlands adjacent to known breeding pools will also be considered suitable habitat for dispersal, resting and foraging.
Note: As stated earlier, the species may also occur in atypical habitat (e.g. ditches, dump sites). In such situations, suitable habitat may deviate from the criteria described.

3. Special conditions: Any pond deemed to be a suitable habitat occurring within the species' New Jersey range, but for which no documentation exists, should be surveyed for breeding salamanders during the early spring of the year. Researchers also note that ephemeral breeding pools exhibit significant variability in maximum depth, volume and hydroperiod from year to year (Colburn, 2004). Therefore, pools for which no breeding activity is observed any particular year may nonetheless function as breeding habitat during years that experience increased hydrologic inputs. Ambystoma species

salamanders, whose long-term genetic stability depends upon dispersal of individuals to adjacent pools, also rely upon nearby wetlands within the area of documentation as dispersal habitat, often to link two more distant pools which offer more consistent breeding habitat. Therefore, evidence of annual breeding activity alone will not govern the suitability determination of wetlands adjacent to a known breeding pool.

Rationale:

Blue-spotted salamanders require additional upland and wetland habitat outside of their specific breeding habitat for survival. In order to preserve individual populations, additional protection of surrounding habitats is necessary to maintain sufficient non-breeding habitat for adult salamanders. Semlitsch (1998) predicts that a minimum 164 meter "life zone" would be required adjacent to ambystoma species breeding pools to ensure survival of 95% of it's breeding ambystomids, acknowledging that this distance is likely an underestimate and that this "life zone" itself would then warrant a protective "buffer." In a two year study, Regosin, et al (2005) documented that 52% of adult blue spotted salamanders wintered greater than 100 meters from their breeding pol. Further, preservation of any single breeding pool and it's surrounding dispersal habitat preserves the connectivity among separate breeding pools in the region, thereby preserving the genetic health of the local metapopulation (Calhoun + deMaynadier, 2008). The reliance on home range/movement data compiled for other species is appropriate due to the similarities in habitat usage amongst the *Ambystoma* genus in general, and, more specifically, the genetic connection between the species of the *A. laterale-A. jeffersonianum* complex. The designation of all wetlands within a conservative home range will serve to protect sufficient habitat, maintain the documented population, and protect the topographic and drainage conditions which provide pond hydrology. Surveying suitable habitats will assist in preventing further loss of local populations of a species with a limited New Jersey range.

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Name: Eastern Tiger Salamander (*Ambystoma tigrinum tigrinum*)

Status: State endangered.

New Jersey Distribution:

Historically, Eastern tiger salamanders have been distributed on the coastal plain strip extending from Bordentown (Burlington County) to Tom's River (Ocean County). To date, populations are concentrated in Cumberland and Cape May Counties.

Habitat:

Eastern tiger salamanders require both aquatic and terrestrial habitats.

Breeding habitat: The most productive breeding ponds observed in southern New Jersey were temporary or semi-permanent vernal pools, or permanent ponds free of fish. The species is considered to be an "obligate" vernal habitat breeder. Breeding sites are typically surrounded by forests composed of oak (*Quercus* spp.) and pine (*Pinus* spp.) with sandy, gravelly soils. Willows (*Salix* spp.) were often present along pond edges, though many New Jersey breeding ponds are manmade, such as sand or gravel pits, and have disturbed or unvegetated banks. A few successful breeding pools exhibit generally unimpressive vegetative structure within the pool basin, however, typically assorted aquatic vegetation grew in breeding ponds, including cattails (*Typha* spp.) and common reed (*Phragmites*). Some sites featured sphagnum or star moss along the banks (Zappalorti 1980). Aquatic vegetation, sticks or brush is needed in the breeding ponds for egg-attachment sites, while stumps and logs on the floor of the pond are desirable for cover (Zappalorti and Johnson 1981). Leaf litter, detritus or debris on the pool floor also serves as cover. Relatively clean, unpolluted water is essential to larvae survival. Ponds near agricultural areas may be adversely affected by fertilizers. Soil types at documented breeding ponds in Cape May and Salem counties have included: Downer loamy sand (0-3% slopes) and Fort Mott Sand (0-5% slopes) in Cape May County; Fallsington sandy loam (0-3% slopes) and Woodstown sand loam (0-5% slopes) in Salem County (Zappalorti 1980). Breeding ponds in Delaware were 0.0003-4.7 ha. (0.00075-11.75 acres) in size, 0.5-1.6 meters (1.64-5.25 feet) deep. Their pH ranged from 5.5 to 7.8 (Arndt 1989). All ponds were partially surrounded by mature deciduous or mixed forest and featured substrates composed of firm sandy loams, sand and clay, or heavy organic mud.

Terrestrial Habitat: Eastern tiger salamanders make extensive use of wetland and non-wetland habitat adjacent to breeding pools. Due to their fossorial habits, there is little documentation that associates Eastern tiger salamanders with specific vegetative communities. Several authors have shown that forested upland habitat is favored over agricultural or field habitats for post-breeding habitat (Semlitsch 1981; Clark 1988; Madison in Clark 1990). These conclusions are supported by studies of the great distance moved by the tiger salamander from a breeding pond surrounded by agricultural fields to forested areas (Biedermann 1988). Eastern tiger salamanders have also been captured, rather frequently, in underground burrows (Semlitsch 1981; Semlitsch 1983; Madison 1990). Eastern tiger salamanders commonly excavate their own burrow (Petranka, 1998), and for this reason prefer sandy soils in their dispersal range. Typical of the genus, they

will also utilize small mammal burrows, root cavities as refugia, or may be found under logs or debris. Dispersal ranges for salamanders of the genus *Ambystoma* is known to be extensive (see Appendix II, Table 1). Semlitsch (1983) recaptured a dispersing male Eastern tiger salamander in a pine plantation. Forested wetlands and uplands within this range are critical to population survival.

Survey Methodologies:

The placement of drift fences and pitfall trap arrays around potential breeding ponds is the most frequently used method of survey (Semlitsch 1983; Zappalorti 1990). In New Jersey, adult salamanders may migrate to breeding ponds on rainy nights from late October to February (Zappalorti pers. comm.), however migrations in December and January are most typical. Adults may be observed in breeding pools, typically by nightime survey, throughout the breeding period. However, this opportunity is often complicated due to ponds freezing over (which is typical and has no adverse effect on the species breeding success). Active breeding may take place as long as 2 months in New Jersey (Petranka, 1998, D. Golden, pers. comm), which is longer than for most ambystomids. Following the breeding season, egg mass surveys may be conducted. In New Jersey, eggs may be deposited from late January to the middle of March (Clark 1988). Eggs are found in clear to whitish masses attached to stem vegetation, sticks or related debris generally 0.6-1.3 meters (2-4 ft) below the pond surface, and are typically the only ambystomatid egg masses present at that time. Larval Eastern tiger salamanders may be identified after hatching (March-April) via netting, use of minnow traps (Golden, pers comm) or shining a flashlight through the water column upon entering the breeding pond (Zappalorti pers. comm.). However, the fall-breeding marbled salamander (*A. opacum*) often utilize the same breeding pools as eastern tiger salamanders, so larval identification is typically necessary. Due to seasonal and annual variability of the pond habitat, single-season surveys may not be indicative of the absence of a tiger salamander population.

Regulatory Guidelines:

1. Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Suitable breeding ponds typically feature the following characteristics:
    a. water depths a minimum of 0.25 meters through June;
    b. at least one side of the pond or gravel pit complex is forested or in the immediate vicinity of forested habitat;
    c. forested dispersal corridors are present through lands surrounding the breeding site; and
    d. low numbers or the complete absence of predators (e.g. fish, diving beetles).

Suitable dispersing, resting or foraging habitats may include any additional forested or scrub-shrub wetlands within the area of documentation.

3. Special Conditions: It should be noted that exceptions to the criteria provided above do exist. The absence of one or more of these features will not automatically preclude the presence of the species and/or suitability of the habitat. . Researchers also note that ephemeral breeding pools exhibit significant variability in maximum depth, volume and hydroperiod from year to year (Colburn, 2004). Therefore, pools for which no breeding activity is observed any particular year may nonetheless function as breeding habitat during years that experience increased hydrologic inputs. Ambystoma species salamanders, whose long-term genetic stability depends upon dispersal of individuals to adjacent pools, also rely upon nearby wetlands within the area of documentation as dispersal habitat, often to link two more distant pools which offer more consistent breeding habitat. Therefore, evidence of annual breeding activity alone will not govern the suitability determination of wetlands adjacent to a known breeding pool.

Comments:

While Eastern tiger salamanders are considered to be a site-tenacious species, reintroductions of populations into created ponds using eggs have met with some success (Clark 1988).

Rationale:

Eastern tiger salamanders require significant habitat outside of the breeding pond. In order to ensure that sufficient wetland and upland habitat is available for the adults and dispersing population, wetlands outside of the immediate vicinity of the breeding pond must be protected. Semlitsch (1998) predicts that a minimum 164 meter "life zone" would be required adjacent to ambystoma species breeding pools to ensure survival of 95% of it's breeding ambystomids, acknowledging that this distance is likely an underestimate and that this "life zone" itself would then warrant a protective "buffer." In New York, buffers of 305 meters (1000 feet), consisting of a 103 meter (500 foot) radius to the breeding pond and an additional 103 meters (500 feet) in the form of dispersal corridors, are requested for documented tiger salamander habitats (Madison in Clark 1990). Preservation of any single breeding pool and it's surrounding dispersal habitat also preserves the connectivity among separate breeding pools in the region, thereby preserving the genetic health of the local metapopulation (Calhoun and deMaynadier, 2008).

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Name: Wood Turtle (*Glyptemys insculpta*)

Status: State threatened.

New Jersey Distribution:

Historically, wood turtles have occurred throughout a range that included all of northern New Jersey, outside of Hudson County, towards southern New Jersey, as far as Gloucester and Atlantic Counties. Like the bog turtle, this species now occurs in disjunct populations along particular drainages within its former range. Examples include the Wallkill and Paulins Kill Rivers (Sussex), the Ramapo River (Bergen), and the Passaic River (Morris and Somerset).

Habitat:

Wood turtles require both aquatic and terrestrial habitat. In New York, Burt and Collins (no date) found wood turtles to be mostly aquatic from mid-November to mid-March, mostly terrestrial from mid-May to mid-September, and in transition the remainder of the time. In Pennsylvania, Ernst (1986) affirmed that wood turtles were aquatic in spring (April-May) and largely terrestrial from the middle of June to autumn. In New Jersey, wood turtles are predominantly terrestrial from mid-May to October (Farrell and Zappalorti 1979; Zappalorti et al. 1984).

Aquatic habitat: In general, wood turtles will use streams and rivers for breeding and hibernating. Riverine habitat in Wisconsin consisted of a river channel 3-5 meters (10-16 feet) in width and 0.3-1.5 meters (12-57 inches) deep and featured several oxbow backwaters and adjacent alder (*Alnus regosa*) thickets (Brewster and Brewster 1991).

Breeding occurs underwater often in slow, meandering streams with sandy bottoms and shoals. The two breeding seasons are spring, from April to May, and fall, from September to October (Fisher 1945; Swanson 1952; Ernst and Barbour 1972; Harding and Bloomer 1979; Zappalorti and Farrell 1980; Farrell and Graham 1991). During hibernation, wood turtles can be found on the bottom of or in the banks of waterways (Ernst and Barbour 1972; Carroll and Ehrenfeld 1978; Farrell and Zappalorti 1980; Strang 1983; Kaufman 1989). In Pennsylvania, Ernst (1986) found brumating wood turtles on the stream bottom, buried to depths of 18-30 cm (7-13 inches) in soft substrate, and wedged under overhanging banks. Those waterways were free flowing, 100-230 cm (40-92 inches) deep, and never froze completely. Farrell and Graham (1991) located a wood turtle hibernaculum at the bend of a stream under the roots of a large sycamore (*Platanus occidentalis*). Use of muskrat (*Ondatra zibethicus*) burrows for hibernation have also been reported (Carr 1952; Zappalorti et al 1984; S. Sweet, pers. comm. in Farrell and Graham 1991).

Terrestrial habitat: Outside of the activities described above, wood turtles make use of wetlands and uplands adjacent to their breeding/hibernating streams and rivers. The extent of use and the characteristics of this habitat vary when described in the literature.

Carroll and Ehrenfeld (1978) reported wood turtle activity primarily in the wooded and marshy borders of streams. Stang (1983) found wood turtle activity predominantly confined to lowland, mid-successional forested areas dominated by oaks (*Quercus* spp.), black birch (*Betula lenta*) and red maple (*Acer rubrum*). Burt and Collins (no date) determined that wood turtles made far greater use of aquatic, cornfield, and stream margin habitats than they did of successional field and woodland forest. Quinn and Tate (1991) established non-aquatic wood turtle habitat in Algonquin Park, Canada, which is predominantly alder thickets and mixed forests characterized by white and red pine (*Pinus strobus* and *Pinus resinosa*), poplar (*Populus* spp.), white birch (*Betula papyrifera*), red maple (*Acer rubrum*), and red oak (*Quercus rubra*). Calhoun and deMaynadier (2008) cite reports of wood turtles utilizing vernal pools, particularly those adjacent to or within floodplanes, as have local biologists (S. Angus, pers comm). Additional habitats identified in this study being used by wood turtles included grassy openings, upland pine plantations, deciduous forest, and lowland conifers. In New Jersey, Stein (pers. comm.) stated that his personal experience yielded wood turtles in floodplain-associated areas followed by upslope stream corridors and upland areas. Aside from the habitats described above, wood turtles may also bask in multi-flora rose (*Rosa multi-flora*) thickets (R.T. Zappalorti, pers. comm.).

Survey Methodologies:

In New Jersey, wood turtles have been observed from March to December. Most captures have occurred from April to May and in October, with 60% occurring between 11:00-13:00 hrs (Farrell and Zappalorti 1979). This data implies that stream side searches within those particular time frames are most likely to produce results. Burt and Collins (no date) surveyed aquatic habitats by probing stream bottoms, muskrat burrows, and beneath undercut banks. In Canada, Quinn and Tate (1991) principally found turtles by searching roads during May and June. In early June, female wood turtles are often observed in cultivated gardens and farm fields where they deposit their eggs (R. Stein pers. comm; Kaufmann 1992). Hatchling wood turtles have been found near such nest sites in September (R. Stein pers. comm.).

Regulatory Guidelines:

1. Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Due to this species' highly variable habitat use, it is difficult to qualify particular characteristics which define a suitable habitat. In field evaluation, characteristics which affect the suitability of a particular habitat include:

a. streams or rivers featuring flowing water of varying depths, undercut banks, muskrat burrows, fish populations, and evidence of good water quality. Potential barriers to wood turtle movement (e.g. road crossings, lakes) along a particular stream corridor also affect habitat suitability;

b. favored adjacent upland/wetland habitats are characterized by mosaics of forest, field, shrubs, ephemeral wetlands and agricultural lands, though wood turtles also occur in more monotypic areas. Thickets of alder, greenbriar (*Smilax* spp.), or multi-flora rose adjacent to aquatic habitats are favored basking areas; and

c. the availability of food species including invertebrates, tadpoles, earthworms, blackberries, raspberries, violets, fungi, willow (*Salix* spp.) leaves and carrion (Kaufman 1986, Farrell and Zappalorti 1980, Farrell and Graham 1991).

Comments:

Wood turtles are often found in association with other *Glyptemys* species, *Clemmys* species and trout waters (Zappalorti and Johnson 1981, Ernst 1986, Farrell and Graham 1991). They are also good climbers and have been documented to scale 1.8 meter (6 foot) chain-link fences (Behler and King 1979).

Rationale:

Wood turtles are an extremely mobile species which have been documented to move at least 1.8 kilometers (1 mile) along a stream corridor and exhibit familiarity with wetland habitats two kilometers (1.2 miles) from an initial capture point. In addition, wood turtles require additional upland/wetland habitats outside of their aquatic habitats. Establishment of a minimum of 3.7 kilometers (2 miles) area of documentation along portions of the stream corridor/wetland complexes known to feature wood turtles ensures that sufficient aquatic and terrestrial habitat is preserved for this species.

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Name: Bog Turtle (*Glyptemys muhlenbergii*)

Status: Federally threatened.
State endangered.

New Jersey Distribution:

Historically, the bog turtle range extended to nearly every county in New Jersey except for Hudson County. Currently, this species is considered extirpated from Bergen, Camden, Cape May, Mercer and Middlesex counties (USFWS 2001). Present distribution is reduced and disjunct, with populations being clustered within particular drainages. Examples include the Manasquan River (Monmouth), Papakating Creek (Sussex), the Passaic River basin (Morris), and Raccoon Creek (Gloucester).

Habitat:

Bog turtles are associated with bogs, swamps, ponds, grazed meadows, and other wetlands that support moisture-loving plants and which feature an abundance of grass or moss cover (Carr 1952; Barton and Price 1955; Campbell 1960; Nemuras 1965; Ernst and Barbour 1972; Kiviat 1978; Chase et al. 1989). Seep bogs may feature rust-colored iron-oxide deposits (Arndt 1977). An open canopy is also frequently cited as a characteristic of suitable bog turtle wetland habitat (Boyer 1965; Zappalorti 1979; M. Klemens in DeGraff and Rudis 1986).

Outside of the "typical" habitat, bog turtles may also utilize more densely vegetated areas for hibernation and may be found, incidentally, in a wide variety of habitats when making relatively long-distance movements (Buhlmann et al. 1997 in USFWS 2001, Carter et al. 1999 in USFWS 2001, Morrow et al. 2001 in USFWS 2001). In New York, Breich (1986) reported one female bog turtle to inhabit a red maple swamp, moving to an open meadow habitat to lay eggs.

In Maryland, Taylor et al. (1984) documented over 200 bog turtle colonies. All sites were sedge meadows with the majority being less than 2 acres in size. Of the 67 species of herbaceous plants found on those sites, the following species were the most dominant: tussock sedge (*Carex aquatilis*), rice cut grass (*Leersia oryzoides*), tearthumb (*Polygonum sagittatum*), arrowhead (*Sagittaria* spp.), skunk cabbage *(Symplocarpus foetidus*), soft rush (*Juncus* spp.), and various other grasses and sedges. Further analysis of Maryland bog turtle colonies indicated that the greater the population density, the more likely the site was to:

a. be located in a circular basin;
b. feature spring-fed pockets of shallow water;
c. have a bottom substrate of soft mud or rock;
d. have a dominant vegetation of sedges and grasses; and
e. have interspersed wet and dry pockets (Chase et al. 1989)

Of 132 turtles captured, 81 were found in the water. Of the 81 taken from the water, 72 were found less than 8 cm below the surface of the water. In addition, 77 bog turtles from that same group in the water were found less than 10 cm from vegetation.

Arndt (1977) characterized bog turtle habitat in Delaware as featuring a substrate of deep mud, numerous small springs, constantly flowing clear and relatively cool water, networks of rivulets, shallow pools, muskrat (*Ondatra zibethicus*) runways, and an open canopy. Dominant meadow species included rice cut-grass (*Leersia oryzoides*), arrow-leaved tearthumb (*Polygonum sagittarium*), halberd-leaved tearthumb (*Polygonum arifolium*), spotted touch-me-not (*Impatiens capensis*), skunk cabbage (*Symplocarpus foetidus*), sensitive fern (*Onoclea sensibilis*), bullrush (*Scirpus* spp.), and asters (*Aster* spp.).

In New Jersey, Zappalorti and Zanelli (1978) listed the following species as those commonly found in wetlands featuring bog turtles: red maple (*Acer rubrum*); alder (*Alnus* spp.); willow (*Salix* spp.); watercress (*Cardamine rotundifolia*); pondweed (*Potamogeton* spp.); sphagnum moss (*Sphagnum* spp.); sundew (*Drosera rotundifolia*); skunk cabbage; smartweed; jewelweed; goldenrod (*Solidago* spp.); cinnamon fern (*Osmunda cinnamonea*); day lily (*Hemerocallis fulva*); and swamp rose (*Rosa palustris*). Warner (1985) reported many of the plants discussed above as well as cattail (*Typha latifolia*) and pitcher plants (*Saracenia purpurea*) from a bog near Lafayette. In Sussex and Warren Counties, bog turtles occur almost exclusively in limestone associated, calcareous fens. These fens possess unique calcicolous plant communities comprising herbaceous species such as *Carex sterilis, C. flava, Scleria verticillata, Parnassia glauca, Selaginella apoda, Sarracenia purpurea, Deschampsia caespitosa* and low growing shrubs including *Rhamnus alnifolia, Ribes hirtellum*, *Pentaphylloides floribunda*, and *Rhus vernix*. *Juniperus virginiana* and *Larix larcina* are often scattered in these fens but are usually dwarfed, presumably due to low nutrient levels (Boyer and Wheeler 1989).

Hibernacula: Ernst et al. (1989) studied 44 hibernacula in Pennsylvania and New Jersey. Hibernating bog turtles were found in soft stream bottoms (19), muskrat burrows (12), at the base of sedge clumps (2), at the base of a cedar stump (5), and in meadow vole burrows (6). Turtle depth below the water and mud varied from 5-55 cms. In Massachusetts, Klemens (1993a in USFWS 2001) reported that many early season captures were concentrated on or near shrubby hummocks that served as hibernacula at the interface zone between open fen habitats and shrub and wooded swamp. These hummocks were surrounded by small trees and shrubs with springs percolating up around them. Hibernating turtles have also been found under water in soft mud, within crevices between rocks or tangled roots (USFWS 2001). Bog turtles may use a hibernaculum annually.

Survey Methodologies:

In New Jersey, bog turtles are active from early April to November, with most captures occurring from May to August (Zappalorti and Zanelli 1978; J. Sciascia pers. comm.). Survey techniques consist of:

1. Visually scanning the muddy streams, muskrat runways, seepage ditches, grassy stream banks, and sedge tussocks for basking or foraging turtles;
2. Probing in the mud of rivulets with a four-foot probing stick; and
3. Feeling underneath tussocks, or into muskrat holes, with hands and feet.

Surveys conducted in the early spring (April-May) before vegetation leaf-out, on clear to mostly sunny days with air temperatures at or above 21 ºC (70 ºF), offer a greater chance for success in identifying the species. Activity patterns suggest that surveys conducted during the morning hours (0600-0900 hrs) may be more fruitful than those conducted later in the day. While no consensus on the survey effort required to determine the absence of bog turtles from a site has been reached, a minimum of five visits, lasting between one and two hours each, by an experienced herpetologist has been suggested (R. Arndt, pers. comm.; R.T. Zappalorti, pers. comm.).

Gemmell (1989) sectioned wetlands in a 20 by 20-meter grid and used six baited funnel traps to capture bog turtles. Traps must be partially submerged in water and should be checked daily and moved every three to five days. Caution should be taken using this survey option since trapped turtles are susceptible to predation by raccoons. J. Sciascia (pers. comm.) trapped turtles in New Jersey using drift fence/eel trap networks within suitable habitat.

In general, no current survey methodology has been demonstrated to consistently yield accurate results in establishing the presence, absence, or viability of populations of the bog turtle. Gemmell (pers. comm) indicated that many variables including vegetation density, water levels, weather, expertise of surveyor, and population density will impact the success of a particular survey effort in a particular wetland. He does not recommend his techniques for use in all wetlands.

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Spring fed meadows or bogs featuring emergent vegetation and/or successional vegetation species identified above. Portions of the bog must feature water levels, streams, or rivulets which maintain continuous flows of 1-8 cms in depth.

Rationale:

A study commissioned by the NJDEPE suggested that out of 75 known bog turtle-inhabited wetlands, only 24 continued to feature suitable habitat (Zappalorti and Farrell 1989). Many of these sites were believed to be victims of development, stormwater discharges, and/or natural succession. More extensive surveys conducted by the Department from 1993-2000 found 165 potential habitats, less that half (72) of which were considered viable (USFWS 2001). The Department believes that to ensure the long-term protection of these sites, there is a need to establish an exceptional resource value classification for both the "core" habitat and additional wetlands interconnected with the "documented" wetland. This additional protection is justified by:

a. the successional nature of existing habitats and the potential that current habitats will become unsuitable in the future;
b. the requirement of the species of groundwater/spring-fed waters;
c. studies that suggest that the species may roam more widely than previously thought; and
d. the necessity to maintain connection to other bog turtle populations and/or suitable habitats to allow for gene exchange between populations and immigration, or emigration, of turtles or colonies as successional changes occur to the wetland habitat.

Comments:

In addition to the direct protection provided to bog turtle habitats under an exceptional classification, the Department will also look carefully at Statewide General Permit activities proposed for such areas. Due to the sensitive nature of these habitats, even minor impacts, such as a road crossing or stormwater discharge, may have adverse affects (Torok 1994). In addition, due to a variety of concerns including groundwater recharge and contamination, the USFWS may request wetland buffers in excess of 150 feet in certain instances.

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Name: Timber Rattlesnake (*Crotalus horridus*)

Status: State endangered.

New Jersey Distribution:

There are two disjunct populations. The northern Jersey populations occur on rock outcroppings and talus slopes along the Kittatinny Ridge and other mountainous areas of Sussex, Morris, Warren, Passaic, and Bergen counties. The southern Jersey populations historically occurred in the pine barrens and fringe areas in Monmouth, Ocean, Burlington and Cumberland counties. Presently, this species is known to be extant in Burlington and Ocean county only.

Habitat:

Timber rattlesnakes require both upland and wetland habitat. In a New Jersey pine barrens study, the typical random habitat site in the study area was characterized as forested with better than 50% canopy closure, dense surface vegetation (approximately 75% closure), and dead-down material. Preferred habitat for gravid females was open (approximately 25% canopy closure) area featuring fallen logs and mixed leaf litter/vegetated ground cover (Reinhart and Zappalorti 1988a and 1988b). South Jersey populations are commonly associated with Lakewood, Woodmansie, and Lakehurst soils.

Hibernacula occur in sphagnum hummocks undermined by running water which maintains a critical micro-climate for this species. While in hibernation, the snakes were found to coil among tree roots in the water table of Atlantic white cedar (*Chamaecyparis thyoides*) swamps (Reinhart and Zappalorti 1988a). Timber rattlesnakes have also been reported to hibernate near seepage springs under sphagnum moss (Kauffeld 1957; Zapparlorti 1980). Typical vegetation at New Jersey den sites include pitch pine (*Pinus rigida*), several oak species (*Quercus* spp.), short-leaf pine (*Pinus echinata*), virginia scrub pine (*Pinus virginiana*), *Smilax*, low-bush blueberry (*Vaccinium vacillans*), high-bush blueberry (*Vaccinium corymbosum*), pitcher plant (*Sarracenia purpurea*), and sundews (*Drosera* spp.) (Zappalorti 1980).

In north Jersey, timber rattlesnakes use communal den sites located in rock outcroppings and talus areas along the major ridges of the Ridge and Valley Highlands physical provinces. Rattlesnakes disperse away from the den and use primarily forested habitats within a 3.3 kilometer (2 mi) radius of the den during summer months (R. Stechert, pers. comm.). Wetlands in the summer habitat of the northern Jersey populations are used in varying degrees depending on the type of wetland habitats present, the percentage of total summer habitat comprised by wetlands, and the location of the wetlands relative to the den site (J. Sciascia, pers. comm.).

Regulatory Guidelines:

Due to differences in habitat usage, wetland protection strategies must be applied differently to northern and southern Jersey populations.

1. North Jersey: Timber rattlesnake populations in this portion of the state are predominantly found in association with rocky mountain slopes located around den sites. While hibernacula occur in upland talus slope/forest areas, rattlesnakes disperse away from the den site and use predominantly forested habitats, including forested wetlands, during the summer months. The establishment of an "area of documentation" will be done on a case by case evaluation, integrating the Department's information on each individual regional population with home range data and location/sighting reports. Suitability will be determined largely by proximity of sightings, distance from den site, wetland habitat type and surrounding land uses.

2. South Jersey: Timber rattlesnake populations in this portion of the state are highly dependent on wetland habitats due to their use of such habitats for hibernation. Maintenance of water volume and flow, in streams and wetlands providing denning habitat, is essential to ensure a stable micro-climate and maintain regional rattlesnake populations. Wetlands which are directly associated with the wetland/stream corridor complex featuring a den site will be considered a "documented" habitat; the extent of which will be determined on a case-by-case basis. Additional wetlands within a 3.3 kilometer (2 mi) radius will be evaluated for use by "resting or feeding" rattlesnakes. Suitability will be determined largely by proximity of sightings, distance from den site, wetland habitat type and surrounding land uses.

For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

Comments:

Rattlesnakes are vulnerable to severe collecting pressure. Den location information is of an extremely sensitive nature. Extant southern Jersey populations predominantly, if not exclusively, occur on land within the jurisdiction of the Pinelands Commission.

Rationale:

Timber rattlesnakes are listed as endangered in New Jersey and there is serious concern about northeastern populations in general. Protection of likely feeding and dispersing areas in northern Jersey is necessary to maintain tracts of suitable habitat in the vicinity of den sites and to minimize human and snake interactions. South Jersey populations are dependent on wetland habitats to maintain suitable hibernacula microclimates and also to provide sufficient resting and feeding habitats.

Principal Author:

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Name: Long-Tailed Salamander (*Eurycea longicauda*)

Status: State threatened.

New Jersey Distribution:

Commonly associated with the limestone regions of New Jersey; primarily in Sussex and Warren counties. They have also been recorded from Hunterdon, Mercer, Morris, Passaic, Somerset, and Union counties.

Habitat:

Long-tailed salamanders require wetland and upland habitats.

Aquatic habitat: Long-tailed salamanders are somewhat catholic in their habitat requirements, being recorded from shale banks, springs, spring runs, river sides, floodplains, caves, mines, and streams in Hunterdon County (Anderson and Martino 1966; Stein 1992). In New Jersey, the species is also frequently found in vernal ponds and sinkholes in limestone areas of Warren and Sussex counties (Anderson and Martino 1966; Zappalorti and Reap 1983) and in streams of Hunterdon and Somerset Counties (R. Stein, pers. comm.).

Ponds studied in Sussex county were characterized by their association with Kittatinny limestone, either in out-croppings or boulders, widely varying water depths (1.5-1.8 meters; 5-6 feet in the spring, dry by mid-summer), size (0.5-5.5 hectares; 1.3 to 13.8 acres), and forested uplands. Forested uplands featured silver maple (*Acer saccharinum*), chestnut oak (*Quercus prinus*), red oak (*Quercus rubra*), white oak (*Quercus alba*), sugar maple (*Acer saccharum*), shag-bark hickory (*Carya ovata*), walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*), willows (*Salix* spp.), and ashes (*Fraxinus* spp.) (Anderson and Martino 1966). The species has also been observed in iron mines and spring houses (Anderson and Martino 1967; M. Rapp pers. comm.)

In a survey of 59 sites in northern and central New Jersey, Stein (1992) evaluated the vegetational communities at occupied sites. Overstory species typically observed included red maple (*Acer rubrum*), Sycamore, White ash (*Fraxinus americana*), American elm (*Ulmus americana*), white oak, tulip poplar (*Liriodendron tulipifera*), and hemlock (*Tsuga canadensis*). Shrub layers consisted of arrowwood (*Viburnum recognitum*), alder (*Alnus* spp.), ironwood (*Carpinus caroliniana*), various saplings, poison ivy (*Rhus radican*), and spicebush (*Lindera benzoin*). Herbaceous vegetation was dominated by jewelweed (*Impatiens camprensis*), smartweed (*Polygonum* spp.), grasses, and ferns.

Terrestrial habitat: Anderson and Martino (1966) reported finding adult long-tailed salamanders, beneath rocks, bark, and logs under the forest canopy during the day. During nocturnal hours, salamanders were observed crawling on the tope of their daytime habitats as well as up tree trunks. Sciascia (1989) found salamanders in similar habitats as well as crevices in vertical rock faces and noted that forest parameters did not appear to limit abundance. R. Stein (1992) indicated that a closed forest canopy appeared to be an essential characteristic of all stream/pond

habitats investigated. Long-tailed salamanders have also been found in a man-made tunnel and in a dried up well (R. Stein, pers. comm.)

Survey Methodologies:

Analysis of survey efforts indicates that the periods from April to June and from August to September resulted in the most observations. Anderson and Martino (1966) collected larval long-tailed salamanders by sweeping a net through leaf litter and dead vegetation in the shallowest sections of ponds. Early spring collections were more successful than later attempts due the growth of aquatic vegetation and dispersal of larvae throughout the pond. Stein (pers. comm.) surveyed historic sites by using a metal-hooked broom handle to flip rocks and logs. Sites were visited a minimum of two times during the periods described above but he cautioned that additional visits would frequently be necessary to confirm the absence of the species from apparently suitable habitats. Long-tailed salamanders may also be identified at night by searching rock outcrops with a flashlight (Stein 1992).

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

   2. Suitable habitat: In most cases, the presence or absence of the species will factor significantly in the "suitability" of a habitat. Pond and steam corridor habitat characteristics to be evaluated include:

      a. good water quality, noting indicators of water quality such as invertebrate fauna, other salamander species, algae growths, stormwater outfalls, pH, etc.;
      b. limestone formation association; and
      c. shading from forest canopy along 50% of pond/stream border featuring one or more of the species identified above.

Comments:

Habitat and life history are not well defined in the literature. The association of New Jersey's long-tailed salamanders with limestone formations is apparently unique within the species' range.

Primary Author:

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Literature Cited:

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Name: Pine Barrens Treefrog (*Hyla andersonii*)

Status: State threatened.

New Jersey Distribution:

Pine Barrens Treefrog occurs throughout the Pine Barrens in Burlington, Ocean and Atlantic counties. Smaller populations have been recorded from Monmouth, Camden, Gloucester, Cumberland, and Cape May counties and they are believed to have been extirpated from Middlesex county. This species has a disjunct range with other populations occurring in North Carolina, South Carolina, Florida, Georgia, and Alabama.

Suitable Habitat:

Pine Barrens treefrogs require wetland and terrestrial habitats.

Wetland habitat: Generally, Pine Barrens treefrogs have been reported to breed in seepage bogs, cranberry bogs, small and ephemeral ponds, streamlets, Atlantic white cedar (*Chamaecyparis thyoides*) swamps, and pitch pine (*Pinus rigida*) lowlands (Means and Longden 1976; Hulmes et al 1979; Cely and Sorrow Jr. 1986). Pine Barrens treefrogs have also been reported to colonize disturbed habitats such as wet areas within power and gas ROWs, borrow pits, and vehicle ruts. If the area is suitable, shrub and herb vegetation is present (Freda and Morin 1984). Because breeding commences later in the season (May-June), Pine Barrens treefrogs typically make use of sites in which ponded hydrologic conditions persist through August thereby allowing time for metamorphosis of larva.

Based on an analysis of 40 sites in New Jersey, North Carolina, South Carolina, Florida, and 13 sites in the New Jersey Pinelands [(Freda and Morin, 1984), (Laidig, Zampella, Bunnell, Dow and Sulikowski, 2001), respectively], typical suitable pine barren treefrog habitat has been described as:

1. Areas featuring an open canopy with overstory density ranging from 0-112 trees per 100 square meters;
2. Shrub understory an average height of 1.6 meters;
3. Shrub stem density an average of 32 stems per meter (approx. 50% foliage cover);
4. Pond depths which average approximately one meter (0.1->2 meters) and;
5. Waters with a pH of between 3.8 and 4.6.

Plant species reported from treefrog breeding sites include: sphagnum moss, sundews (*Drosera* spp.); various sedges (C*arex* spp.), rushes (*Eleocharis and Rhynchospera spp.*), and grasses (*Panicum spp.*); wool grass (*Scripus cypernus*); pitcher plants (*Sarracenia purporea*); orchids (*Platanthera* spp.); Atlantic white cedar; pitch pine; mountain laurel (*Kalmia latifolia*); high-bush blueberry (*Vaccinium corymbosum*); swamp azalea (*Rhododendron viscosum*); sheep laurel (*Kalmia angustifolia*); leatherleaf (*Chamaedaphne calyculata*); black-jack oak (*Quercus marylandica*); magnolia (*Magnolia virginiana*); greenbriar (*Smilax* spp.); maples (*Acer* spp.);

and sweet pepperbush (*Clethra alnifolia*) (Means and Longden 1976; Hulmes et al. 1980; Freda and Morin 1984).

Terrestrial habitat: Pine Barrens treefrogs move into upland areas adjacent to breeding ponds during July and August. The species has been identified while calling from pitch pines, cedars, oaks (*Quercus* spp.), and highbush blueberry thickets (Hulmes et al. 1980). Isotope-tagged frogs were found on the ground, under leaf litter, and calling from vegetation (Freda and Morin 1984).

Survey Methodologies:

Male Pine Barrens treefrogs may be identified by their call from mid-May to August. It is recommended that surveys be conducted during warm (≥ 70 ºF), humid or rainy nights in May and June. It is also recommended that a control population be used to evaluate the suitability of weather conditions. Taped calls of treefrog calls may be used to elicit responses. Recent studies have also investigated the use of artificial refugia (PVC pipe) as a survey methodology for Hylid treefrogs (Boughton, Staiger and Franz, 2000) which may be less seasonally dependent.

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Wetland habitats consistent with the structural, chemical, and vegetative characteristics described above.

Rationale:

Suitable breeding habitat for the Pine Barrens treefrog is ephemeral in nature, being subject to annual variations in rainfall and the effects of succession. Pine Barrens treefrog breeding populations have demonstrated the ability to colonize suitable habitat within contiguous wetland complexes. As a result, the protection of additional wetland and upland areas outside of the immediate vicinity of the individual breeding ponds is necessary to provide for the long term continuation of a breeding population. In addition, the establishment of upland buffers of 46 m (150 ft) serves to provide some of the species' upland habitat requirements while minimizing impacts to wetland hydrology and pH.

Primary Author:

Larry Torok, WLM, Division of Watershed Protection and Restoration

DRAFT DATE: 08/08/94 UPDATE: 02/11/04

Literature Cited:

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Freda, J. and R.J. Gonzalez. 1986. Daily movements of the treefrog, *Hyla andersonii*. J. of Herpet. 20(3):469-471.

Freda, J. and P.J. Morin. 1984. Adult home range of the pine barrens treefrog (*Hyla andersonii*) and the physical, chemical, and ecological characteristics of its preferred breeding ponds. Final Report to the NJDEP, Division of Fish, Game, and Wildlife, Endangered and Nongame Species Program. 42pp.

Hulmes, D., P. Hulmes, and R.T. Zappalorti. 1979. An ecological study of the Pine Barrens treefrog (*Hyla andersonii*) Baird. in southern New Jersey. Part I. Unpublished report to the NJDEP, Division of Fish, Game, and Wildlife, Endangered and Nongame Species Program. by Herpetological Associates. 33pp.

_____. 1980. An ecological study of the Pine Barrens treefrog (*Hyla andersonii*) Baird. in southern New Jersey, with especial notes on habitat description. Part II. Unpublished report to the NJDEP, Division of Fish, Game, and Wildlife, Endangered and Nongame Species Program. by Herpetological Associates. 42pp.

Means, D.B. and C.J. Longden. 1976. Aspects of the biology and zoogeography of the Pine Barrens treefrog (*Hyla andersonii*) in northern Florida. Herpetologica 32(2):117-130.

Name: Cope's Gray Treefrog (*Hyla chrysoscelis*)

Status: State endangered.

New Jersey Distribution:

Presently known to occur in Ocean, Atlantic, Cape May and Cumberland counties only.

Suitable Habitat:

Cope's gray treefrogs require wetland and terrestrial habitats.

Wetland habitat: In New Jersey, Cope's gray treefrogs have been reported to breed in gravel pits, natural woodland ponds, shrubby wooded farm ponds, and emergent wetlands dominarted by common reed (*Phragmites)*. Beyond New Jersey, they have been known to use swamps, bogs, ponds, weedy lakes, and roadside ditches (Zappalorti and Hulmes 1980; DeGraaf and Rudis 1981). A breakdown of 80 confirmed sites in southern New Jersey yielded 26 man-made borrow pits, 23 natural vernal ponds, 22 stream floodplain corridors, 5 retention/detention ponds, and 4 man-made pond/lakes (Zappalorti and Dowdell 1991b). Farm ponds, used for breeding, are described as stream fed waters which are grazed by livestock. Farm pond sites often had few or no trees but low shrubs and bushes were always present along the periphery (Zappalorti and Hulmes 1989).

Habitat evaluations conducted by Zappalorti and Dowdell (1991a) of 50 breeding pond sites in southern New Jersey revealed the following plant community associations:

a. Overstory species: scarlet oak (*Quercus coccinea*), willow oak (*Quercus phellos*), white oak (*Quercus alba*), scrub oak (*Quercus ilicafolia*), blackjack oak (*Quercus marilandica*), red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), swamp willow (*Salix nigra*), pitch pine (*Pinus rigida*), short leaf pine (*Pinus echinata*), Virginia pine (*Pinus australis*) and American holly (*Ilex opaca*);

b. Understory shrub species: buttonbush, huckleberry, highbush blueberry (*Vaccinium corymbosum*), alder (*Alnu*s spp.), inkberry (*Ilex glabra*), catbriar or *Smilax*, cattail (*Typha latifolia*), and phragmites; and

c. ground cover species: sphagnum moss, star moss, club moss, sundews (*Drosera rotundifolia*), pitcher plants (*Saracenia purpurea*), and various forbs and grasses.

Hardwood forest occurred next to every confirmed breeding pond, with the overstory canopy being within 25 feet of the water's edge. A study in Tennessee found documented breeding ponds to be dry during parts of June, July, and August (Ritke et al. 1991). Adult male treefrogs often remained at breeding pond sites during dry spells.

Terrestrial habitat: Cope's gray treefrogs move over land between ponds during the breeding season (Ritke et al. 1991), and adult northern gray treefrogs (*Hyla versicolor*) have been

documented traveling as far as 200 meters from a central breeding pool during the breeding season to oviposit in adjacent available sites (Johnson and Semlitsch 2003). Radio telemetry has demonstrated that Copes gray treefrogs in New Jersey are capable of long-distance movements away from breeding pools following the breeding season. Distances up to 1,226 feet have been documented (D. Golden, unpublished report, 2004). During the summer months, Cope's gray treefrogs have been found in moist areas of hollow trees, under loose bark, and in rotted logs (DeGraaf and Rudis 1981, D. Golden, per. comm). Cope's gray treefrogs have been identified calling from ground level as well as at much higher elevations in the trees (Behler and King 1979; Zappalorti and Hulmes 1980). Zappalorti and Dowdell (1991a) reported treefrogs calling from willows, oaks, pitch pines, maples, holly, and cedars adjacent to breeding ponds.

Survey Methodologies:

Male Cope's gray treefrogs may best be identified by their call from early May through July near breeding ponds. Zappalorti and Dowdell (1991a) conducted random nocturnal road surveys to identify potential breeding ponds. Surveys were conducted by driving at slow speeds (25-30 mph) using a team of one or two people to listen for calling frogs. To reconfirm documented sites, taped calls were used to solicit responses. Favorable weather conditions for surveys include temperatures above 70 ºF, humidity levels above 60 % and wind speed at 5 mph or less. Recent studies have also investigated the use of artificial refugia (PVC pipe), which may be less seasonally dependant, as a survey methodology for *Hylid* treefrogs (Boughton, Staiger and Franz, 2000).

Comments:

Cope's gray treefrogs are visually indistinguishable from the more common Northern gray treefrog (*Hyla versicolor*). Both species occur in Atlantic, Cape May and Cumberland counties. Cope's gray treefrogs can be differentiated from Northern gray treefrogs by analysis of blood cell size and chromosome number. The species may also be distinguished through variations between their calls, with Cope's gray treefrogs having a faster trill. Caution should be used in trying to differentiate between the species by call without sonogram analysis because at low temperatures both species may sound identical.

Regulatory Guidelines:

1. Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Wetland habitats consistent with the structural and vegetative characteristic described above.

Rationale:

Suitable breeding habitat for Cope's gray treefrogs is ephemeral in nature, subject to annual variations in rainfall and the effects of succession. Cope's gray treefrog breeding populations have demonstrated the ability to colonize suitable habitat within contiguous or nearby wetland complexes and also to move between breeding ponds during the breeding season. They also make extensive use of upland areas adjacent to wetland breeding sites. As a result, the protection of additional wetland and upland areas outside of the immediate vicinity of the individual breeding ponds is necessary to provide for the long-term subsistence and genetic viability of a breeding population. In addition, the establishment of upland buffers of 46 meters (150 feet) serves to provide some of the species' upland habitat requirements while minimizing impacts to wetland hydrology and movement corridors.

Primary Author:

Larry Torok, WLM, Division of Watershed Protection and Restoration

DRAFT DATE: 08/08/94 UPDATE: 05/13/08

Literature Cited:

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Boughton, R. G., Staiger, J. and Franz, R. 2000. Use of PVC pipe refugia as a sampling technique for Hylid treefrogs. Amer. Mid. Naturalist, Vol. 144, No. 1., pp. 168-177.

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_____ and J. Dowdell. 1991a. An updated distributional survey and habitat evaluation of the southern gray treefrog (*Hyla chrysoscelis* Cope) in southern New Jersey-both historic sites and newly discovered locations. Part 1. Unpublished report to NJDEP, Division of Fish, Game, and Wildlife, Endangered and Nongame Species Program by Herpetological Associates. 26 pp.

_____ 1991b. Mapping and localities of a distributional survey and habitat evaluation of the southern gray treefrog (*Hyla chrysoscelis* Cope) in southern New Jersey-both historic sites and newly discovered locations. Part II. Unpublished report to NJDEP, Division of Fish, Game, and Wildlife, Endangered and Nongame Species Program by Herpetological Associates. 113 pp.

Species: Eastern Mud Salamander (*Pseudotriton montanus montanus*)

Status: State endangered.

New Jersey Distribution:

This species has been verified at one location in Burlington County. There have been sightings reported (but unconfirmed) from Burlington, Ocean and Atlantic counties. It seems that the Eastern mud salamander is restricted to wetlands in southern New Jersey.

Habitat:

Eastern mud salamanders inhabit muddy or mucky microhabitats in, or along, margins of swamps, bogs, springs, floodplain forests, and small headwater tributaries (Conant 1975; Petranka 1998). Adults and juveniles usually remain within 20 meters of the breeding pond under woody cover or in burrows, though some reports of individuals being found further away exist (Barbour 1957 in Petranka 1998; Bruce 1975 in Pretranka 1998). The single confirmed record for New Jersey occurred in a vegetation-choked ditch in a fallow cranberry bog (Conant 1957). Several authors suggest that the species requires good water quality (Cromartie 1982; NJDEP and US Soil Conservation Service 1986).

Survey Methodologies:

No specifics are provided in the literature. The only suggestion is that of systematic searches of potential habitat by looking under rocks, logs, and decaying vegetation, and in muddy streambank burrows.

Regulatory Guidelines:

1. Area of Documentation: Wetlands featuring a documented sighting of the species. No sightings presently identified on the Landscape Project mapping.

2. Suitable habitat: Little specifics provided. See discussion of habitat above.

Rationale:

Due to the lack of information on the distribution in New Jersey and the habitat requirements of this species, firm guidelines for the designation of exceptional resource value wetlands resting upon sightings of this species are not affirmed. As a result, the Department will determine the extent of exceptional resource value (wetlands) concerning sightings of this species in a circumstantial manner.

Comments:

Present information concerning distribution of this species in New Jersey is inadequate. Species may be confined to the Pine Barrens.

Primary Author:

Larry Torok, WLM, Division of Watershed Protection and Restoration

DRAFT DATE: 08/08/94 UPDATE: 07/17/02

Literature Cited:

Cromartie, W.J. (ed.). 1982. New Jersey's Endangered and threatened plants and animals. Center for Environ. Research, Stockton State College, Pomona, NJ. pp. 152-153.

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Petranka, J.W. 1998. Salamanders of the United Statues and Canda. Smithsonian Institution Press, Washington D.C. and London, England. 587 pp.

NJDEPE, Division of Fish, Game, and Wildlife, Endangered and Nongame Species Program and USDA, Soil Conservation Service. 1980. Endangered and threatened species of New Jersey. A cooperative agency publication. pp. 7-8

Species: Henslow's Sparrow (*Ammodramus henslowii*)

Status: State endangered.

New Jersey Distribution:

Henslow's sparrow, historically, was observed from southern Sussex, Middlesex, and Mercer counties as well as along the Delaware Bay shore. Always rare and occurring in disjunct populations, recent sightings have come from Hunterdon, Morris, Bergen and Ocean counties. The last documented breeding occurrences were outside of Princeton in 1972 and at the Lakehurst Naval Air Station in 1994 (Walsh et al. 1999).

Habitat:

Henslow's sparrow will use a variety of early successional habitats with no definitive preference being shown for wetlands or uplands (Hyde 1939; Bull 1974). Robins (1971) suggested that the species preferred an intermediate moisture regime, avoiding areas which were "too wet" or "too dry". Other studies which have suggested the use of wetland areas by Henslow's sparrow have come from New York (Peterson 1983), Connecticut (Craig 1979), Vermont (Kibbe and Laughlin 1985), and Massachusetts (Forbush 1929).

Structurally, sites featuring Henslow's sparrow are dominated by sedges (*Carex* spp.), rushes (*Scirpus* spp.), grasses, and other non-woody vegetation (Wiens 1969; Peterson 1988). It has been suggested that some level of shrubby vegetation occurs as a component of occupied habitats (Whitney et al 1978; Johnsgard 1979; Fall and Eliason 1982). In Kansas, herbaceous vegetation ranged in height from 30-50 cm (10-20 in.) within breeding territories (Zimmerman 1988). Herkert (1994) found occupied sites in Illinois to feature a greater density of low vegetation [< 25 cm. (10 in.)] and more standing dead vegetation than unoccupied sites. Wiens (1969) identified the use of shorter grass sites for foraging. Other characteristics of Henslow's sparrow habitat include a layer of ground litter (Wiens 1969; Robins 1971; Fall and Eliason 1982) and dead standing vegetation (Zimmerman 1988).

Survey Methodologies:

No specific techniques have been developed to survey for Henslow's sparrow. Aural listening in suitable habitats and / or the use of taped calls to elicit responses from territorial birds have been recommended (Zimmerman 1988). Nests may be located by dragging a heavy rope between two people through suitable habitat with one or two people walking behind looking for flushed birds (M. Valent, pers. comm.). Hanson (1987) advised walking through suitable habitats during the nesting season (mid-April through June) rather than conducting surveys from the road. Several years of data is preferred over single season surveys (Hands et al. 1989).

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

   2. Suitable habitat: Wetlands suitable for use by Henslow's sparrow can be characterized as:

      a. marshes, meadows, or wet fields which are not saturated, flooded or ponded;
      b. emergent areas featuring a predominance of sedges, rushes, and/or grasses; and
      c. a sparce shrub community of 1-2 meters (3.28-6.5 ft.) in height.

In addition, the Department will weigh the continuity of suitable wetland habitat with evidence suggesting that the species may require wetland habitat complexes up to 100. ha (250 ac.) in size

Rationale:

Henslow's sparrow is highly dependent on a sensitive wetland hydrologic regime and a successional vegetative community. Habitats which become too wet or too dry are abandoned. Habitats which change due to the invasion of woody plant species and maturation of the existing vegetation may also become unsuitable. The establishment of their habitat as being of exceptional resource value is necessary to minimize direct impacts to the wetlands and, perhaps more importantly, ensure that activities adjacent to the wetlands, which can impact the hydrology of the wetland complex, will also be regulated.

Comments:

It has been suggested that Henslow's sparrow has similar habitat requirements to those of the sedge wren (*Cistothorus platensis*). Due to the species' habit of using both upland and wetland habitat, not all sightings of the species will lead to exceptional resource value classifications. Management may also be necessary to maintain suitable habitat conditions.

Primary Author:

Larry Torok, WLM, Division of Watershed Protection and Restoration

DRAFT DATE: 08/08/94 UPDATE: 06/28/02

Literature Cited:

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Kibbe, D.P., and S.B. Laughlin. 1985. Henslow's sparrow (*Ammodramus henslowii*). Pages 404-405 in S.B. Laughlin and D.P. Kibbe, eds. The atlas of breeding birds of Vermont. Univ. Press of New England, Hanover, New Hampshire. 456 pp.

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Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. Henslow’s sparrow (*Ammodramus henslowii*) pgs. 578-580 in Birds of New Jersey. New Jersey Audubon Society. 704 pp.

Whitney, N.R., B.E. Harrell, B.K. Harris, N. Holden, J.W. Johnson, B.J. Rose, and P.F. Springer. 1978. The birds of South Dakota: an annotated checklist. South Dakota Ornithol. Union, Vermillion, South Dakota. 118 pp.

Wiens, J.A. 1969. An approach to the study of ecological relationships amoung grassland birds. Ornithol. Mono. No. 8. 93 pp.

Zimmerman, J.L. 1988. Breeding season habitat selection by the Henslow's sparrow (*Ammodramus henslowi*i) in Kansas. Wilson Bull. 100:17-24.

Name: Short-Eared Owl (*Asio flammeus*)

Status: State endangered.

New Jersey Distribution:

Historically, short-eared owls nested in salt and brackish water marshes in the coastal zone; from the Meadowlands to Cape May. Recent studies have identified the species as an unconfirmed or infrequent breeder of Ocean, Atlantic, Cape May, Salem and Sussex counties (USDA and NJDEP 1980; D. Hughes in Tate 1992). The last suggested nesting attempt documented was in Supawna Meadows, Salem County in 1989 (Walsh et al. 1999). This species occurs more widely as a winter resident in the state.

Habitat:

Short-eared owls occur in New Jersey during the breeding season and also as a winter resident. Habitat types frequently mentioned as suitable include fresh and saltwater marshes, bogs, prairies, grassy plains, and old fields (Bull 1964; Clark 1975; Holt and Melvin 1986). Nests are usually located in upland areas which are frequently adjacent to wetlands (Clark 1975; Tate and Melvin 1988; Combs and Melvin 1989). Surrounding habitat is generally dominated by low dense shrub cover such as bayberry (*Myrica pennsylvanica*), black huckleberry (*Gaylussacia baccata*) and dense grasses (Tate and Melvin 1987, 1988).

Habitat structurally similar to nesting habitat is used by the short-eared owl for foraging, resting, and roosting during the breeding season and winter. In addition to the structure of the habitat, suitable habitat is described as sizeable (see discussion under home range) and should also feature "abundant" populations of prey (Craighead and Craighead 1956; Clark 1975; Johnsgard 1988). Roosting has been documented from abandoned dumps, quarries, gravel pits, storage yards, stump piles, small evergreen groves, bayberry thickets, dunes, and open abandoned cellars (Clark 1975; Bosakowski 1986). Wintering short-eared owls in Hunterdon County have been identified using agricultural land featuring wet mowed fields segmented by shrubby hedge rows and roadways (L. Torok pers. comm.)

Home Range/Movements:

A summary of home range/territory data for the short-eared owl is provided in Table One. Based on these data, Tate (1992) suggested that areas a minimum of 50 ha (125 ac) of low, open grasslands or similar habitat which featured abundant rodent populations warranted protection. It must be noted that the data provided above is based on diurnal activity and it has been suggested that nocturnal foraging may be more extensive (K.P. Combs in Tate 1992).

Survey Methodologies:

Combs and Griffin (1990) surveyed for short-eared owls by driving survey routes within suitable habitats during the early morning and late afternoon. Tate (1992) recommended surveying for

the species in early morning, at dawn and just after; and late afternoons, two to three hours before sunset.

Regulatory Guidelines:

1. Area of Documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: The following characteristics will be evaluated when establishing the suitability of wetland habitats for the short-eared owl.
   a. Favored vegetation structure is open field/successional type habitats featuring variable stands of shrub cover (see discussion above).
   b. Evidence of small mammal populations; abundant populations of small mammals are favored in short-eared owl habitats. The current lack of details on densities within documented territories lend evaluation of this characteristic to an individual analysis.
   c. For the extent of available habitat, please see the home range discussion above.

Rationale:

Due to the precarious status of the short-eared owl in New Jersey, the protection of current or historic breeding sites which remain suitable is paramount in maintaining the species as a component of our natural resource base. The protection of wintering habitats is required in that winter habitats often share similar characteristics with breeding habitats and have been documented as becoming breeding grounds (Clark 1975). The variable use of upland and wetland areas and the lack of more specific quantification of the habitat requirements of this species make establishing firm guidelines on designating exceptional resource value wetlands based on sightings of short-eared owls a difficult task. As a result, the Department will determine the extent of exceptional resource value wetlands, based on sightings of this species, on a site-by-site basis.

Comments:

Short-eared owls share similar habitat requirements and often co-occur with the northern harrier (*Circus cyaneus*) in breeding and wintering habitats.

Primary Author:
Larry Torok, WLM, Division of Watershed Protection and Restoration.

DRAFT DATE: 08/08/94 UPDATE: 06/28/02

Literature Cited:

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Village, A. 1987. Numbers, territory-size and turnover of short-eared owls Asio flammeus in relation to vole abundance. Ornis. Scand. 18:198-204.

Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. Short-eared owl (*Asio flammus*) pgs 336-337 in Birds of New Jersey. New Jersey Audubon Society. 704 pp.

Name: American Bittern (*Botarus lentiginosus*)

Status: State endangered.

New Jersey Distribution:

The species' breeding range occurs throughout all of New Jersey. In state records are localized and widespread, with a majority occurring in northern New Jersey. Breeding records have come from Trenton Marsh (Mercer), Lincoln Park gravel pits (Morris), Great Swamp NWR (Morris), and Kearny Marsh (Hudson). New Jersey Breeding Bird Atlas surveys have confirmed four breeding locales in Sussex, Burlington, and Salem counties during a five-year survey period (Walsh et al. 1999).

Habitat:

Breeding American bitterns are typically found in wet areas such as marshes, swamps, and bogs with emergent vegetation. They may also breed in wet meadows and have been documented to use dry meadows, pastures, and fields (Palmer 1962). The preferred herbaceous species include arum (*Peltandra* spp.), cattails (*Typh*a spp.), bullrushes (*Scirpus* spp.), wild rice (*Zizania aquatica*), and sedges (*Carex* spp.) (Bent 1929; Palmer 1962). In a study conducted in Wisconsin, Manci and Rusch (1988) heard American bitterns in shallow water cattail and dry cattail habitats only.

Wetlands that are home to American bitterns in Missouri and Minnesota are characterized by water depths less than or equal to 10 cm (4 inches) and dense vegetation with a mean height of 1.3 m (4.3 ft) (Frederickson and Reid 1986; Hanowski and Niemi 1986). Wetlands in Maine were dominated by emergent (e.g., cattails and sedges) and aquatic vegetation, with a high degree of cover/water interspersion (Gibbs and Melvin 1990; Gibbs et al. 1991). Lake sites in Québec featured patches of floating vegetation, emergent shoreline vegetation and good amphibian populations (DesGranges and Houde 1989).

Wetland nesting sites tended to be 5-20 cm (2-8 inches) above the water (Bent 1926; Middleton 1949). Azure (1998) characterized Minnesota nest sites as being dominated by cattail, common reed (*Phragmites asutralis*), and sedges with an average water depth at nests of 31 cm (12 inches). In studies conducted in Minnesota and North Dakota, Brininger (1996) found bittern nests on floating wetlands dominated by cattail, hardstem bullrush (*Schoenoplectus acutus*), sedge, common reed, and whitetop (*Cardaria pubescens*) with an average vegetation height of 126 cm (51 inces). Upland nesting sites in North Dakota and South Dakota occurred primarily in vegetation greater than 58 cm (23 inches) in height where the nest was concealed on the sides and top (Duebbert and Lokemoen 1977). Svedarsky (1992) described upland nest sites in Minnesota to consist of tall (> 60 cm), dense (44 cm mean 100% vertical visual obstruction) vegetation consisting of quackgrass (*Elymus repens*), redtop creeping bentgrass (*Agrostis stolonifera*), switchgrass (*Panicum virgatum*), timothy (*Phleum pratense*), reed canary grass (*Phalaris arundinacea*), sweet clover (*Melilotus* spp.), smooth brome (*Bromus inermis*) and big bluestem (*Andropogon gerardii*).

American bitterns have also been reported as using coastal salt or brackish marshes for breeding (Bent 1929). Other authors have indicated that the incidence of breeding in coastal areas is low, with use in these areas being higher during migration and the winter season (Bull 1964; Torok 1987). The species is reported to abandon marshes when exposed to low levels of disturbance (DeGraaf and Rudis 1986).

Survey Methodologies:

Brown and Dinsmore (1986) visited swamps between sunrise and 1000 hours, three times annually. Six-minute observation periods were executed at each stop with taped calls being played to elicit responses during the last 2 minutes of each period. Gibbs et al. (1991) surveyed wetlands for a variety of wetland species through repeated listening periods of two to three hours, begining one-half hour before sunrise or one and one-half hours prior to sunset, from April through August. Gibbs and Melvin (1993) further refined the survey process using taped calls to elicit responses. Survey points were established in a density of approximately one-fifth hectare (12 ac), with most survey work being done by canoe. Tapes used featured 50 seconds of male territorial vocalizations followed by 10 seconds of silence. Results indicated that survey work for American bitterns was more successful when conducted early in the breeding season (May, in Maine) and daytime (before 8 A.M.)

Comments:

Current information on the natural history of this species is lacking as well as information on its abundance and distribution in New Jersey.

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

   2. Suitable habitat: Areas of emergent marsh habitat which features cattails, bullrushes, and/or other wetland species described above. Mosaic wetland habitats will be evaluated on a case-by-case basis. Level of human intrusion into and around a wetland or wetland complex will also influence the suitability of such areas to support American bitterns.

Rationale:

Little information is available on the spatial requirements for this species. The information that is available suggests that the species may be area-dependent and that as a breeder, American bitterns are extremely susceptible to disturbance. Designation of the extent of exceptional resource value wetlands must be sensitive to these concerns while remaining flexible enough to adapt to yet unidentified spatial and habitat requirements.

Primary Author:

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DRAFT DATE: 08/08/94 UPDATE: 06/28/02

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Name: Red-Shouldered Hawk (*Buteo linneatus*)

Status: State endangered (breeding)

New Jersey Distribution:

Red-shouldered hawks may occur throughout the state; however, two regions appear to feature a majority of the breeding population. In southern New Jersey, limited numbers of red-shouldered hawks occur in swamps along Delaware Bay, primarily in Cape May and Cumberland counties. In northern New Jersey, the species is concentrated in the Pequannock Watershed within Passaic County. Other known locales include the Kittatinny Mountains in Sussex and Warren counties, the Great Swamp in Morris County, and the Ramapo Mountains in Bergen County. Scattered records occur from additional locales. Red-shouldered hawks were listed as possible, probable, or confirmed in 111 survey blocks by the New Jersey breeding bird atlas (Walsh et al. 1999)

Suitable Habitat:

The breeding habitat used by red-shouldered hawks varies from lowland hardwood, mixed, and conifer forests to upland mixed and conifer forests (Henny et al. 1973; Bednarz and Dinsmore 1981; Titus and Mosher 1981; Falk 1990; Crocoll and Parker 1991). Surrounding habitats were almost always characterized by nearby waterbodies (e.g. swamps, rivers, ponds) and tracts of forest (Kimmel and Fredrickson 1981; Morris and Lemon 1983).

Nest sites in Massachusetts were located in wet deciduous forests with mature yellow (*Betula lutea*) and black (*B. lenta*) birches being the favored nest tree species (Portnoy and Dodge 1979). In Maryland, Titus and Mosher (1981) identified red-shouldered hawk nests in white oak (*Quercus alba*), red oak (*Quercus rubra*), tulip (*Liriodendron tulipifera*), and American beech (*Fagus grandifolia*). Falk (1990) reported a strong association between red-shouldered hawk nest sites and beech, red maple (*Acer rubrum*), and hemlock (*Tsuga canadensis*) concentrations in Connecticut. A review of the literature on red-shouldered hawk nest sites, conducted by Bednarz and Dinsmore (1981), revealed use of 40 different tree species.

Several studies have further analyzed the characteristics of the habitat surrounding red-shouldered hawk nest sites. In Arkansas, Preston et al., (1989) evaluated the habitat surrounding nests located in forest communities of oak-hickory, elm-ash-cottonwood, and oak-gum-cypress. All nest sites were determined to be located closer to water and to feature larger trees with a more dense understory than random sites. Titus and Mosher (1981) found that red-shouldered hawk nest sites in Maryland featured denser understories, greater basal areas, larger overstory trees, and that they occurred lower in the canopy, closer to water than nests of four other raptor species. In northern New Jersey, Bosakowski et al. (1991) found nests to be located in areas characterized by significantly greater amounts of wetlands and coniferous-to-mixed forest; as opposed to suburban areas and deciduous forest. In a further analysis of occupied and unoccupied sites, Bosakowski et al. (1992) found a greater amount of wetlands surrounding occupied nest sites than that among unused sites. One nest site was located within a forested wetland among a complex of vernal pools (J. Heilferty, pers comm.). For southern New Jersey, Sutton and Sutton (1985) found Cumberland County nests to occur in old growth, hardwood

swamp forest, and, Cape May County nests to occur in less mature, wet woods. Vegetative communities associated with the 1991-1992 surveys of southern New Jersey were typified by Atlantic white cedar (*Chamaecyparis thyoides*), red maple (*Acer rubrum*), black tupelo (*Nyssa sylvatica*), sassafrass (*Sassafras albidum*) and sweetbay magnolia (*Magnolia virginiana*) with surrounding habitats of oak-pine forest and agricultural field (Dowdell and Sutton 1992).

Senchak (1991) studied breeding and post-breeding habitat use by red-shouldered hawks on the Patuxent Wildlife Research Center in Maryland. Her data indicated that water sources (river and ponds) were the most frequently selected habitat type used by the species. Other favored habitat types included bottomland forest, river swamp, terrace/bluff forest, and residential/commercial areas. Occasional or avoided habitats consisted of seepage swamp, pine forest, pine/oak forest, upland oak forest, and power lines. Tree species occurring in the favored habitat included beech, tulip-popular, sweetgum (*Liquidambar styraciflua*), river birch (*Betula nigra*), and red maple.

When venturing away from nests to forage, or during the non-breeding seasons, red-shouldered hawks tend to broaden the habitats used. Various authors have indicated the use of primarily non-forested areas within their home ranges for foraging (Bent 1937; Protnoy 1974 in Bednarz and Dinsmore 1981; Bednarz and Dinsmore 1981). A red-shouldered hawk nesting in a vernal habitat complex in northern NJ was flushed from ground level at the edge of a vernal pool (J. Heilferty, pers comm.). During the winter, this species has been observed making use of open habitats (Craighead and Craighead 1956; Bohall and Collopy 1984). In Maryland, wintering hawks were often observed foraging in edge habitats between fields and forest (M.R. Fuller in Hands et al. 1989).

Special Considerations: Great horned owls (*Bubo virginianus*) are known predators of red-shouldered hawks, having been documented to have caused several nest failures during Department funded surveys (Bosakowski et al. 1991; Bosakowski and Smith 1992; Dowdel and Sutton 1992). Red-tailed hawks (*Buteo jamacansis*) may out-compete and, thereby, drive red-shouldered hawks from their territories (Bent 1937; Craighead and Craighead 1956). Levels of human disturbance may also have adverse impacts on the use of a particular habitat by this species. Factors such as off-road vehicle use, logging, and hikers have been identified as affecting red-shouldered hawk nesting success (Bosakowski et al. 1991; Speiser et al. 1999; McKay et al. 2001). Conversely, red-shouldered hawks in Ohio and California have shown success nesting in urbanized environments (Bloom et al. 1993, Rottenborn 2000; Dykstra et al. 2002).

Survey Methodologies:

Bosakowski et al. (1991) surveyed for breeding red-shouldered hawks in New Jersey from March through June. Tape recorded vocalizations of red-shouldered hawks and red-tailed hawks were used to elicit responses from nearby hawks. The tape consisted of an initial period of silence (to allow for researchers to seek cover) followed by three minutes of red-shouldered hawk calls, three minutes of silence, and three minutes of red-tailed hawk calls. Dowdell and Sutton (1992) surveyed regions of southern New Jersey in the following fashion. Routes consisting of 10-13 survey points were run nine times during March through June. Each point was surveyed a maximum of nine times. Five minutes of passive listening followed by a four-

minute period of red-shouldered hawk calls and a five minute listening period were conducted during each survey session.

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

   2. Suitable habitat: See discussion provided above for details on plant species composition, vegetative community structural features, and surrounding land uses. The evaluation of each wetland will take into account the following characteristics:

      a. Locational factors: proximity to residential, industrial, or commercial development, intensity of development, various human disturbance factors (see habitat discussion), agricultural lands, and forest block size and continuity.
      b. Vegetative factors: forest age, canopy height and closure, forest species composition, understory height, stem density, and species composition.

Rationale:

Red-shouldered hawks are an area-dependent species and evidence suggests that sizeable tracts of mature forest (in excess of 400 ha/1000 ac) are required for successful reproduction. In addition, the species is extremely sensitive to disturbance, predation, and competition during the breeding season. The identification and protection of suitable habitats, specifically breeding habitat, within the likely home range of the species offers the best protection strategy for ensuring the continued existence of the red-shouldered hawk within currently occupied areas. The success of this strategy is contingent upon the size and configuration of wetland habitats in relation to the eventual degree of upland development within each particular red-shouldered hawk home range.

Primary Author:
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Name: Northern Harrier (*Circus cyaneus*)

Status: State endangered (breeding).

New Jersey Distribution:

This species is principally a breeder in tidal marshes along the Delaware Bay and Atlantic coast. Inland reports of northern harriers observed during the breeding season occur from various counties (D. Hughes in Serrentino 1992) but documented nesting is rare. Reports of northern harriers exist from marshes associated with the Hackensack Meadowlands and Raritan River. The New Jersey breeding bird atlas surveys yielded breeding records from known coastal locales, the Hackensack Meadowlands, and Somerset County (Walsh et al 1999).

Habitat:

Northern harriers are primarily a species of the open country; occurring in such habitats as farm fields, salt and freshwater marshes, swamps, bogs, and wet meadows (Hall 1983; Laughlin and Kibbe 1985; Serrentino 1989). While northern harriers use grasslands and agricultural areas for nesting and foraging during the winter and summer, Bildstein (1988) suggested that freshwater wetlands were the preferred breeding habitat. New Jersey's breeding northern harrier population occurs predominately in tidally influenced marshes.

Species associations identified within northern harrier freshwater breeding areas have included meadowsweet (*Spiraea latifolia*) and red-osier dogwood (*Cornus stolonifera*) in New Hampshire; sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), goldenrod (*Solidago* spp.), meadowsweet, and willow (*Sali*x spp.) in Wisconsin; and, wet hayfields dominated by reed canary grass (*Phalaris arundinacea*) in Vermont (Serrentino 1987; Hamerstrom and Kopeny 1981; Laughlin and Kibbe 1985).

Coastal breeding habitats have featured northern bayberry (*Myrica pensylvanica*), black huckleberry (*Gaylussacia baccata*) and wild rose (*Rosa* spp.) in Massachusetts; common reed (*Phragmites australis*), salt hay grass (*Spartina patens*), and smooth cordgrass (*S. alterniflora*) in New Jersey; and common reed and poison ivy (*Toxicodendron radicans*) in New York (Holt and Melvin 1986; Dunne 1984; England 1989). Nests are commonly located on the ground in stands of dense vegetation (Bent 1937; Hecht 1951; Serrentino 1987). Other nest sites used include sedge tussocks, willow clumps, or over water upon gathered and piled sticks (DeGraaf and Rudis 1986).

Northern harriers will use habitats similar to the breeding habitats for hunting and roosting during the summer and winter (Bosakowski 1983; Root 1988). In Arkansas, Preston (1990) reported that northern harriers avoided foraging over areas of dense vegetation and used wet fields dominated by bulrushes and smartweeds (*Polygonum* spp.) to a greater extent than expected. Roost sites may feature large numbers (≥ 60) of northern harriers as well as short-eared owls (*Asio flammeus*) (Serrentino 1992).

Survey Methodologies:

Dunne (1986) conducted northern harrier surveys in southern New Jersey in the following manner. Suitable habitats were surveyed a minimum of three times between April 9 and July 15. The criteria used to confirm nesting were:

a. Prey exchange between a male and female;
b. Male dropping prey to a suspected nest; and/or
c. Male behaving territorially towards an intruder in the vicinity of a suspected nesting site.

Sightings of a pair or of an individual male, during the breeding season, without any of the other criteria cited being observed, were not considered in order to establish a confirmed nesting.

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: The following characteristics will be evaluated when establishing the suitability of wetland habitats for the northern harrier.

a. *Vegetative characteristics*. Favored vegetation is open field, marsh and early successional type habitats featuring variable stands of shrub cover (see discussion above).

b. *Abundance of small mammal populations*. As indicated above, population densities of small mammals influence the suitability of a habitat and the number of pairs of northern harriers that habitat can support. The current lack of details on densities within documented territories lend evaluation of this characteristic to a case-by-case basis.

c. *Extent and continuity of available habitat*. See home range discussion above.

Special Considerations:

Northern harriers are known to roost communally in the winter. The Department will review winter roost sites on a case-by-case basis to determine if any wetlands associated with them would warrant an exceptional resource value classification.

Comments:

Currently, the Department does not have documentation of confirmed northern harrier breeding in freshwater wetlands. Fringe wetlands along the Delaware Bay, from Alloways Creek in Salem County through Cape May, and along the Atlantic coast, from the Tuckahoe-Great Egg Harbor marshes through the Forsythe NWR, may provide suitable foraging habitat. Northern harriers share similar habitat requirements and often co-occur with the short-eared owl (*Asio flammeus*) in breeding and wintering habitats.

Rationale:

Northern harriers are currently only identified as nesting in brackish marshes along the Delaware Bay shore and in Atlantic coastal areas. The protection of the freshwater wetland fringe and application of transition areas on these sites serves to maintain suitable expanses of foraging areas and habitat for prey.

Despite not currently being documented from freshwater wetlands, breeding northern harriers occur in such habitats in nearby states. As a result, the protection of inland breeding sites, when they are identified, is instrumental in maintaining breeding populations in New Jersey. The variable use of upland and wetland areas, and the lack of a more specific quantification of the habitat requirements for this species, makes establishing firm guidelines on designating exceptional resource value wetlands based on sightings of this species a difficult task. As a result, the Department will determine the extent of exceptional resource value wetlands based on sightings of this species on a case-by-case basis.

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Name: Sedge Wren (*Cistothorus platensis*)

Status: **State endangered.**

New Jersey Distribution:

New Jersey State breeding range has been suggested as the coastal strip stretching from Burlington through Cape May County and north, to the Hackensack Meadowlands. Most records, however, are drawn from along the Delaware bayshore area, in Cumberland and Cape May counties, and the large marsh complexes of northeastern New Jersey. Isolated records have been reported from Sussex, Burlington, and Salem counties. The New Jersey Breeding Bird Atlas survey efforts observed breeding activity in Sussex, Somerset, Salem and Cumberland counties (Walsh et al. 1999).

Habitat:

Sedge wrens occur in early successional sedge (*Carex* spp.) meadows, shallow sedge marshes with scattered shrubs and little to no open water, and coastal brackish marshes featuring *Spartina patens* or switchgrass (*Panicum virgatum*) with scattered low shrubs and herbs (Stewert and Robbins 1958; Crawford 1977; Leck 1984; Anderle and Carroll 1988). The species is highly sensitive to site hydrology and will abandon sites that become "too wet" or "too dry" and/or overgrown with shrubs (Gibbs and Melvin 1992).

Various studies throughout the country have identified several characteristics typical of sedge wren habitats. Emergent wetland habitats, featuring sedges, are frequently observed (Palmer 1949; Stewert and Robbins 1958; Picman and Picman 1980; Burns 1982; Manci and Rusch 1988). Other species common to sedge wren locales include bulrushes (*Scirpus* spp.), white-top (*Scolochloa festucacea*), and reed canary grass (*Phalaris arundinacea*) (Burns 1982; Picman and Picman 1980; Crawford 1977). Niemi (1985) characterized sedge wren habitats in Minnesota to feature 303 sedge stems/sq. meter, 16 forb stems/ sq. meter, 50 shrub stems/sq. meter, and a predominant vegetation height of 1.1 meters. In Wisconsin, Sample (1989) found sedge wrens to occupy areas with an average of 2% woody cover, 82% herbaceous cover, 17% litter cover, 0.2% bare ground, 7% standing residual cover, and 1% water cover. In Nebraska, Lingle and Bedell (1989) reported sedge wrens to nest near wetland borders where the predominant vegetation consisted of water sedge (*Carex aquatilis*), common ragweed (*Ambrosia artemisiifolia*), and river bulrush (*Schoenoplectus fluviatilis*). Manci and Rusch (1988) reported that sedge wrens avoided areas of deepwater cattail (*Typha* spp.), shallow-water cattail, and river bulrush. Sparce shrub growth has also been commonly identified as a component of successful sedge wren breeding areas (Palmer 1949; Tordoff and Young 1951; Niemi and Hanowski 1984).

Little information is available on the use of wetland habitats by over-wintering sedge wrens. Brackish and freshwater emergent meadows and marshes have been identified (Howell 1932).

Survey Methodologies:

No specific techniques have been developed to survey for sedge wrens. Aural listening in suitable habitats and/or the use of previously taped calls to elicit responses from territorial birds has been suggested (Manci and Rusch 1988). Since the species may not establish a breeding territory until late June or July, survey efforts should be conducted from April through these months. Sedge wrens will also sing during migration (Cromartie 1982).

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Wetlands suitable for use by sedge wrens can be characterized as:

   a. marshes, meadows, or wet fields which are not saturated, flooded or ponded;
   b. emergent areas featuring a predominance of sedges, rushes, and/or grasses;
   c. a sparce shrub community of 1-2 meters (3.28-6.5 ft.) in height.

Rationale:

Sedge wrens are highly dependent on a sensitive wetland hydrologic regime. Habitats which become too wet or too dry are abandoned. Sedge wren habitat is also subject to impacts from vegetational succession. The establishment of their habitat as being of exceptional resource value is necessary to minimize direct impacts to the wetlands and, perhaps more importantly, ensure that activities adjacent to the wetlands which can impact the hydrology of the wetland complex will also be regulated.

Comments:

Sedge wrens are apparently not site tenacious, often abandoning sites after one to three years. However, such habitat instability may reflect variations in local or annual weather conditions rather than the absolute unsuitableness of a particular habitat. Management may also be necessary to maintain suitable habitat conditions.

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Name: Bald Eagle (*Haliaeetus leucocephalus*)

Status:

State endangered (breeding)
State threatened (non-breeding)

New Jersey Distribution:

Research has documented a minimum of 22 bald eagle nests in New Jersey prior to 1960 (Niles 1984, Holstrom 1986). Through the summer of 2003, active breeding behavior was shown by 35 pairs of eagles in the State, while another five pairs were watched for potential nesting (Smith et al 2003). Breeding pairs occur in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Hunterdon, Monmouth, Salem, and Warren counties. Significant wintering areas occur along the Delaware Bay, Maurice River, Egg Harbor River, Wading River, and the Delaware River; from Belvidere northward to the New York State border.

Habitat:

There are two populations of bald eagles in New Jersey. The main population, also referred to as the breeding population, exists in forests and marshes within the drainage system of the Delaware Bay and along the Delaware River. The State's winter population consists of overwintering breeders and transient birds from breeding sites to the north. This population is largely concentrated along tributary waters of the Delaware Bay and the Delaware River.

Breeding habitat: Preferred nesting habitat generally consists of large nest trees in discontinuous forest stands near open water feeding grounds (Jaffee 1980; Evans 1982; Andrew and Mosher 1982). In their research of bald eagle habitat along the Chesapeake Bay in Maryland, Andrew and Mosher (1982) selected their study area boundaries based on the assumption that suitable breeding habitat consisted of forested areas with trees featuring a dbh of at least 30 cm (12 in) which occurred within 3 km (1.8 mi) of open water. In Virginia, Cline (1993) noted that eagle nests were often located in open mature forest stands at least 8 ha (20 ac.) in size, within 1 km (0.6 mi) of both wetlands and waters.

Trees used for nesting by bald eagles may be either hardwood or softwood and are generally characterized by their large size and height (Smith 1936; Hansen 1987). The 70 nest sites studied by Andrew and Mosher (1982) included ten different species averaging 62 cm (24.8 in) in diameter and 23 m (75 ft) in height. Similar findings were made in Alaska and Virginia (Robards and Hodges 1974; Jaffee 1980). In New Jersey, most nest trees are taller than the surrounding forest habitat (L. Niles pers. comm.). Tree species used for nesting include sycamore (*Platanus occidentalis*), hickory (*Carya ovata*) and loblolly pine (*Pinus taeda*)(Niles et al. 1991).

Another important characteristic of bald eagle nesting habitat are openings in the canopy of the nest tree and the forest around it. In Florida, Wood and Collopy (1989) reported that nest trees were not significantly taller than the surrounding forest. Instead, nest trees appeared to be generally larger than the trees of the surrounding forest and featured stem densities that permitted

access through the crown. Jaffee (1980) suggested that the form of the tree was more important to its suitability for nesting than the species. In regard to the closure of the canopy in surrounding forests, this feature has been documented to vary from 61% in Maryland (Mosher and Andrew 1981) to less than 20 % in California (Lehman et al. 1980). It has been suggested that this discontinuity of canopy is necessary to allow eagles to maneuver around their nests (Grubb 1976; Todd 1979; Andrew and Mosher 1982).

Nest trees are commonly found in proximity to water. Mean distances from water have varied from 36 m (118 ft) in Alaska to over 1.2 km (0.7 mi) in Oregon (Robards and Hodges 1977; Anthony and Isaacs 1981). Additional work in Oregon determined that 84% of eagle nests occurred within 1.6 km (1 mi) of water, with a maximum distance of 7.4 km (4.4 mi) (Anthony and Isaac 1989). In Maryland, over 90% of the eagle nests occurred within 1.5 km (0.9 mi) of water (Taylor and Therres 1981).

Resting and feeding habitat: The primary prey item for eagles is fish (Retfalvi 1970; Dunstan and Harper 1975; DeGraaf et al. 1980; Todd et al. 1982). However, eagles will also take various species of birds, reptiles, mammals, and invertebrates in direct relation to their availability (Cline and Clark 1981; Frenzel 1984).

Given these feeding habits, preferred foraging habitat for bald eagles are rivers, lakes, and estuaries (DeGraaf et al. 1980). Large water bodies are favored over small ones with little use being made of smaller streams and ponds (Leighton et al 1979). Based on his review of existing documentation, Peterson (1986) concluded that waterbodies should be a minimum 8 ha (20 ac) in size, with lakes featuring a surface area greater than 10 km^2 (3.8 mi^2) considered as optimum size. For Maine, Livingston et al. (1990) suggested that waterbodies a minimum of 30 ha (75 ac) in size were necessary for eagle nesting.

Wintering habitat: In general, wintering bald eagles will tend to concentrate in forested areas often adjacent to open, unfrozen, water bodies (Evans 1982). Habitat components important to wintering bald eagles include the availability of prey, perch sites and roosting areas.

Diets of wintering bald eagles differ from breeding eagles primarily in the diversity of food taken. As mentioned above, eagles principally feed upon fish during the breeding season. During the winter, studies have indicated that eagles feed upon such prey items as sick and crippled waterfowl (Southern 1964; Griffin et al. 1982; Keister et al 1987) small mammals (Frenzel and Anthony 1989), deer carcasses (A. Peterson, N.Y. DEC, Albany; unpubl. in Peterson 1986), road kills (Retfalvi 1970; Platt 1976) and fish (Knight and Knight 1983) in direct relation to their availability. Eagles at an inland roost site in Illinois, studied by Harper et al. (1988), fed primarily on carrion and small birds.

The characteristics and availability of suitable perch sites is also of significance to wintering bald eagles. Steenof et al. (1980) analyzed the characteristics of bald eagle perch sites within a floodplain in South Dakota. Trees were the favored perch sites for eagles in this study, though they were also observed on the ground, cliff faces and partially submerged logs. Ninety-four percent of the perched eagles were observed within 30 meters (98.4 ft.) of the riverbank. Favored perch sites generally consisted of tall (mean 21.1 m/69 ft), large (mean 42.3 cm/17 in)

trees featuring stout, horizontal branches with at least one side facing an open area. The authors also noted that the proximity to a quality foraging site may be more important than stand characteristics in perch site selection.

Similar habitat use was observed by Stalmaster and Newman (1979) in northwestern Washington. All eagles observed were perched within 50 meters (164 ft.) of the riverbank, predominantly in large snags or black cottonwoods (*Populus trichocarpa*) with little preference being shown for evergreen species. Other characteristics identified were similar to those mentioned above. Chester et al. (1990) reported seasonal variation in the use of perch sites in North Carolina. Pines were used to a greater extent than hardwoods during the seasons when leaves were present and to a lesser extent during the seasons when leaves were absent. Bowerman et al. (1994) established an age variation in perch site selection in Michigan. They observed that adult birds used both deciduous and evergreen trees for perching equally, while juvenile birds favored deciduous trees. This study also indicated that levels of disturbance affect perch site selection with birds favoring taller trees near residences and conifers over deciduous trees in areas of human disturbance.

Bald eagle winter roost habitat tends to feature structural characteristics similar to those identified for breeding and perch habitat. For one, roost sites are commonly located in proximity to suitable open water feeding areas. Buehler et al. (1991a) reported 95% of the roost sites identified along Chesapeake Bay to occur within 790 meters (2591 ft) of water. Hansen et al. (1980) reported roost site from feeding site distances to vary from 0.25 km (0.15 mi) to 2.4 km (1.4 mi). Stalmaster and Gessaman (1984) concluded that the maximum distance metabolically favorable between a roost site and suitable feeding habitat is 3.9 km (2.3 mi).

The size of forest stands used for roosting is highly variable. In Virginia, Cline (1993) found communal roosts to be 0.39-1 ha (1-2.5 ac) and found them to occur within much larger forest stands [aver. 1543 ha (3800 ac)]. Sites evaluated by Keister and Anthony (1983) varied from 8 ha to 254 ha (12 to 575 ac.). Other variables examined in this study included trees per hectare (25.6-79.2), dbh [50.4-61.3 cm (20.2-24.5 in)] and height [24.6-27.2 m (80.7-90.5 ft). In contrast, inland roost sites in Illinois occurred 13-20 km (7.8-12 mi) from suitable feeding habitats along the Mississippi River (Harper et al. 1988). All roost sites appeared to be selected in areas protected from the prevailing winds (Steenof 1978; Keister et al. 1985). Keister et al. (1987) determined that eagles shifted their roost locations in response to stressful weather conditions and prey populations. They also determined that adult eagles, rather than sub-adults, tended to roost in areas further from prey.

Roost trees may be hardwood or softwood. Stalmaster and Gessaman (1984) suggested that old growth conifer stands were generally favored over deciduous stands with some variation based on proximity to feeding habitat and severity of weather. In Maryland, Buehler et al. (1991a) found roost habitat, rather than random sites, likely to feature hardwoods, high canopies, and snags. In northwestern Washington, stands of predominantly Douglas fir (*Pseudotsuga menziesii*) and western red cedar (*Thuja plicata*) were favored (Stalmaster and Newman 1979). Keister and Anthony (1983) reported roost sites to be dominated by ponderosa pine (*Pinus ponderosa*) and other mixed conifers in the Klamath Basin in Oregon and California. Roost sites in North Carolina featured relatively open crowns with large branches and were dominated by

sizable, dead hardwoods and loblolly pines (Chester et al. 1990). Roost trees were generally taller than the surrounding canopy or were associated with open areas (Stalmaster and Newman 1979). Management recommendations for maintaining suitable roosting habitat have included actions which preserve old growth stands and maximize large open structure and dead, or spike-topped, trees (Keister and Anthony 1983).

Survey Methodologies:

No systematic methodology has been established to survey for bald eagles. Due to the conspicuous nature of the species and its nest, most surveys consist of searching suitable habitat on the ground, and from the air, for evidence of the species (Steenhof et al 1980; Andrew and Mosher 1982). In New Jersey, winter surveys are conducted by all-day visual watches within suitable (e.g. open water, mature forest stands) habitats.

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Due to the necessity to minimize various forms of disturbance in the vicinity of a nest site, the Department will apply the following criteria in accessing the suitability of habitat for breeding eagles.

   a. **Breeding habitat**: All vegetated wetlands within, and contiguous with, a 1 km (0.6 mi) radius of the nest will be considered a suitable component of eagle habitat. Tracts of forested wetland contiguous with the nest location within this radius will be considered to be suitable breeding habitat. Wet farm fields, other "disturbed" wetland habitats and wetlands under 0.4 ha (1 ac) in size will be judged on a case-by-case basis.

   b**. Suitable feeding/resting habitat** sites will consist of:

   i. Forested wetlands featuring dead and/or live trees with a dbh greater than 12 cm (8 in) contiguous with a suitable water body [e.g. > 8 ha (20 ac.)] featuring the prey items discussed above;

   ii. Forested wetlands which are a component of a contiguous forest stand within 300 m (984 ft) of a suitable waterbody (e.g. > 8 ha) featuring the prey items discussed above;

   iii. Scrub-shrub or emergent freshwater wetlands will be considered on a case-by-case basis.

Special Consideration:

Many additional factors may affect the suitability of a particular habitat for use by eagles. These include the likelihood, timing and duration of human disturbance and the type, configuration, and density of surrounding development. Within the entire area of documentation and/or as they may relate to an individual wetland, these factors will be evaluated along with the structural characteristics of that wetland when establishing its suitability for bald eagle use. Densities of greater than one house per hectare, and human disturbance within 500 m (1640 ft) of the shoreline of the Chesapeake Bay, affected the presence of nesting eagles (Buehler, et al., 1991b). It should be noted that variation occurs in reference to the tolerance of bald eagles to disturbance. Additional information on the effects of various types of disturbance on eagles may be found in Anthony et al. (1995).

In addition, due to the occasionally irregular nesting habits of bald eagles in New Jersey, the Department will continue to consider nest sites abandoned less than 5 full breeding seasons to be active nest sites. This standard is consistent with criteria applied in Maine and recommendations made by the USFWS. (MDIFW 2005; USFWS 2007)

Rationale:

The selection of breeding sites for bald eagles is largely a function of the availability of nest trees or a forest stand suitable for nesting and sufficiently isolated from constant disturbance to allow for successful reproduction. In order to maintain the suitability of breeding sites, direct protection of the habitat is necessary as well as indirect protection by keeping various types of disturbance distant from the nest. The extension of an exceptional resource value classification to wetlands associated with a "zone of disturbance" around a breeding location is necessary to maintain the suitability of a habitat for breeding by bald eagles by keeping sources of disturbance away from the breeding site. Such protection also addresses the needs of fledged young and their habitat use near the nest prior to dispersing.

In regard to the designation of resting and feeding sites for breeding and wintering eagles, various setbacks have been suggested to maintain the suitability of feeding sites. Documentation has suggested that buffers of between 100 m (328 ft) to 500 m (1640 ft) may be necessary adjacent to breeding or wintering eagle perching and feeding sites to maintain their suitability (Stalmaster and Newman 1978; Knight and Knight 1984; Cline 1985; Cline 1993). In designing the bald eagle foraging model, the Department incorporated 90 m (300 ft) setbacks of off suitable open water foraging habitat and contiguous marsh habitats. While in some cases, these recommendations exceed the setbacks adjacent to wetlands provided by the Freshwater Wetlands Protection Act, they do provide criteria where the establishment of transition areas will assist in maintaining the suitability of habitat for use by the species. In addition, the protection of winter habitat benefits the state's breeding population because all of New Jersey's breeders remain in the state during the winter.

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Species: Black Rail (*Laterallus jamaicensis*)

Status: State endangered (breeding), State-threatened (non-breeding).

New Jersey Distribution:

Historically, black rail populations have been concentrated in coastal marshes from the vicinity of Philadelphia to Cape May and along the Atlantic coast, as far north as Sandy Hook in Monmouth County (Kievit 1980; Kerlinger and Sutton 1989). Inland reports come from Bergen, Morris, Mercer, and Camden County (D. Hughes in Davidson 1992). New Jersey Breeding Bird Atlas surveys only confirmed breeding in one locale (Sussex County) and found possible or probable breeding in twelve other locales along the coast and Delaware Bay (Walsh et al. 1999).

Habitat:

Black rails have been reported from both salt and freshwater marshes throughout their North American range. In New Jersey, the species has predominantly been found in salt and brackish water marshes, but several scattered freshwater wetland records exist (Torok 1987).

Salt or brackish water habitats are characterized by stands of saltmeadow cordgrass (*Spartina patens*), mixed with saltwater cordgrass (*S. alterniflora*), big cordgrass (*S. cynosuriodes*), marsh spike grass (*Distichlis spicata*), black needlerush (*Juncus roemerianus*), black rush (*J. gerarde*), or olney's bulrush (*Scirpus americansis*) (Kerlinger and Sutton 1988; H. Wierenga in Davidson 1992). Other species mixing in, along upland/wetland fringes, include marsh elder (*Iva frutescens*) and groundsel tree (*Baccharis halimifolia*) (Kerlinger and Wiedner 1990). Succession from saltmeadow to saltwater cordgrass dominated communities is reported to adversely impact the suitability of salt marsh habitats for black rails (Kerlinger and Sutton 1988). Nesting locales typically occur in areas flooded by unusually high tides (Todd 1977; Andrle and Carroll 1988).

Black rails nesting in inland areas generally occur in wetland complexes dominated by sedges, rushes, and grasses (Todd 1977; Proctor 1981). Use of cattail (*Typha* spp.) and oat (*Avena sativa*) habitat has also been recorded (Bryant 1962; Armistead 1990). In a study of black rail habitat use along the lower Colorado River in Arizona, Repking and Ohmart (1977) concluded that black rails were closely associated with wetland communities which: (a) were dominated by three-square bulrush; (b) featured gently sloping shorelines; and (c) experienced a minimum of water level fluctuations. Shallow water levels, between two and four centimeters (0.8-1.4 in), have been identified as typical of black rail habitat in this area (R. Flores in Davidson 1992).

Survey Methodologies:

Repking and Ohmart (1977) surveyed for black rails from the periphery of marsh habitats using taped calls. Surveys were conducted from approximately one hour before sunrise to 10:00 A.M. Taped calls were played every 40 m (132 ft) for three to five minutes with an additional two minute listening period afterward. Kerlinger and Sutton (1988) searched suitable southern New

Jersey habitats using listening periods consisting of a three-to-five-minute listening session upon arrival, followed by a one-to-three-minute tape call. The process was then repeated. Each survey session required ten to thirty minutes, depending on site conditions. Surveys in Maryland were conducted in the evening between 10 P.M. and 4 A.M. from roadside survey points (H. Wierenga in Davidson 1992).

Regulatory Guidelines:

1. Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Freshwater or regulated brackish water wetland marshes, or wetland fringes featuring a species composition similar to that described above, will be considered suitable black rail habitat.

Rationale:

Black rails principally occur in saltwater, or brackish water, marshes in New Jersey along the wetland fringe that exists between the tidal wetlands and the adjacent uplands. Evidence suggests that black rails prefer habitat along the drier edges of these marshes and make extensive use of these transitional zones. A reduction in suitability of this habitat for the black rail is possible and due to a few factors: (1) invasion by aggressive vegetative species, such as *Phragmites,* and subsequent alteration of the vegetative structure of the habitat; and (2) a change in the hydrology of the habitat. Additionally, the drier areas of the marshes provide refugium from high tide events, those which can reduce reproductive success (Bailey 1927; Todd 1977) thereby causing increased black rail predation (Evans and Page 1986).

As a result, the protection of these fringe freshwater wetlands is important to maintaining the continued existence of black rails in New Jersey. The protection of these drier wetland habitats and adjacent upland buffers is paramount to maintaining the suitability of the habitat for black rails. In a discussion on habitat protection efforts for this species, Davidson (1992) suggested that preservation design should encompass suitable breeding habitat and a secondary ecological boundary of marshland and upland areas. This proposal is consistent with recommended protection actions.

Comments:

Due to the infrequent occurrence of black rails within interior freshwater wetlands, the Department will evaluate the habitat conditions surrounding reported inland sightings and make classification determinations on a case-by-case basis. It is likely that standards similar to those proposed of coastal wetlands, will be applied.

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Walsh, J., V. Elia, R. Kane, and T. Halliwell. 1999. Black Rail (*Laterallus jamaicensis*) pgs 208-209 in Birds of New Jersey. New Jersey Audubon Society. 704 pp.

Name: Pied-Billed Grebe (*Podilymbus podiceps*)

Status: State endangered (breeding population).

New Jersey Distribution:

All of New Jersey occurs within the species' breeding range. In state records are localized and widespread. Breeding sites include Mannington Meadows (Salem), Trenton Marsh (Mercer), Whitesbog (Burlington), and Kearny Marsh (Hudson). The New Jersey breeding bird survey confirmed grebes in scattered locales in Sussex, Burlington, Salem, Cape May, Monmouth, Middlesex, and Hudson counties (Walsh et al. 1999).

Habitat:

Pied-billed grebes occur primarily in freshwater marshes featuring an interspersion of open water and emergent vegetation habitats. They may also use sluggish streams which feature overhanging vegetation. A discussion of the habitat identified in various studies follows.

Glover (1953) compiled data on grebe nesting areas in northwestern Iowa. Sites were characterized as emergent/open water complexes. Nest site vegetation commonly consisted of fairly dense stands of pale spike rush (*Eleocharis macrostachya*), hard-stemmed bulrush (*Scirpus acutus*), and soft-stemmed bulrush (*Scirpus validus*). Nests were generally located in waters 27-100 cm. (11-40 inches) deep and within 18 meters (60 ft.) of open water habitats. Successful nests were an average of 97 meters (305 ft.) from the shore.

In Louisiana, Chabreck (1963) reported the habitat conditions used by nesting pied-billed grebes in a brackish marsh. The 80 ha (200 ac) impoundment was characterized by open water areas featuring submerged growths of wigeongrass (*Ruppia maritima*). Emergent areas (about 25%) were dominated by wiregrass (*Spartina patens*). Water depths averaged 45 cm (18 inches) in open water areas and varied from 20-30 cm (8-12 inches) in the Spartina stands.

In North Dakota, Faaborg (1976) described breeding pied-billed grebe habitat as ponds which averaged 2.2 ha (5.5 ac) in size with a range of 0.6 to 7 ha (0.24-17.5 ac). Such ponds generally featured dense stands of vegetation (usually *Typha* spp.) in conjunction with open water areas. Fifty percent of the small ponds occupied by grebes had only 20-40% open water. Of the larger (> 2 ha) ponds featuring nesting grebes, all featured dense stands of emergent shoreline vegetation.

Prairie pothole habitats in Manitoba featured emergent vegetation composed of bulrushes, cattail, and whitetop (Scholochioa festucacea) (Sealy 1978). Nests were located in water, averaging 35 cm (14 inches) in depth, and were within 6 m (20 ft) of the shore and 1.3 m (4 ft) of open water. Other work conducted on prairie pothole wetlands by Nudds (1982) and Barnes and Nudds (1989) indicated a partitioning of such habitats between pied-billed grebes, horned grebes (*Podiceps auritus*), eared grebes (*P. nigricollis*) and American coots (*Fulica americana*). They concluded that pied-billed grebes occurred in wetland habitats of generally shallow water, larger

size, denser vegetation, and which featured greater "spacial heterogeneity" than habitats used by the other species.

Forbes et al. (1989) analyzed pied-billed grebe nesting habitats on a 35 ha (87.5 ac) impoundment in Nova Scotia, Canada. The site consisted of 65% open water and 35% emergent vegetation. Emergent areas consisted of cattail, burreed (Sparganium eurycarpum), soft-stemmed rush (*Scirpus validus*) and reed (*Phragmites australis*) in densities of 59.2%, 33.8%, 3.6% and 3.4% respectively. Nest sites occurred in areas with less emergent vegetation, greater water depths, near to open water, and were further from shore than random points. Based on these findings, the authors concluded that pied-billed grebes prefer "fragmented habitats of interspersed emergent vegetation and open water areas over denser stands of vegetation for nesting". In a similar site in South Carolina, Post and Seals (1991) established a correlation between numbers of nesting grebes and an increase in emergent vegetation (*Hydrilla verticillata*). In a study conducted in Maine, Gibbs et al. (1991) determined that wetlands used featured greater levels of aquatic-bed vegetation, ericaceous vegetation, and emergent vegetation than did unused sites.

Survey Methodologies:

Brown and Dinsmore (1986) visited swamps between sunrise and 1000 hours three times annually. Six-minute observation periods were used at each stop with tape calls being played to elicit responses during the last 2 minutes of each period. Gibbs et al. (1991) surveyed wetlands for a variety of wetland species through repeated listening periods of 2-3 hrs beginning one-half hour before sunrise or 1.5 hrs prior to sunset during April through August. Gibbs and Melvin (1993) further refined the survey process using tape calls to elicit responses. Survey points were established in a density of approximately one-fifth hectare (12 ac) with most survey work being done by canoe. Tapes used featured 50 seconds of male territory vocalizations followed by ten seconds of silence. They suggested that surveys for pied-billed grebes should be conducted during the morning (4-10 A.M.) during the breeding season (mid-May to late June in Maine).

Regulatory Guidelines:

1. Area of Documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See “New Jersey Division of Fish and Wildlife. 2017. New Jersey’s Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program” for more details.

   2. Suitable habitat: Suitable habitat for the pied-billed grebe consists of fragmented or interspersed areas of dense emergent vegetation with channels or other open water areas. Associated vegetation species include cattails, bullrushes, and phragmites. Given the spacial variation of documented pied-billed grebe habitats, ranging from 0.6 ha (1.5 ac) to 80 ha (100 ac), no definitive size standards can be applied. Each wetland complex will be evaluated on a case-by-case basis. Gibbs and Melvin (1992) suggest that a minimum wetland size of 5 ha (12.5 ac) be applied in the Northeast.

Rationale:

Protection of the emergent, breeding habitat of the pied-billed grebe is required to insure the species' continued existence in New Jersey. Sufficient wetland areas will need to be identified on a case-by-case basis to make certain that impacts are minimized to suitable breeding habitat. In general, ponded marsh areas featuring emergent vegetation interspersed with open water habitat will receive an exceptional designation. However, on larger wetland complexes or complexes featuring a mosaic of wetland habitats (e.g. Trenton Marsh), inclusion of additional wetland "buffer" areas outside of the emergent habitat may be required.

Primary Author:

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Name: Golden-winged Warbler (*Vermivora chrysoptera*)

Status: State endangered (breeding population)

New Jersey Distribution:

The golden-winged warbler may be observed throughout the entire state of New Jersey during migration. However, it has only been documented to breed within the northwestern portion of the state primarily in Sussex, Warren, Morris and Passaic counties (Davenport, 2011).

Golden-winged warblers leave New Jersey and begin their migration south in late August. The birds spend the winter in Central and South America and migrate back north through the Midwest, Northeast and Appalachian regions in early April (Confer, 1992)

NOTE: Golden-winged and Blue-winged warblers *(Vermivora cyanoptera)* commonly hybridize where their ranges overlap. The hybrid forms were once thought to be two separate species (Brewster's and Lawrence's Warbler). Later these were understood to be hybrids which carry the dominant and recessive traits of the two parental species (Confer et al., 2011). Amongst other phenotypic characteristics, the most outstanding factor to consider between the two hybrids is the black throat which the Lawrence's must have and the Brewster's must lack. Of the two hybrid forms, the Brewster's warbler occurs more commonly (Peterson, 1947). As such it is important to consider the effect of hybridization on population decline in the golden-winged warbler.

Habitat:

Breeding habitat for the golden-winged warbler consists of open scrubby areas or wetlands as well as brushy, early successional habitat. They require a somewhat unique habitat of sparse trees and shrubs with an herbaceous understory of grasses and forbs in either upland or wetland settings (Sauer et al., 1994). Vegetation will usually be dominated by herbaceous growth which includes golden rod *(Solidago* spp.*)* and shrubs species such as dogwood (*Cornus* spp.*)* and *Virburnum* spp. In wetter areas, suitable habitat vegetation has included sedge and alders, but rarely cattails (Cornell Lab of Ornithology). Golden-winged warblers have also been found to breed in patchy scrubland, along forested edges, scrubby fields, marshes and bogs (All About Birds, 2011).

The golden-winged warbler prefers to nest in areas such as powerline rights-of-way, shrubby fields, alder swamps, beaver-created wetlands and abandoned orchards (Dunn et al., 1997). In New Jersey, about half of the known golden-winged warbler breeding population nests within utility rights-of-way while the remaining population nests within forested or shrub wetlands, including beaver-created wetlands and early successional upland forest (Petzinger, unpubl. data). Golden-winged Warblers nest on the ground in areas with scattered trees and shrubs and an herbaceous understory of grasses and forbs found in either upland or wetland settings (Bulluck et al., 2008). Vegetation associated

with nesting areas has often been found to be composed of a mixture of grasses (*Andropogon* spp., *Dactylis glomerata*, and others), asters (*Aster* spp.), goldenrod and blackberry (*Rubus* spp.) (Klaus et al., 2001). The nest itself consists of an open cup of grasses, bark and dead leaves. Leaves may form a cap over eggs (All About Birds, 2011). The average clutch size for the golden-winged warbler generally ranges from three to six eggs. (Buehler, 2007).

Habitat tracts of 25-75 acres (10-50 hectares) can support several golden-winged warbler pairs and are preferred over both smaller and larger areas (Confer, 1992). As a result, golden-winged warblers avoid patches less than 5 acres (2 hectares) in size, while use of an area has been found to increase as patch size ranges from 30-100 acres (12 to 40 hectares) (Hunter et al., 2001). Territories are large; typically, two to four acres (1-2 hectares) but can range from just over one-half acre to almost 20 acres (0.3 – 7.8 ha) (Petzinger, unpubl. data). Oblong territories will often extend for 600 feet (175 meters) (Cornell Lab of Ornithology).

Survey Methodology:

Survey methodologies for golden-winged warbler focus on suitable habitat characteristics, song identification and visual identification. Since golden-winged and blue-winged warblers commonly hybridize where their ranges overlap, surveys commonly check for the presence of all three species (Cornell Lab of Ornithology).

The Cornell Lab of Ornithology (Cornell Lab of Ornithology) has outlined a two-step study protocol to survey for golden-winged warbler. They first suggest a visual survey to determine areas of suitable habitat and to visually note the presence and location of any golden-winged warblers. The second part of the study involves a series of 17-minute point counts using a combination of passive listening periods and call playbacks (with a speaker box and MP3 player) as well as visual confirmation of species singing.

Surveys must be started between 5:15 and 7:00am. The Cornell Lab of Ornithology recommends that the surveys end by the following times depending on the date they are conducted:

By 11:00am before May 20;
By 10:30am between May 20 and May 31; or,
By 10:00am between May 31 and June 15.

Surveys should not be conducted during times when the temperature is below 32^{o}F or above 80^{o}F. It is also important not to conduct surveys when winds keep small twigs in constant motion or if there is any precipitation.

Survey points should be at least 400 meters apart. This will prevent multiple records for a single bird.

At each survey point, a 17-minute point count with call playback should be conducted. Initially, a three-minute passive count will be performed where a visual and auditory scan for any golden-winged warblers, blue-winged warblers, hybrid species, or other shrub-dependent songbirds should be done. Next, one complete track of the GOWAP MP3 or CD should be played, letting it run for the remainder of the count. This call playback consists of a five-minute GWWA Type I song, a one-minute silent observation period, a one-minute GWWA Type II song, another one-minute silent observation period, a five-minute mobbing sequence, and a final one-minute silent observation period.

It is important to search in all directions for golden-winged warblers, blue-winged warblers and hybrids. At each survey point, the total number of individuals must be determined for each minute of the entire 17-minute period. In order to record a bird as being present during the count, a visual identification must be made since golden-wings and blue-wings are able to sing each other's songs.

The golden-winged warbler breeding season is generally short, lasting only about six weeks (Buehler, 2007). Appropriate dates for study are from May 10 through June 15 (Cornell Lab of Ornithology).

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Due to the specific habitat requirements of the golden-winged warbler, suitable documented habitat will be established on a case-by-case basis. Please refer to the "Habitat" section for details on plant species composition, vegetative community structural features and surrounding land uses. The evaluation of each wetland area in question will take the following characteristics into account:

    a. Extent of available habitat: usually greater than 5 aces (2hectares). Available habitat does not have to be contiguous, but it should be within one-half mile of other suitable habitat; b. Vegetative factors: herbaceous understory of grasses and forbs with sparse trees and shrubs; and, c. Location factors: proximity of habitat to development such as homes, roads and commercial development as well as the extent of forest surrounding the habitat.

Rationale:

Many of the golden-winged warbler's habitat attributes are ephemeral in nature, and this is a main reason for their declining population (Buehler, 2007). The disappearance of herbaceous cover, through natural succession or man-made development, may cause golden-winged warblers to abandon habitat otherwise suitable for breeding (Klaus et al., 2001). Optimal early successional habitat may be available for as little as four or five years before it is too brushy for golden-winged warbler presence. The decline of the golden-winged warbler is part of a widespread reduction in early successional species (Sauer et al., 1997). In essence, golden-winged warbler range is constantly changing as a result of land use patterns and forest succession (West Virginia Division of Natural Resources, 2003).

The golden-winged warbler commonly hybridizes with blue-winged warblers where their ranges overlap. The pairing results in the creation of two distinct phenotypes; the dominant Brewster's Warbler (*Vermivora leucobronchalis*) and the recessive, less common, Lawrence's Warbler (*Vermivora lawrenci*). Appearances of hybrid phenotypes have been correlated with the northeastward spread of blue-winged warblers into the range of golden-winged warblers (Gill et al., 1972). Furthermore, it has been suggested that predictable local extirpation of golden-winged warblers follows a brief period of hybridization, typically within 50 years of initial contact (Gill, 1980). In northwestern New Jersey, however, blue-winged and golden-winged warblers have been documented to co-exist and hybridize for almost 100 years (Eaton, 1934).

Hybridization: Brewster's Warbler (dominant, white wing bars and belly, white throat)
Lawrence's Warbler (recessive, yellow wing bars and belly, black throat)

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Species: Long-Eared Owl (*Asio otus*)

Status: State threatened.

New Jersey Distribution:

In general, long-eared owl range extends throughout the state of New Jersey. Historical records are widely distributed. More recently, breeding acitivity has been largely concentrated in Hunterdon and Sussex counties, with other breeders occurring in several large, northern New Jersey swamp complexes (e.g. Great Piece Meadows, Troy Meadows) (Bosakowski et al. 1989c). New Jersey Breeding Bird Atlas surveys confirmed breeding in Sussex, Morris, and Essex counties only (Walsh et al. 1999). Large areas of potential breeding habitat in coastal areas of the Delaware Bay have largely gone unsurveyed. Winter populations are more widespread.

Habitat:

As with several other species, long-eared owls may use both upland and wetland habitats. The controlling factor appears to be the structural characteristics of the habitat rather than a particular reliance on the hydrologic attibutes of wetlands.

In general, long-eared owls are associated with open field or meadow habitats interspersed with hedge rows, wood lots, conifer groves or plantations for breeding and winter roosts (Bent 1938; DeGraaf and Rudis 1986; Bosakowski et al. 1989a). Various studies throughout North America and Europe have confirmed these findings (e.g. Craig and Trost 1979; Wijnandts 1984; Marks 1986; Kren 1987).

Breeding habitat: Nesting usually occurs in dense stands of either hardwood or evergreen forest (DeGraaf and Rudis 1986). Details for the few comprehensive studies are provided below.

Perhaps the most complete evaluation of long-eared owl nesting habitat comes from Britain (Glue 1977). An analysis of 200 records of nest sites yielded use of a variety of upland and wetland habitats. Wetland habitats identified as being used by long-eared owls included unimproved mosslands (9.5%), lowland heath (4.5%), and marshes (3.5%). It is likely that other wetland sites occurred in the forest and farmland categories which accounted for a majority of the habitats used.

Nest sites of various studies in Idaho most frequently occurred in areas characterized as sagebrush (*Artemisia tridentata*)-grass prairie interrupted by riverine systems composed of cottonwood (*Populus* spp.), willow *(Salix* spp.), black locust (*Robinia pseudoacacia*), or Russian olive (*Elaeagnus angustifolia*) stands with understories of river hawthorn (*Crataegus rivularis*) and wild rose (*Rosa* spp.) (Marks 1984; Marks 1986; Craig et al. 1988). Further analysis by Marks (1986) indicated that nests were only located in clumped vegetation, were generally in forest stands wider than 10 m (33 ft), and they were located near water or wet areas. Other habitats used by breeding long-eared owls include wet, dense coniferous woods or plantations and, to a lesser extent, deciduous or mixed forests in Ontario, Canada (Peck and James 1983 in

Johnsgard 1988). Emory oaks (*Quercus emoryii*) were heavily used in Arizona (Stophlet 1959). In Massachusetts, Bent (1938) recorded long-eared owls in dense evergreen stands almost exclusively.

In New Jersey, documented long-eared owl nests are predominately associated with agricultural areas. Haines (1942) reported a Burlington county nest to occur in a mixed forest glen featuring red cedars (*Juniperus virginiana*) and birches (*Betula* spp.), with a ground cover of honeysuckle (*Lonicera* spp.), adjacent to a meadow. In a summary of the status of long-eared owls in New Jersey, Bosakowski et al. (1989b) indicated that most recent breeding activity occurs in hedgerows and woodlots interspersed within tracts of extensive farmland in Hunterdon and Sussex counties.

Abandoned crow (*Corvus* spp.) or magpie (*Pica* spp.) nests are commonly identified as the favored locale for nesting long-eared owls (Whitman 1924; Glue 1977; Marks 1986). Other structures used include hawk nests, squirrel nests, and artifical nest boxes (Stophlet 1959; Glue 1977; Johnsgard 1988). In an analysis of 198 nesting trees in Britain, the average height of long-eared owl nests was 6.7 m (22 ft) (Glue 1977). These data are consistent with other studies in Arizona, where nests were mostly between 4.6-6.1 m (15-20 ft) above ground (Stophlet 1959), and in Idaho, where nests were an average of 3.1 m (10 ft) in height (Marks 1986). Various species of hardwood and softwood are used for nesting (Whitman 1924; Stophlet 1959; Marti 1974; Craig et al 1988)

Roosting Habitat: Habitat used by long-eared owls for roosting is similar to habitats used for nesting. A communal summer roost in Idaho consisted of a stand of willows and birch along a small, dry stream channel (Craig et al. 1985). Getz (1961) reported winter roosting in a black spruce (*Picea mariana*) stand. A Pennsylvania roost featured monotypic stands of red pine (*Pinus resinosa*) and white pine (*P. strobus*), with a strip of red spruce (*Picea rubens*) between them (Smith 1981). In Ohio, long-eared owls made extensive use of evergreen plantations consisting of red pine, scotch pin (*Pinus sylvestris*), white cedar (*Thuja accidentalis*) and red cedar (Randle and Austing 1952). Favored trees were rarely over 4.6 m (15 ft) in height. Surrounding habitats consisted of fallow fields, moist brushy openings, open orchards, deciduous woodlands, and scattered tree stands. Bosakowski et al. (1989b) listed the following tree species, in order of preference, as typical components of long-eared owl roost habitat: Scotch pine *(P. sylvestris*), Austrian pine (*P. nigra*), Virginia pine (*P. virginiana*), red cedar, Norway spruce (*Picea abies*), arborvitae (*Thuja orientalis*), eastern hemlock (*Tsuga canadensis*), red pine and white pine.

Feeding Habitat: Various studies have indicated that the vole is the primary food item for the long-eared owl (Microtis spp.) (Scott 1948; Getz 1961; Marti 1976; Craig et al 1985). In a study of long-eared owl food habits in Idaho, Marks (1984) found owls to prey upon five rodent species and suggested that prey size and availability are the primary determinants of diet rather than species.

Habitats used by the species for foraging are reflective of this preference. Getz (1961) found long-eared owls to feed over open field habitats because of the low amount of cover available for

microtine prey. Areas less favored included bog, marsh, and several forested habitats. It was believed that low use of the wetland areas was a result of low prey populations and a heavy mat of grasses and sedges. In their study in Ohio, Randle and Austing (1952) found prey populations to be indicative of habitats used for hunting. In drier, upland habitats, *Peromyscus ochragaster* was the major prey item. In brushy, moist field habitats, *P. pennsylvanicus* were consumed to a greater extent.

Other factors: Competition with, and predation by, the Great horned owl (*Bubo virginianus*) has been suggested as a potential factor influencing the status and distribution of long-eared owls in New Jersey (Bosakowski et al. 1989a; Bosakowski et al. 1989c)

Survey Methodologies:

No specific survey methodologies have been documented to determine the presence or absence of long-eared owls.

Regulatory Guidelines:

1. Area of Documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: For breeding or roosting, the Department will consider contiguous dense forest stands of either hardwood or softwood featuring documented breeding or roosting owls as suitable habitats. For feeding habitat, suitable wetland habitat should feature good small mammal populations, emergent or early successional vegetation, and be a minimum of four hectares (10 ac) in size.

Comments:

Unlike some of the other raptor species with large home ranges occurring in New Jersey (e.g., barred owls, red-shouldered hawks), the literature and species' habitat requirements do not appear to indicate a strong association between long-eared owls and wetland habitats. Additional information on this species' status and habitat use in New Jersey is needed.

Rationale:

A review of the available literature for long-eared owls does not demonstrate a strong relationship between this species and wetland habitats. The Department is of the opinion that for the purposes of providing the regulatory protection of the Freshwater Wetland Protection Act, it must be concluded that wetlands, receiving an exceptional resource value classification based on the presence of suitable habitat for the long-eared owl, play an essential role in maintaining this species within an "area of documentation". As a result, nesting or roosting sites must be in

wetlands or regulated transition areas for the Department to initiate the exceptional resource value classification process, and, feeding habitat must be of sufficient size to be self-sustaining if development occurs in adjacent unregulated uplands.

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Cattle Egret (*Bubulcus ibis*)

Status: NJ – threatened (breeder)

New Jersey Distribution:
Cattle egrets first appeared in New Jersey as a breeder in 1958 (Fowler 1958). Known rookeries are largely confined to coastal areas, occurring in the Arthur Kill/Hudson region of north Jersey and on islands in Atlantic and Cape May counties to the south (Walsh et al. 1999). Individuals may wander widely during the late summer dispersal and are rarely seen past November.

Habitat:

Breeding habitat: Cattle egrets are listed as a threatened species only during the breeding season. Consistent with the behavior of most wading birds, they tend to nest in mixed species colonies (Telfair 2011). In North America, nesting habitats are defined as: (1) woodlands: upland woods or motts with or without understory and with or without adjacent streams or ponds; (2) swamps with trees or shrubs in water; (3) inland wooded islands with trees and shrubs on islands in the water; and (4) coastal islands with trees, shrubs and/or herbaceous vegetation on natural islands or dredge sites (Telfair 2006a). In New Jersey, most nesting locations are found in marshlands and islands along the coast and scattered small islands in the Arthur Kill area of North Jersey (Davenport 2011). Walsh et al (1999) note that cattle egrets arrive in New Jersey in late March or early April, disperse from rookeries in late August and early September and are known to wander wildly during the post-breeding dispersal.

Tree species identified at a rookery site in Pennsylvania included river birch (*Betula nigra*), silver maple (*Acer sacccharinum*) and box elder (*Acer negundo*) (Schutsky 1976). New Jersey's first nest was reported from a bayberry (*Myrica cerifera*) tree on a bay island (Fowler 1958). A rookery studied by Burger (1978) was classified into four heterogeneous types: dense phragmites, sparse phragmites, dense phragmites with sparse *Rhus toxicondendron*, and sparse phragmites with dense *Rhus*. Two rookery sites in North Carolina that featured cattle egrets featured the following species composition: marsh elder (*Iva frutescens*), vaupon (*Ilex vomitoria*), eastern red cedar (*Juniperus virginiana*), white mulberry (*Marus alba*), groundsel bush (*Baccharis halimifolia*), wax myrtle (*Myrica cerifera*) and loblolly pine (*Pinus taeda*) (McCrimmon 1978).

In regard to structural characteristics of cattle egret nest sites, a study of multi-species rookeries in North Carolina, McCrimmon (1978) determined that cattle egrets tended to nest in locations similar to those occupied by other similarly sized wading bird species but did show a tendency to nest in areas slightly higher and with a less woody vegetation above the nest than other wading bird species. Telfair (2011) reported most nests to be bowl shaped.

Foraging habitat: Cattle egrets feed predominantly on large insects and arthropods, but will also eat small mammals, worms, reptiles and amphibians (Granholm 1990; Telfair

2006b; Davenport 2011; Telfair 2011). As a result, habitat types associated with cattle egret foraging are often those featuring good insect populations. Recorded foraging habitats or communities include irrigated meadows, rice paddies, edges of wet or water habitats and fields, garbage dumps, active pastures, plowed fields, and other short, vegetated communities (Erwin 1983; Mora 1992; Burger 1996; Seedikkoya et al 2005). Foraging activities are often associated with farm machinery or grazing animals (Telfair 2006b). In a study of cattle egret foraging habitats in the Mexicali Valley of Baja California, Mora (1992) found cattle egrets foraged in greater numbers and with greater success in irrigated agricultural fields than drier habitats or those with tractor activity. Favored habitats included alfalfa fields, pasture and fallow fields. Fields dominated by asparagus, cantaloupe and cotton received some, but significantly less, use.

Roosting habitat: Little specific information is reported on roost habitat. Studies conducted in Hawaii showed that cattle egret roosts tended to be located near fresh or brackish water bodies or impoundments rather than streams (Paton et al. 1986). These researchers also noted that traditional roost sites, those used annually for roosting and/or nesting, tended to feature trees of 10 meters or less in height, while permanent or temporary roost locations featured herbaceous and minimal woody vegetation.

Home range: Due to their wide geographic range, data on cattle egret home ranges is highly variable. In North Carolina, cattle egrets traveled from 4-6 km to foraging sites from their nesting colonies (Custer and Osborn 1978). In Barbados, cattle egrets were observed foraging up to 5.7 km from breeding colonies (Krebs et al 1994). In southeastern Australia, 60% of cattle egrets fed within 6.5 km of the breeding colony (Richardson and Taylor 2003). In central Minnesota the average distance that the herons flew from the colony to a foraging area was 6.5 km (maximum distance 20.4 km) and 53% of the herons in the study fed within 4 km of the colony (Thompson 1978). In Texas, foraging flights ranged from 4-25 km, with 67% of those flights from 10-15 km (Mora and Miller 1998). In Baja, California, cattle egrets flew 2.5 - 35 km to foraging sites, most (80%) within 15 km of the breeding colony and 46% from 10- 12.5 km (Mora 1997). In Alabama, cattle egrets traveled 26-32 km from their breeding colonies to foraging sites (Bateman 1970).

Regulatory Guidelines:

1. Documented Habitat: For Version 3.3, contiguous habitat patches associated with know sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2012. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable Habitat: For breeding sites, contiguous jurisdictional forest, shrub and/or herbaceous community consistent with that found within the mapped rookery location will be considered suitable breeding habitat. Full extent of this area will

be determined on a case-by-case basis based on the specific vegetative community characteristics present on the location in question.

Foraging habitat: Within the defined boundaries of the foraging range for each rookery site as defined above, the Department will evaluate wetlands featuring the vegetative communities defined above or facsimiles thereof. These may include, but are not limited to, emergent marshes, wet meadows, scrub-shrub wetlands or modified agricultural wetlands.

Special Considerations: In instances where suitable feeding habitat (i.e. wet meadows, emergent freshwater and coastal marsh) occurs within a much larger expanse of unsuitable wetland habitat, the Department will apply the following regulatory criteria for freshwater wetland classification determination. If a buffer of 100 meters (328 ft) is applied to the extent of foraging habitat as described above, encompasses regulated freshwater wetlands and exceeds the standard 50 ft buffer of an intermediate resource value wetland, the Department will consider the freshwater wetlands to be a critical component of a foraging habitat and classify the wetlands as being of exceptional resource value. The ability to reduce the standard 150 ft transition area between wetlands and development will be dependent upon the extent to which the characteristics of the existing wetlands and transition area serve to mitigate disturbance to the foraging habitat. The Department will evaluate the necessary buffer size on a case-by-case basis.

Rationale: Cattle egrets are threatened in the state of New Jersey as a breeder. The first documented cattle egret nest was found in New Jersey in 1958 (Fowler 1958). Numbers of breeding pairs seem to have peaked in the late 1970's to early 1980's and declined sharply after. As with other wading bird species, the protection of rookery sites and associated foraging areas is key to the existence and recovery of the species in New Jersey.

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Species: **Bobolink (*Dolichonyx oryzivorus*)**

Status: State threatened.

New Jersey Distribution:

In New Jersey, bobolinks occur widely in localized areas of early successional fields, meadows, agricultural lands, and airports. The New Jersey Breeding Bird Atlas surveys have found populations to be largely concentrated in Hunterdon, Warren, Sussex, Salem and Burlington counties (Walsh et al. 1999).

Suitable Habitat:

In general, bobolinks breed in hayfields, meadows, marshes and fallow fields featuring taller grasses and forbs (DeGraaf and Rudis 1987; Ehrlich et al. 1988). Moist habitats may be preferred over drier areas for foraging and breeding (Whittenberger 1978; Whittenberger 1982; DeGraaf and Rudis 1987).

In Oregon, habitats used by bobolinks were characterized as grassy meadows intermixed with sedges (*Carex* spp.) and forbs. Cow parsnips (*Heracleum lanatum*), fences, and scattered willows (*Salix* spp.) were used as perch sites (Whittenberger 1978). Major forb species present included dandelions (*Taxaracum officinale*), cinquefoil (*Potentilla glomerata*), yarrow (*Achillea millefolium*), Canadian thistle (*Cirgium arvense*), false lupine (*Thermopsis montana*) and mallow (*Malva moschata*). Minor species included sweet clover (*Melilotus officunalis*), bur-clover (*Medicago lupulins*), red clover (*Trifoloum pratense*), vetch (*Vicia americana*), groundsel (*Senecio hydrophilus*), false Solomon's seal (*Smilacina stellata*), and pepper grass (*Lepidium perfodiatum*)(Whittenterger 1980).

In New York, boblink studies by Martin (1974) occurred in floodplain habitat surrounded by forest. Sedges dominated the wetter areas while bluegrass (*Poa pratensis*) and meadow rue (*Thalictrum* spp.) dominated ridges and drier areas of the field. Habitats studied in New York consisted of hayfields and meadows featuring grasses (e.g. *Phleum pratense*; *Anthoxanthum odoratum*), forbs (e.g. *Solidago* spp., *Fragaria* spp., *Taraxacum* spp.), and saplings of dogwood and white ash (Gavin 1984).

Aside from the type of vegetation occurring in wetlands, the hydrologic characteristics of wetland habitats tend to influence the use of these habitats by bobolinks. Studies in Oregon have indicated that males initially settle in areas of low sedge cover and high forb cover which are not flooded or excessively dry (Whittenberger 1978; Whittenberger 1982). Territories established in mesic and wet habitats were more productive than those established in dry habitats (e.g. greater numbers of monogamous and polygamous males compared to the number of bachelor males) (Whittenberger 1980). In addition, wetter territories featured higher vegetational mass, growth, and higher insect biomass.

Survey Methodologies:

Surveys conducted by the Division of Fish and Wildlife, Endangered and Nongame Species Program checked suitable habitats four times every other week beginning the third week of May and extending through the last week of June. Routes began at sunrise and three minutes were spent listening at each stop (Kalka 1986).

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Suitable nesting habitat includes open fields and meadows dominated by early successional grass and forb species. Scattered saplings, shrubs or fence posts are appropriate for perch habitat. The minimum size of wetland habitat required within a larger complex of upland suitable habitat will be 0.74 ha (1.8 ac), which is the minimum documented bobolink territory size.

Comments:

This species is reliant on early successional habitats for nesting. Timing and frequency of maintenance and upkeep for field habitats greatly affects the success or failure of nesting bobolinks (Bent 1958; Weins 1969). Due to use of both upland and wetland habitats for breeding, resting, and feeding, not all sightings of this species will lead to an exceptional resource value classification determination of adjacent wetlands. Presence/absence surveys may assist in establishing the suitability of succeeding habitats.

Rationale:

Studies have found a direct association between successful bobolink reproduction and wetland habitats. This could be attributed to the subtle hydrologic characteristics (e.g. not too dry or inundated) found in many of the wetlands utilized by the species. It is necessary to maintain and protect not only the wetland habitat used by bobolinks but also the nearby upland edges, as they assist in maintaining the wetland habitat hydrology.

Primary Author:

Larry Torok, NJDEP, WLM, Division of Watershed Protection and Restoration

DRAFT DATE: 08/08/94 UPDATE: 06/28/02

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Name: Red-Headed Woodpecker (*Melanerpes erythrocephalus*)

Status: State threatened.

New Jersey Distribution:

Historically, red-headed woodpeckers ranged throughout the state but were always more abundant in the north than the south. New Jersey Breeding Bird Atlas surveys found widely scattered potential breeding sites but confirmed the species at only six sites in four counties; Hunterdon, Burlington, Atlantic and Cape May counties (Walsh et al. 1999).

Suitable Habitat:

The species may breed in a variety of habitats including river bottom forests, wood swamps, beaver ponds, open deciduous groves, orchards, and agricultural areas (Wilson 1970; Reller 1972). Habitats used by the species are characterized by scatterings of mature trees with an open or herbaceous understory or forest edge associated with nearby open areas (Conner 1976; Hardin and Evans 1977).

Nest cavities are usually in dead trees or, less frequently, dead limbs in living trees (Reller 1972). Red-headed woodpeckers prefer vertically facing cavities and limbs without bark. Nest cavities are usually excavated from existing indentations or cracks (Reller 1972; Jackson 1976). Nests are typcially located 7 - 12.4 m (23-40 ft) above the forest floor, though they have been documented as high as 24.2 m (80 ft) (Bull 1975).

Tree species used for nesting in New Jersey include red maples (*Acer rubra*), *oaks (Quercus* spp.) and pitch pine (*Pinus rigida*) (Cromartie 1982). Graber et al (1977) reported the species to nest in a bottom land forest characterized by oaks, hickories (*Carya* spp.), elms (*Ulmus* spp.), and hackleberry (*Celtis* spp.). Wander and Brady (1980) reported the species to nest in a forest stand characterized by scattered pitch pines (*Pinus rigida*) with an understory of oak sprouts, and a sparse ground cover of lowbush blueberry (*Vaccinium vacillans*) and huckleberry (*Gaylussacia* spp.) in the Pine Barrens. They also identified a "probable" nest site in a roadside utility pole. A wetland nesting site in Sussex County is characterized as a seasonally flooded sedge meadow featuring numerous standing dead trees interspersed and bordered by hardwood forest (L. Torok, pers. comm).

A study on woodpecker foraging characteristics in a Texas bottomland forest indicated that red-headed woodpeckers favored dead trees over live, foraged largely on tree trunks, and did not vary foraging heights when changing foraging substrates (e.g. live trees vs. dead) (Conner et al. 1994). This study also showed a significant preference for oak species over all other tree species in the forest for foraging. The presence of mast producing tree species has also been suggested as an important component to wintering habitat for the red-headed woodpecker (Kilham 1958).

Survey Methodologies:

No standard methodology has been recommended for this species. Most survey work consists of searching suitable habitats during the breeding season for this species.

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

   2. Suitable habitat: Hardwood or softwood stands featuring the vegetative characteristics described above. Key characteristics include an open understory and the presence of snags and/or dead limbs to provide suitable nesting habitat. It should be noted that use is also made of atypical sites (e.g. utility poles, orchards) so these crtieria are not inclusive.

Comments:

Red-headed woodpeckers occur in upland and wetland habitats. As a result, not all sightings of the species will result in exceptional resource value wetland classifications.

Rationale:

Without more data on the spatial requirements of the red-headed woodpecker, the amount of wetland habitat to be considered when making an exceptional resource value classification determination will be driven by sighting specific information and the extent of suitable habitat available contiguous with the area(s) where the species has been observed. Flexibility on the type of habitat determined to constitute "suitable habitat" is necessary due to occasional use of atypical habitats.

Primary Author:

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DRAFT DATE: 08/08/94 UPDATE: 06/28/02

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Name: Black-Crowned Night Heron (*Nycticorax nycticorax*)

Status: State threatened.

New Jersey Distribution:

Black-crowned night herons primarily nest along the Atlantic Coast of New Jersey, from Cape May County up to the Hackensack Meadowlands (Liguori 2003). The distribution of the bird inland and along Delaware Bay has noticeably declined in the past 20 years (Walsh et al., 1999). Breeding migrants typically arrive in March, and spring migrants reach New Jersey throughout April and May. The fall migration of the heron peaks in mid-to-late September and may extend into November (Liguori 2003 and Walsh et al., 1999). Although rare in the harshest winter, some birds will remain throughout the winter, assembling in roosts near open water (Walsh et al., 1999).

Habitat:

Black-crowned night herons require wetland habitat for breeding, resting and feeding. They prefer vegetated sites that provide cover. These include forest, scrub/shrub, marsh and pond habitats. The plant species characteristic of black-crowned night heron forest habitat are red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), and blueberry (*Vaccinium spp*.). Commonly found plant species observed in heron scrub/shrub habitat are red cedar (*Juniperus virginiana*), holly (*Ilex opaca*), greenbrier (*Smilax spp*.), and poison ivy (*Toxicodendron radicans*). Marsh heron-related habitat is mainly composed of *Phragmites communis* and marsh elder (*Iva frutescens*) (Liguori 2003). Black-crowned night herons prefer, but do not limit themselves to, marshes greater than 20 ha in size (Brown and Dinsmore 1986).

Breeding Habitat and Range: Black-crowned night herons are colonial breeders, choosing to build their nests in heronries or rookeries. In New Jersey, the heronries are typically found in coastal areas, and the black-crowned night heron nests are found in shrubs and trees near water or in reed beds near the ground (Walsh et al. 1999). Cover and proximity to foraging habitat seem to be the primary drivers of black-crowned night heron nest-site selection. They will build nests in a variety of vegetation and cover types (Gross 1923) including mixed hardwood forests, where the birds may nest between 0.19 m and 3.95 m above the ground (Burger 1978), and salt marsh communities, where the birds may nest on the ground in mixed vegetation (Liguori 2003). In an analysis of heron nest site selection, Wiese (1978) found that when habitat options exist, such as bare ground, short or tall grass, forbs, shrubs or hardwoods, 50% of the subject black-crowned night herons chose to nest in the tall grass *Phragmites* marsh.

The black-crowned night heron's breeding range extends from parts of southern Canada, southward through much of the United States and into parts of Central America, the West Indies and Hawaii (Bent 1963 and Byrd 1978). The herons are known wanderers and migrants. They will migrate to the northern part of their breeding range for winter. Birds have been banded in Massachusetts and recovered in areas as distant as Texas and

Ontario (Byrd 1978). Despite the extensive post-breeding dispersal, black-crowned night herons typically practice natal nest fidelity (Liguori 2003). That is, they will return to their birth-nest when they are ready to breed. Due to the wandering nature of the heron, it is challenging to define populations and track migration patterns.

Foraging Habitat: Black-crowned night herons are customarily nocturnal foragers (Walsh et al. 1999). They are generalist predators that will feed on fish and crustaceans (crabs, crayfish, shrimp), in coastal marsh systems, and earthworms, mollusks, frogs, toads, tadpoles, salamanders, lizards, snakes, eggs and young of other birds, in freshwater wetland systems (Liguori 2003). The preferred feeding habitat of the black-crowned night heron is along the edges of tidal creeks and ponds, and within marshes and estuaries. Tidal cycles affecting the availability of prey species and human disturbance may determine the foraging patterns and behavior of the herons in these habitats. Upon a walking approach, Rodgers and Smith (1995) determined the flush distance of the heron to be within a range of 15 to 50 meters, but Vos et al. (1985) and Erwin (1989) recommended set back distances of 100 to 250 meters for breeding colonies of wading birds. The HEP model for the great blue heron (Ardea herodias) suggested 100 m (328ft) setbacks from human disturbance and 50 m (164ft) setbacks from slow moving traffic so to maintain the utilization of suitable foraging habitats (Short and Cooper 1985). Brown and Dinsmore (1986) described the species as 'possibly area-dependent' when they found the bird only on marshes greater than 20 ha. Black-crowned night herons will choose a nesting habitat based on its close proximity to good foraging habitat (Bent 1963). The foraging range may extend well beyond the rookery and nest sites, justifying a wide set back distance.

Regulatory Guidelines:

In New Jersey, night herons begin arriving at their breeding colonies in late March and into April. Typically, young have fledged and left the nest by late July. The post-breeding migrations occur in September and into October. Some birds will over-winter in New Jersey assembling in roosts near open water.

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable Habitat: Black-crowned night heron rookeries generally occur in trees or low marsh vegetation (i.e. Phragmites). When in trees, the area of contiguous forest will be determined by the physical characteristics of the stand (see above) outside of the actual nesting area and the need to minimize current or potential disturbance to the rookery. When nests occur in beds of marsh vegetation, the area will be defined by the classification of the wetland upon which the nest rests and the special considerations described below.

Freshwater, brackish, or tidal ponds, pools, ditches, and mudflats are considered to be suitable foraging sites.

Special Considerations*:*

In instances where suitable feeding habitat (i.e. ditches, ponds, creeks, mudflats) occurs within a much larger expanse of wetland habitat, the Department will apply the following regulatory criteria for freshwater wetland classification determinations. If a "buffer" of 100 meters (328 ft), applied to the extent of foraging habitat as described above, encompasses regulated freshwater wetlands and exceeds the standard 50 ft buffer of an intermediate resource value wetland; the Department will consider the freshwater wetlands to be a critical component of a foraging habitat and classify the wetlands as being of exceptional resource value. The ability to reduce the standard 150 ft transition area will be dependent upon the extent to which the characteristics of the existing freshwater wetlands and transition area serve to alleviate disturbance to the foraging habitat. The Department will evaluate the necessary buffer size on a case-by-case basis.

Rationale:

The black-crowned night heron is a threatened species in New Jersey. During the 20th century, populations declined due to habitat destruction (Liguori 2003), egg-taking at breeding colonies, hunting of adult herons, and eggshell thinning due to exposure to DDT (Walsh et al. 1999). In the 1970s black-crowned night heron populations began to recover after bans on plume sales in the early part of the century and a halt in pesticide use. However, numbers of individual birds have declined from approximately 1,500 in the 1970s to approximately 200 in the 1990s. At this time, nests are primarily limited to coastal areas with virtually no nests inland or along the Delaware Bay. Habitat destruction and contamination of wetlands are to blame for this decline (Liguori 2003).

Habitat destruction through development and contamination of wetlands has limited the number of suitable nest sites and foraging habitat for the herons. Accordingly, risks of human intrusion into rookeries and nest sites have increased as well. Experimental visits to black-crowned night heron nests have led to egg mortality through nest abandonment and egg predation, especially earlier in the nesting season (Tremblay and Ellison 1979). Rodgers and Smith (1995) found that black-crowned night herons were flushed from their nest when approached by an individual on foot starting at 50 m. They recommend a setback distance of 100 m for all wading bird colonies**.** Due to similar factors, the application of wetland buffers is necessary to maintain the suitability of critical foraging habitats within the designated foraging radii (9.65 km) (Niles et al. 2004).

Primary Author:

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Yellow-Crowned Night Heron (*Nyctanassa violacea*)

Status: NJ – threatened

New Jersey Distribution: Yellow-crowned night herons nest along coastal New Jersey from the Hackensack Meadowlands to Cape May (Liguori 2003). However, the majority of nest sites have been found in Cape May and Ocean Counties (Walsh 1999). The birds have only recently maintained a breeding population in the state. The first yellow-crowned night heron nest in New Jersey was documented in 1927 (Walsh 1999). Migrating herons usually arrive to nest in New Jersey by late March. They will migrate south in the fall by late October. Any yellow-crowned night heron found during winter months is considered to be accidental (Watts 1989, Walsh 1999 and Liguori 2003).

Habitat: Yellow-crowned night herons prefer to forage along the shores and in the marsh cord grass (*Sparatina alterniflora*) of tidal pools and ditches (Liguori 2003). However, they will forage in a variety of wetland habitats including marshes, swamps, lakes and lagoons (Terwilliger 1991). Yellow-crowned night herons are capable of living in a wide variety of habitats (Bent 1963). They prefer forested wetlands or scrub/shrub thickets for nest building, and they nest in colonies or in pairs (Liguori 2003). Recently the herons have increasingly been documented nesting in habitats in close proximity to human activity like parks and residential areas (Liguori 2003 and Walsh 1999).

Breeding Habitat and Range: The breeding habitat of the yellow-crowned night heron is loosely defined. The herons breed in small colonies or in pairs. They will build nests lower in canopy vegetation with the actual height of the nest above ground dependent upon the height of the surrounding vegetation (Watts 1989). Burger (1978) suggests that vegetation cover over the nests provides shade and protection from sun for the chicks as well as potential visual protection from aerial predators. The herons will nest in multiple tree species including cherry (*Prunus sp*.) (Burger 1978), oak (*Quercus sp*.) (Price 1946 and Watts 1989) and pine (*Pinus taeda*) (Watts 1989) and in scrub/shrub thickets (Liguori 2003).

The breeding distribution of the yellow-crowned night heron extends from Massachusetts south to Florida, across the gulf coast and up to Wisconsin (Walsh 1999). Isolated breeding patches exist in the Galapagos Islands, Baja California and Sonora, Mexico (Terwilliger 1991). Typically, the herons winter in Central America, the West Indies (Walsh 1999) and the southern parts of their range, rarely coming north as far as Virginia (Terwilliger 1991 and Liguori 2003).

Foraging Habitat: Yellow-crowned night herons feed almost exclusively on crustaceans (Riengner 1982). In salt water, their diet is primarily crabs (Watts 1988 and Terwilliger 1991) and in fresh water, the herons eat crayfish (Price 1946). Their diet may include small numbers of insects, prawns, snails, fish, eels, frogs, toads, tadpoles, newts, snakes, lizards, turtles, rodents and birds (Liguori 2003). The availability of prey may influence

the foraging behavior of the heron. Watts (1988) found that the yellow-crowned night herons preferentially selected feeding areas based on the presence of 'prey complexes', large collections of desirable prey species. These 'prey complexes' will in part constitute foraging centers that are critical to the success of the yellow-crowned night heron (Watts 1988). In New Jersey the foraging habitat of the heron primarily includes, but is not limited to, the shores of tidal creeks and tidal pools within a salt marsh dominated by *Spartina alterniflora*. Tidal cycles affecting the availability of prey species and human disturbance may determine the foraging patterns and behavior of the herons in these habitats. Upon a walking approach, Rodgers and Smith (1995) determined the flush distance of the black-crowned night heron to be within a range of 15-50meters, but Vos et al. (1985) and Erwin (1989) recommend set back distances of 100-250 meters for breeding colonies of wading birds. The Harbor Estuaries Program (HEP) model for the great blue heron (*Ardea herodias*) (a bird with similar sensitivity to disturbance (Rodgers and Smith 1995) suggested 100 m (328ft) set back distance from human disturbance.

Regulatory Guidelines:

1. Area of Documention: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2012. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable Habitat: Yellow-crowned night heron rookeries occur primarily in trees or shrubs. When in trees, the area of contiguous forest will be determined by the physical characteristics of the stand (see above) outside of the actual nesting area and the need to minimize current or potential disturbance to the rookery. Set back distances of between 328 and 656 ft were suggested to suitably protect heronries of wading birds (Erwin 1989 and Rodgers and Smith 1995). However, the habituation level of the herons may influence the determination of disturbance to the rookery. That is, when rookeries occur in previously residential or urbanized areas, the determination of take and the required buffer size will be evaluated on a case-by-case basis subject to the bird's adaptation to human development. Yellow-crowned night herons nest primarily in trees. However, when nests occur in shrubs or beds of marsh vegetation, the area will be defined by the classification of the wetland on which the nest rests and the special considerations described below. Freshwater, brackish, or tidal ponds, pools, ditches, and mudflats are considered to be suitable foraging sites. As yellow-crowned night herons are increasingly adaptable in their nest site selection, the loss of suitable foraging habitat to coastal development and habitat loss is the primary force limiting their population.

Special Consideration: In instances where suitable feeding habitat (i.e. tidal ditches, ponds, creeks, mudflats) occurs within a much larger expanse of unsuitable wetland habitat, the Department will apply the following regulatory criteria for freshwater wetland classification determination. If a buffer of 100 meters (328 ft) is applied to the extent of foraging habitat as described above, encompasses regulated freshwater wetlands and exceeds the standard 50 ft buffer of an intermediate resource value wetland, the Department will consider the freshwater wetlands to be a critical component of a foraging habitat and classify the wetlands as being of exceptional resource value. The ability to reduce the standard 150 ft transition area between wetlands and development will be dependent upon the extent to which the characteristics of the existing wetlands and transition area serve to mitigate disturbance to the foraging habitat. The Department will evaluate the necessary buffer size on a case-by-case basis.

Rationale: Yellow-crowned night herons are threatened in the state of New Jersey. The first yellow-crowned night heron nest was found in New Jersey in 1927 (Walsh 1999). However, the birds were extensively hunted and killed for feathers and meat in the late 1800s and early 1900s, and it is hypothesized that the first documented nests of yellow-crowned night herons may in fact be a recolonization of the species (Bull 1964 and Watts 1995). Since then, the heron population has not grown substantially and has been in decline since 1978. Historically small populations and difficulty in finding small colonies has led to over or underestimates of numbers (Walsh 1999). Measurements of population size may be sketchy.

Loss of foraging habitat is the primary threat to yellow-crowned night heron populations (Terwilliger 1991 and Liguori 2003). The herons forage specifically on crustaceans whose populations depend on healthy wetland, mudflats, marsh and tidal creek habitat. Destruction of habitat in the form of sea walling, intense residential development, contamination of water and filling of wetlands destroys crustacean populations and yellow-crowned night heron resources (Terwilliger 1991). Regulation of yellow-crowned night heron populations must be handled on a case-by-case basis. Although some individuals have become adaptable to human development in their nesting habits, the species is still highly specialized in its diet and foraging requirements. This species needs large areas of undisturbed wetland to forage.

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Species: **Osprey (*Pandion haliaetus*)**

Status: State threatened (breeding population).

New Jersey Distribution:

The osprey population of New Jersey is largely concentrated along the Atlantic coast and back bays, along the Delaware Bay shore and up several large river channels (Walsh et al. 1999). Inland breeding populations have historically occurred in Passaic County and also along the upper Delaware River. Currently, one nest site is known along the Delaware River. No inland nests have been recently documented despite numerous sightings.

Habitat:

In general, ospreys are associated with riverine, lacustrine, or coastal waterbodies or bays which feature suitable populations of fish (Bent 1937; Wood 1979; Brown and Amadon 1968 in Vana-Miller 1987).

Breeding habitat: Ospreys will nest on a variety of structures including living or dead trees (Roberts 1969; French 1972; D.L. MacCarter 1972; Postupalsky 1977; Henny et al 1978), utility poles (Prevost 1977), channel markers (Reese 1970; Wiemeyer 1971) and artificial nest platforms (Reese 1977; Postupalsky 1978). The particular tree species, height, and surrounding tree density, do not appear to be critical to nest site selection (Bent 1937; Swenson 1975; Richardson 1980). Characteristics which do appear important include proximity to suitable feeding habitat and exposed view of surrounding areas from the nest (Postupalsky and Stackpole 1974; Swenson 1975; Grover 1983).

Ospreys studied in Idaho by Van Daele and Van Daele (1982) favored snags (66%) and live trees (19.7%) over utility poles (8.7%) and nest platforms (5.5%). Nest tree heights in studied populations have proved highly variable. These include 7.6 m (25 ft) - 39.6 m (130 ft) (D.L. MacCarter 1972) and 4.8 m (15.7 ft) - 27.2 m (89 ft) (Grover 1983) in Montana, 9.0 m (29.5 ft)-27.0 m (88.5 ft) in Minnesota (Dunstan 1973), 2.0 m (6.6 ft) – 49.0 m (160.7 ft) in California (Garber 1972), and 15.7 m (51.5 ft)-30.3 m (99.4 ft) in New Hampshire (Smith and Ricardi 1983).

Roosting Habitat: Little documentation exists on the habitats used by roosting ospreys. It is expected that forest stands similar to nesting habitat are used.

Feeding Habitat: Suitable foraging habitats for osprey are generally any water body featuring populations of fish of suitable size. Reservoirs, lakes, rivers, coastal bays and inlets are favored locales. Hughes in Vana-Miller (1987) suggested a range of prey size from 15 – 35 cm (6 – 14 in). Poole (1989) reported that the most fish taken were between 25 – 35 cm (10 – 14 in). Various studies have identified a wide variety of fish species that are preyed upon by the osprey [See Table 1 in Vana-Miller (1987) for more details]. Based on these data, it is widely believed that the abundance or availability of prey is more critical than the type of species present (Prevost 1977; Flook and Forbes 1983).

No standards for minimum size have been applied to establish the suitability of a particular water body for osprey foraging. Suitable habitats must be free of dense emergent or submergent vegetation. They must also be free of dense, overhanging vegetation from shore which may obstruct hunting birds and provide cover for prey species (Hynes 1970; Postupalsky and Stackpole 1974; Prevost 1977). Water clarity is another factor which influences the ability of ospreys to detect and capture prey (Flook and Forbes 1983). Favored perch sites are similar to nest habitat, being live or dead trees, buoys, channel markers, nest platforms, or utility poles (Berger and Mueller 1969; Wiemeyer 1971; MacCarter 1972; Prevost 1977; Rhodes 1977).

Human Disturbance: Another factor which influences the suitability of a habitat for the osprey is the timing and level of human disturbance experienced by that habitat. Many cases of osprey nesting in "disturbed" areas have and continue to exist (e.g. Reese 1970; Poole 1980; Poole and Spitzer 1983). In those situations, the disturbance is largely continuous throughout the nesting cycle. It appears that the osprey maintains the ability to habituate to certain types of disturbance. Other studies have indicated that the timing (i.e. during nest construction or incubation) and frequency of the disturbance (i.e. sporadic, inconsistent) is critical to its impact on nesting ospreys (e.g. French 1972; Garber 1972; Reese 1977; Van Daele and Van Daele 1982; Poole and Spitzer 1983). To offset these impacts, several researchers suggested critical distances from the nest within which human disturbance could have adverse impacts. These distances range from 0.2 – 1.5 km (0.12 – 0.9 mi) (Garber et al. 1973; Swenson 1975; Van Daele and Van Daele 1982; Postupalsky in Vana-Miller 1987). Poole (1989), however, cautioned that such distances are not a solution to the effective protection of nesting ospreys.

Survey Methodologies:

Aerial surveys are conducted in New Jersey during May and June (J. Sciascia pers. comm.; K. Clark pers comm.). These surveys consist of one-to-three-hour periods of time, initiated either at sunrise or three hours before sunset, for searching suitable water-bodies for flying or perched birds. Observed ospreys are followed visually to roosts or nests.

Regulatory Guidelines:

1. Area of Documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: For breeding habitat, all contiguous forest, scrub-shrub, or emergent wetlands within the breeding radius around a nest site. Foraging habitats will be waterbodies featuring the habitat and prey characteristics described above.

Comments:

Currently, a minority of nests occur in inland areas. Recent nesting along the upper Delaware River and an increase of inland osprey sightings suggests that the species may be returning as a breeder to freshwater water bodies. Further review and refinement of the existing guidelines will be necessary as the inland breeding population increases. Osprey nests in the vicinity of the Delaware Bay are still being impacted by contaminants (Griffin and Steidl 1990; K. Clark pers. comm.).

Rationale:

The osprey breeding population of New Jersey is listed as threatened. As a result, an exceptional resource value classification will be granted to those wetlands concerning osprey breeding habitat in order to maintain the suitability of known nest sites. Currently, most sites occur in coastal areas. For these nesting locales, the designation of fringe freshwater wetlands within proximity to a documented osprey nest site will assist in controlling new human related disturbance factors on the nesting birds within the "critical distance" of up to 1 km of a nest (Vana-Miller 1987). It must be noted that the Department will evaluate existing conditions when making these determinations in that level of disturbance around nest sites is highly variable (i.e. a nest site on a light pole in a 7-11 parking lot vs. a nest on a platform in undisturbed marsh). The protection of inland nest sites will be of critical importance to the re-establishment of this species as a breeder in historic habitat and is also significant in meeting the overall recovery goals for this species.

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Name: Barred Owl (*Strix varia*)

Status: State threatened.

New Jersey Distribution:

The entire state of New Jersey is considered within habitat range for this species. Major populations occur along the Kittatinny Mountains in northwestern New Jersey, within the Newark Watershed in Passaic County, within the Passaic River basin in Morris County, and in large swamp complexes in Cape May and Cumberland Counties. Barred owls were found in 149 grids during the New Jersey Breeding Bird Atlas surveys but were nearly absent in 9 of 21 counties (Walsh et al. 1999).

Habitat:

Barred owls are known to occur in both upland and wetland habitats with home ranges typically composed of a mosaic of upland and wetland areas. Suitable habitats are generally described as large tracts of either hardwoods, softwoods, or mixed stands (Soucy 1982; Sutton and Sutton 1985) though Falk (1990) felt that the species may be more of a habitat generalist, being habitat flexible contingent upon the presence of large trees with suitable cavities. In New Jersey, differences exist between habitat used by barred owls in the coastal plain and that of those used in the highland, ridge and valley physical provinces.

In northern New Jersey, Bosakowski et al.(1987) reported preferential use of oak hardwood (*Quercus* spp., *Carya* spp., *Fraxinus americana*, *Acer rubrum*, *Betula lenta*, *Tilia americana*, *Liriodendron tulipera*, *Prunus serotina*, and *Nyssa sylvatica*), northern hardwood (*Acer sacchrum*, *Betula alleghaniensis*, and *Fagus grandifolia*), and hemlock (*Tsuga canadensis*) forests. Ninety-five percent of barred owl locations were within 100 m (328 ft) of a water source. In addition, photo analysis of 27 barred owl locations revealed a significant overutilization of wetlands (9.4%) compared to 20 (5.9%) unused wetlands sited (Bosakowski 1990). This data shows that wetland areas required by barred owls do not have to be large to be suitable for use by this species.

Using radio telemetry, Nicholls and Warner (1972) established Minnesota barred owls to use the following habitats, listed in order of preference; oak *(Quercus* spp.) woods, mixed hardwoods and conifers, white cedar (*Thuja occidentalis*) swamp, alder swamp, emergent marsh, and open field. Further analysis showed that the oak, mixed, and conifer forests were preferred over the other habitat classes listed. The oak woods featured overstory heights of 6.1 – 19.8 m (20 – 65 ft) with little understory vegetation. The mixed and conifer stands featured various combinations of sugar maple, basswood (*Tilia americana*), red oak (*Quercus rubra*), white birch (*Betula papyrifera*), northern pin oak (*Quercus palustrus*), white pine (*Pinus strobus*), red pine (*Pinus resinosa*), and jack pine (*Pinus banksiana*). Understory vegetation was sparse. Conifer swamps consisted of white cedar and tamarack (*Larix laricina*) dominated stands. Other studies in northern areas (e.g. Michigan, Connecticut, New Hampshire, Virginia) have also confirmed barred owl use of similar habitat types (Smith 1978; Elody 1983; Hegdal and Covin 1988).

In their analysis of barred owl habitat use in southern New Jersey, Laidig and Dobkin (1992) found barred owls to be primarily associated with three habitat types; Atlantic white cedar (*Chamaecyparis thyoides*) swamp, pitch pine (*Pinus rigida*) lowland habitat, and hardwood swamp. Cedar swamp habitats featured typical understory vegetation of sweetbay (*Magnolia virginiana*) and highbush blueberry (*Vaccinium corymbosum*), while pitch pine lowlands featured inkberry (*Ilex glauca*) and highbush blueberry. Overstory tree species in hardwood swamps included tulip-tree (*Liriodendron tulopifera*), sweet gum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), and red maple (*Acer rubrum*). Understory species were the same as those in the softwood swamps. In both cases, understory vegetation was considered dense and often contained large amounts of catbriar (*Smilax* spp.). See Laidig (1992) for additional details on the habitat types covered under this study.

Breeding habitat: The USFWS HEP model for the barred owl (Allen 1987), summarizes barred owl reproductive requirements in the following fashion. Nesting habitat in North America is described as mature stands of elm (*Ulmus* spp.), beech (*Fagus* spp.), oaks, hickories (*Carya* spp.), yellow birch (*Betula alleghaniensis*), sycamore (*Platanus occidentalis*), and aspen (*Populus* spp.). Typical nesting trees are large [greater than 50.8 cm (20 in)], living or dead. Nesting cavities are generally found 9 meters (12 feet) above the ground. Falk (1990) reported a strong relationship between sugar maples (*A. saccharum*) and barred owl nests in Connecticut. Nests have also been recorded in broken snags or in abandoned hawk nests. In a Charlotte, North Carolina study, three barred owls were found to nest in house chimneys (Harrold 2003). Barred owls have also used artificial structures for nesting (Johnson 1987; Harrold 2003).

In New Jersey, Bosakowski et al (1987) found three nests in large dead trees which included white oak (*Quercus alba*), sugar maple, and black willow (*Salix nigra*). In southern New Jersey, barred owls have been identified as likely breeders in Atlantic white cedar swamps and pitch pine habitats (Sutton pers. comm.). Neither researcher reported barred owl use of hawk or great horned owl nests. A breeding pair of barred owls was identified in a red maple swamp in Cumberland County (Ormiston 1991). Valent (pers. comm.) recorded a barred owl nest in a sycamore near a single-family house in Warren County.

Feeding and Resting habitat: Nicholls and Warner (1972) postulated that the low use of alder thickets and white cedar swamps by barred owls was a function of one or more of the following characteristics: high stem densities, fewer suitable nest and perch sites, fewer prey, and/or the muffling effect of the wetland vegetation. Similar findings were made by McGarigal and Fraser (1984) in Virginia, and, Devereux and Mosher (1984) in Maryland. Laidig and Dobkin (1992) suggested that barred owls forage along open areas adjacent to cedar bogs where a variety of rodent prey are known to occur and also in less favorable oak-pine upland habitats which feature less dense understories than wetland habitats. D. Dobkin (pers. comm.) also indicated that the barred owl's ability to pounce on prey from above rather than swoop in laterally may permit the species to hunt in the denser forest understories typically found in the pine barrens. Barred owls have also recently been reported foraging in seasonal vernal ponds (Calhoun and DeMaynadier 2008: S. Angus pers. comm.).

Little information exists of habitats used by roosting owls. Dense cedar stands have been documented as being used by roosting owls (Applegate 1975; Fuller 1979). Laidig and Dobkin

(1995) suggested that Atlantic white cedar/pitch pine lowlands provided important camouflage and shelter habitats and may also provide a thermal refugium from hot temperatures during the summer.

Other factors: Human disturbance and structures impact the suitability of forested habitat for the barred owl. In Connecticut and New Hampshire, Smith (1978) reported barred owls to strongly avoid areas containing multi-family dwellings, commercial and institutional buildings, and open water areas. In the Pequannock Watershed of New Jersey, Bosakowski (1990) determined that 27 barred owl locations were further from human habitation, had fewer houses, and had reduced suburban areas compared to 20 unused sites. Contrary to these findings, a study of a barred owl population in Charlotte, North Carolina found the species to exist in a highly modified suburban environment (Harrold, 2003). In New Jersey, pairs of owls have been found in a suburbanized area of English Creek in Atlantic County and near a single-family dwelling in Warren County (Sutton 1989; L. Torok pers. comm.; Valent pers. comm.).

Great horned owls (*Bubo virginianus*) are well documented predators of barred owls (Bent 1938; Grant 1966; Fuller 1979). However, despite this characteristic, great horned owls and barred owls have also been documented to nest in the same tree (Martin 2001). Laidig and Dobkin (1992) suggested that competition for prey items between the two species may also occur while Bosakowski (1990) found that competition for food with great horned owls was moderate but below critical levels. Home range overlap between the two species appeared to vary between north and south; with great horned owls sharing 35% of areas surveyed in southern Jersey vs. 7.5% in the Pequannock Watershed (Bosakowski 1990; Laidig 1992).

Survey Requirements:

Dobkin and Laidig (1990) surveyed for barred owls using taped vocalizations consisting of six 10 second sets of barred owl vocalizations followed by 50 – 60 seconds of silence. The tape player speaker was rotated 180 degrees between each 10 second interval for a period of five minutes. A listening period of five minutes followed each tape sequence. Survey points were located approximately 1 km (0.6 mi) apart. Surveys should be conducted after sunset, when wind speeds are less than 8 mph, and when precipitation was absent, light or intermittent (Valent 1987). While barred owls may respond to taped calls during any month of the year, greater success has been documented during March-July (Bosakowski et. al. 1987). Smith (1978) reported greater owl response success during May-July and after 8:00 P.M. Note that taped vocalization surveys may not always conclusively demonstrate species absence, particularly when the survey is done outside of the breeding season.

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: See the discussion provided above for details on species composition, plant community age, and surrounding land use. The evaluation of each wetland will take into account the following characteristics:

a. Locational factors: proximity to residential, industrial, or commercial development, density of development, other human disturbance factors, agricultural lands, and forest block size and continuity.

b. Vegetative factors: forest age, canopy height, canopy closure, species composition, understory height, stem density, species composition.

Comments:

As discussed above, great horned owls are known to be a predator/competitor of barred owls. While their ranges have been documented to overlap (Bosakowski 1990; Laidig and Dobkin 1992, Kane pers. comm), the presence of this species in areas featuring barred owls will affect the suitability of a particular habitat to support barred owls.

Rationale:

While barred owls will use both upland and wetland habitat, in New Jersey they are primarily associated with forested wetlands. Falk (1990) suggested that the association between barred owls and wetlands is related to a number of factors including prey base, the protection provided by the denser forest cover associated with wet areas, and the greater number of large, decadent trees present there. In addition, barred owls are an area dependent species. Studies have demonstrated that breeding pairs will make use of suitable habitats over large (in excess of 3000 acres) of land (Hamer 1988). Most barred owl documentation consists of responses to tape calls which identify the species at a particular locale but does not always provide habitat specific information.

The identification and protection of suitable freshwater wetland habitat, within likely home range areas, offers the best protection strategy for ensuring the continued existence of the barred owl within the currently occupied locations. The success of such a strategy is contingent upon the size and configuration of wetland habitats in relation to the eventual degree of upland development within each particular barred owl area of documentation.

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Name: Migratory Raptors

Status: State Endangered

Bald Eagle (*Halieetus leucocephalus*) ***
Northern Harrier (*Circus cyaneus*) **
Peregrine Falcon (*Falco peregrinus*)
Red-Shouldered Hawk (*Buteo lineatus*) **

State Threatened
Osprey (*Pandion haliaetus*) **
Long-eared owl (*Asio otus*)
American kestrel (*Falco sparvius*)

** State listing for breeding status only; species breeds, migrates and/or overwinters in Cape May.
*** Breeding population endangered; wintering population threatened.

Habitat:

Types of habitat expected to be used during the migration period, from September 1 to December 1, by each of the six species identified above are described below. Unless otherwise noted, migratory raptors are associated with vegetative communities structurally similar to those used during the breeding season. Factors which affect the suitability of a habitat for breeding use are human disturbance, competition, and predation. The fore mentioned factors, however, do not have a large role in the determination of the suitability of a particular habitat for use by migrating birds.

American Kestrel

Kestrels are commonly associated with open areas with few trees containing cavities; wet meadows; forest edges; and orchards (DeGraaf and Rudis 1986). Wintering kestrels have been shown to favor disturbed grassland habitats but will also use undisturbed grassland, old fields and plowed fields in Missouri (Toland 1987). Habitat use in Kentucky followed a similar pattern with pastureland and old field being the primary habitats used (Sferra 1984). Roost locations for wintering birds in Pennsylvania included tree branches (maples, pines and oaks), tree cavities and multiple human structures (Ardia 2001).

Bald Eagle

The preferred foraging habitat of the bald eagle is open water: rivers, lakes, and estuaries (DeGraaf et al. 1980). The primary prey item for eagles is fish though they will take various species of birds, reptiles, mammals, and invertebrates (Retfalvi 1970; Dunstan and Harper 1975; DeGraaf et al. 1980; Cline and Clark 1981; Todd et al. 1982; Frenzel 1984).

Trees in proximity to water are the favored perch site for eagles (Stalmaster and Neuman 1979; Steenof et al 1980; Chester et al. 1990). Perch sites generally consist of tall (mean 21.1 m / 69 ft), large (mean 42.3 cm / 17 in) trees featuring stout, horizontal branches with at least one side facing an open area (Steenof et al. 1980).

Roosting habitat tends to be located near water and features mature living or dead hardwoods or softwoods (Steenof 1978; Keister and Anthony 1983; Stalmaster and Gessaman 1984; Keister et al. 1985; Buehler et al 1991)

Long-eared owl

In general, long-eared owls are associated with open field or meadow habitats interspersed with hedge rows, wood lots, conifer groves or plantations for breeding and winter roosts (Bent 1938; Craig and Trost 1979: Wijnandts 1984; DeGraaf and Rudis 1986; Marks 1986; Kren 1987: Bosakowski et al. 1989a). Evergreen species are favored for roosting habitat though hardwood stands may also be used (Randle and Austing 1952: Smith 1981; Craig et al. 1985; Bosakowski et al. 1989b:). Getz (1961) found long-eared owls to feed over open field habitats because of the low amount of cover available for microtine prey. Areas less favored included bog, marsh, and several forested habitats. In Cape May, owl banding stations captured long-eared owls in various habitats, including a red cedar (*Juniperus virginiana*) grove, hay fields and brackish marsh (Duffy and Kerlinger 1993)

Norther Harrier

Northern harriers are primarily a species of the open country; occurring in such habitats as farm fields, salt and freshwater marshes, swamps, bogs, and wet meadows (Hall 1983; Laughlin and Kibbe 1985; Serrentino 1989). Freshwater wetland vegetation occurring in northern harrier habitats include meadowsweet (*Spiraea latifolia*), red-osier dogwood (*Cornus stolonifera*), sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), goldenrod (*Solidago* spp.), willow (*Salix* spp.) and wet hayfields dominated by reed canary grass (*Phalaris arundinacea*) (Serrentino 1987; Hamerstrom and Kopeny 1981; Laughlin and Kibbe 1985). Coastal habitats feature northern bayberry (*Myrica pensylvanica*), black huckleberry (*Gaylussacia baccata*), wild rose (*Rosa* spp.), common reed (*Phragmites australis*), salt hay grass (*Spartina patens*), smooth cordgrass (*S. alterniflora*), and poison ivy (*Toxicodendron radicans*) (Holt and Melvin 1986; Dunne 1984; England 1989).

Osprey

Ospreys primarily feed upon fish and forage in estuarine, river, and lake habitats during migration. Water bodies should be free of dense emergent or subemergent vegetation as well as dense, overhanging vegetation from the banks or shore (Hynes 1970; Postupalsky and Stackpole 1974; Prevost 1977). Favored perch sites are similar to nest sites, principally being live or dead trees, but also buoys, channel markers, nest platforms, or utility poles (Berger and Mueller 1969; Wiemeyer 1971; MacCarter 1972; Prevost 1977; Rhodes 1977). Little is documented in regard to osprey roost habitat.

Peregrine Falcon

Peregrine falcons in New Jersey feed primarily on avian prey (Steidl 1989). Foraging habitats are usually open areas such as lakes, rivers, and marshes where prey are abundant and vulnerable (Evans 1982; Palmer 1988). During migration, peregrines will use open areas (e.g. fields), forest and ecotones to forage on passerine prey (K. Clark pers. comm).

Red-Shouldered Hawk

A review of the literature indicates that red-shouldered hawks are commonly associated with habitats varying from lowland hardwood, mixed, and conifer forests to upland mixed and conifer forests (Henny et al. 1973; Bednarz and Dinsmore 1981; Titus and Mosher 1981; Crocoll and Parker 1991). Surrounding habitats were almost always characterized by nearby waterbodies (e.g. swamps, rivers, ponds) and tracts of forest (Kimmel and Fredrickson 1981; Morris and Lemon 1983; Bosakowski et al.1992a). In a study of southern New Jersey breeding habitats, red-shouldered hawks were commonly associated with younger wetland forests typified by Atlantic white cedar, red maple (*Acer rubrum*), black tupelo (*Nyssa sylvatica*), sassafrass (*Sassafras albidum*) and sweetbay (*Magnolia virgiana*) with surrounding habitats of oak-pine forest and agricultural fields (Dowdell and Sutton 1992).

Survey Methodologies:

Additional information regarding the techniques used for the Cape May studies cited above and their applicability to a particular site may be obtained from the:

Endangered and Nongame Species Program
NJDEP
Division of Fish and Wildlife
501 East State Street, Trenton, New Jersey 08625

Regulatory Guidelines:

1. Area of documentation: The lower 10 kilometers (6 miles) of the Cape May peninsula. Identifiable by Universal Transverse Mercator line 43.18 on U.S.G.S. suvey quadrangles Rio Grande and Stone Harbor.

2. Suitable habitat: Vegetational communities featuring the following characteristics will be considered to provide habitat for one or more of the species described above.
   a. Deciduous, mixed, or evergreen wetland forest:
      i. Mature trees of a dbh of 20 cm (8 in) or greater
      ii. Canopy height of 6.1 m (20 ft) or greater
      iii. Snags, dead, or down material

vi. Shrubby understory vegetation. The density of the shrub layer affects raptor foraging habitat suitability.

b. Deciduous, mixed, or evergreen scrub-shrub wetlands:

i. Overstory height of < 6.1 m (20 ft)

ii. Songbird food and cover plants including, but not limited to:

winterberry holly (*Ilex verticillata*)
poison ivy (*Toxicondendron radicans*)
elderberry (*Sambucus canadensis*)
willow oak (*Quercus phellos*)
red maple (*Acer rubrum*)
honeysuckle (*Lonicera* spp.)
red cedar (*Juniperus virginiana*)
Virginia creeper (*Parthenocissus quinquefolia*)
wild cherry (Prunus spp.)
winged sumac (*Rhus copallina*)
hackberry (*Celtis* spp.)
grape (*Vitis* spp.)
holly (*Ilex opaca*)
pokeweed (*Phytolacca americana*)
sourgum (*Nyssa silvatica*)
sassafras (*Sassafras albidum*)
waxmyrtle (*Myrica certifera*)
goundsel tree (*Baccharis halimifolia*)

(Sutton 1989)

c. Freshwater or tidal emergent wetlands:

i. ground cover plants such as:

phragmites
sedges
rushes
salt meadow cordgrass
saltmarsh cordgrass
tall cordgrass (Spartina cynosuriodes)
cattails (*Typha* spp.)
hightide bush (*Iva frutescens*)
red cedars
red maple

ii. Any of the songbird food plants described above.

iii. Interspersed open water areas.

Wetland complexes that feature an interspersion and juxtaposition of the forementioned habitat types are of greater value than monotypic stands. Maintained areas (e.g. lawns, detention basins) will not be considered as suitable habitats.

3. Other factors affecting habitat suitability: The size of the wetland complex associated with a property and the amount of human disturbance present will impact the suitability of the site for use by migratory raptors. As a rule, isolated wetland habitats less than 0.4 ha (1 ac) in size will not be considered suitable habitat unless: (a) the wetland is a component (i.e. within 150 feet) of a larger wetland complex or series of smaller otherwise suitable wetland features proximate to one another; (b) the wetland and entire area of the 150 buffer is a component of a larger upland forest complex (see above description) and/or (c) a listed migratory raptor is observed using the wetland for "resting or feeding" during the migratory season as defined above. For monotypic wetland communities dominated by phragmites or cattails, the structural diversity of the upland buffer community and level of development or disturbance on and adjacent to the property will affect the suitability of the wetland habitat.

   Varying levels of human activity have been demonstrated to alter migratory raptor use of fields and displace prey species at Higbee Beach Wildlife Management Area (Clark and Niles 1986; Niles and Clark 1987). As a result, the intensity of human disturbance experienced by an onsite wetland and the degree of surrounding development must be evaluated, on a case-by-case basis, when determining the suitablity of wetland habitats for migratory raptor use.

Rationale:

The wetlands of the Cape May peninsula have been documented as providing critical habitat for migratory raptors in studies conducted by the staff of the Cape May Bird Observatory and the Division of Fish, Game, and Wildlife (DFGW). Between 47,000 and 88,000 raptors occur on or above the peninsula during the fall migration period (Dunne and Sutton 1986). Kerlinger (1989) listed Cape May as one of the most significant locales for migratory birds in the world. At least eleven species of raptor have been documented during the migrations including both federal (peregrine falcon, bald eagle) and state (red-shouldered hawk, osprey, northern harrier) listed species. As much as 90% of these birds are immature (Niles 1989).

Research conducted by the DFGW's Endangered and Nongame Species Program has further defined the importance of wetland habitats in the lower 10 km of the Cape May peninsula. Studies conducted for a 30-kilometer portion of the peninsula and, subsequently, the lower 10 kilometers have reached the following conclusions:

1. Accipiters, falcons, and ospreys generally increase, significantly, within 10 kilometers of the point while harrier and buteo numbers are evenly distributed throughout the entire peninsula (Niles 1986);

2. A 30% increase in residental development between 1972 and 1986 has resulted in a significant loss of natural habitats available for use by migratory birds in the lower 10 kilometers (Niles 1989);

3. A statistical analysis of raptor observation data indicates that migratory raptor numbers are evenly distributed throughout the lower 10 kilometers and that species tend to be associated with similar structural habitats as those used by breeding birds (L. Niles pers. comm.);

4. Rather than simply flying over the peninsula and continuing south across the Delaware Bay, raptor numbers concentrate in the lower 10 kilometer, generally, and along the western half of the peninsula, specifically. They forage and roost for varying periods before continuing south (Holthuijzen et al. 1982; Niles 1986).

Based on these findings, the Department has concluded that wetland habitats in the lower 10 kilometers of the Cape May peninsula are of local, statewide and regional signficance to the maintenance of North American raptor populations. As a result, suitable wetland habitats within this area are determined to be of exceptional resource value.

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Name: Indiana Bat (*Myotis sodalis*)

Status: Federally endangered.
State endangered.

New Jersey Distribution:

Three established and documented Indiana bat hibernacula exist in Morris County; in Hibernia and Mount Hope. As of July 1999, known locations, suitable as pre-hibernation, post-hibernation, summer foraging and roosting areas, include 18 municipalities in Morris County. These include Boonton Town, Boonton Township, Denville Township, Dover Town, Hopatcong Borough, Jefferson Township, Kinnelon Borough, Mine Hill Township, Montville Township, Mount Arlington Borough, Mountain Lakes Borough, Parsippany-Troy Hills Township, Randolph Township, Rockaway Borough, Rockaway Township, Roxbury Township, Victory Gardens Borough and Wharton Borough. Essex, Hunterdon, Passaic, Somerset, Sussex, Union and Warren counties also provide potential summer and winter habitat.

Habitat:

In New Jersey, the Indiana bat requires habitat for winter hibernation as well as summer roosting and foraging. The characteristics of each of the seasonal habitats are provided below.

Winter Hibernation: Indiana bats mate and hibernate in limestone caves and open, abandoned mine shafts (hibernacula). Caves provide important locations for mating and hibernation. Bats mate from September to mid-October during autumn swarming, with most mating occurring during the first 10 days of October. Mating takes place on the ceilings of large rooms near the entrances to hibernacula. Females begin hibernation almost immediately after mating, while most males remain active into November and even December (Evans, et. al. 1985). *M. sodalis* is highly selective of hibernation sites. Hibernacula are typically medium-sized caves with large, shallow passageways. Suitability is determined by the configuration of the cave so as to trap cold air and provide stable low temperatures that permit bats to maintain low metabolic rates and conserve fat reserves throughout the winter (USFWS 1999). During midwinter, ideal conditions inside caves include an average temperature of 37-43°F (Evans, et. al. 1985) and a relative humidity of 87% (Barbour and Davis 1969), though recent studies have suggested that humidity rates may reach as low as 55% in some instances (USFWS 1999). Throughout hibernation, bats periodically move to the coldest regions of the cave. In addition, hibernating bats will awaken approximately every 8-10 days and spend an hour or more flying about the cave or moving to other clusters, elsewhere in the cave (Barbour and Davis, 1969).

Roosting Habitat: During the summer, females commonly occupy maternity roosts in riparian and floodplain forests under the loose bark of dead or dying trees (Evans et al. 1985). They have also been found under the loose bark of living trees and in cavities of dead trees (Humphrey et al. 1977). The use of upland habitat is also becoming more common for some populations. Other factors influencing the suitability of a particular tree as a roost site include the tree's solar exposure, location in relation to other trees, and the tree's spatial relationship to water sources and foraging areas (Garner and Gardner 1992; Farmer et al. 1997; USFWS 1999). A study in

Illinois by Garner and Gardner (1992) indicated that 75% of roost trees were upland species, while the other 25% were floodplain species. Tree species used as roost sites include, but are not exclusive to: American elm (*Ulmus americana*), slippery elm (*Ulmus rubra*), bitternut hickory (*Carya cordiformis*), shagbark hickory (*Carya ovata*), sweet pignut hickory (*Carya ovalis*), northern red oak (*Quercus rubra*), post oak (*Quercus stellata*), white oak (*Quercus alba*), silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*) and sassafras (*Sassafras albidum*). Another study reported a colony found roosting in the cavity of a dead sycamore (*Platanus occidentalis*) (Kurta, et. al. 1993). However, tree characteristics are considered a greater determinant of roost suitability than species (Farmer et al. 1995; USFWS 1999; MacGregor, pers. comm. in USFWS 2000). Various studies have suggested that Indiana bats show strong site fidelity to summer colony areas (Humphrey et al. 1977; Gardner et al. 1991; Callahan et al. 1997). In a recent development, Indiana bats have also been documented to use buildings in Pennsylvania (Hassinger and Butchkoski 2001).

Maternity colonies may establish both primary and alternate roost sites, which differ in the number of bats using the site and the location of the roost site. Since the temperature of the roost site is important, primary roosts are often located with southeast or south-southwest exposures in areas that can be heated by the sun, such as in openings or at the edges of forests. Alternate roost sites are also located in forest interiors, and are used when temperatures are above normal or when it is raining (Callahan 1993). Use of up to 17 roost trees has been documented for a single Indiana bat maternity colony (USFWS 1999).

Tree roosts used by males are characteristically similar to those used by maternity colonies. However, males will also use trees of smaller diameter or occupy caves during the summer (Harvey 1992; Romme et al 1995; USFWS 1999). In New Jersey, a male Indiana bat captured during the summer was documented to roost in a total of 6 different roost trees over a 13-day period. One primary roost tree, a red maple (*Acer rubrum*), and five secondary roost trees (one red maple, two gray birch (*Betula populifolia*), one yellow birch (*B. alleghaniensis*) and one green ash) were identified. All roost trees used by this particular Indiana bat were dead snags with loose and exfoliating bark (Rinehart and Kunz 1998; Scherer 2000). White ash (*Fraxinus*), red maple, American elm, and red oak were used as daytime roost sites in Pennsylvania (Hassinger and Butchkoski 2001). As in the previous study, all trees had exfoliating bark and six of the seven used were dead.

Foraging Habitat: Trees located within the floodplain and along streamsides are particularly important in providing areas in which to forage for insects. Open bodies of water, such as lakes and reservoirs, are also used as foraging areas. Vernal pools have been documented as bat foraging areas (Biebighauser, 2003; Brooks and Ford, 2005, Calhoun and deMaynadier, 2008; Francl, 2008;), with researchers noting the availability of open water, abundant aerial invertebrates, and a suitable opening in the forest canopy for foraging. Brooks and Ford (2005) noted in particular that bats of the genus *myotis* are smaller and adept at foraging within the small canopy openings afforded by Massachusetts vernal pools, and Biebighauser (2003) specifically noted foraging use of Kentucky vernal pools by Indiana bats. During the summer, females and juveniles forage in riparian and floodplain areas. Pregnant and lactating females also prefer open bodies of water and have been known to fly up to one-and-a-half miles from

upland roosts. In a Pennsylvania study, tagged Indiana bats foraged in either a pole stage deciduous forest with a moderate-to-dense shrub layer, or, in a mature forest with a sparse shrub layer (Hassinger and Butchkoski 2001). This study also suggested preferential use of a lightly sloped, contiguous forest tract over smaller, fragmented patches. Foraging also occurs in the canopy of upland trees, over clearings with early successional vegetation, along the borders of cropland, along wooded fence-rows, and over pastures (Kurta et al. 1993; USFWS, 1999).

Survey Methodologies:

The USFWS and the Indiana bat recovery team consider Indiana bats captured during the period of May 15 to August 15 to be summer residents (McKenzie pers. comm. in USFWS 2000). During the summer, nesting locations should be chosen based on proximity to a travel corridor, the presence of water and the extent of closed canopy. Garner and Gardner (1992) recommend sampling on calm nights with no precipitation and a temperature of at least 50° F.

The fall swarming/foraging period begins in August and may extend into November, depending on annual local weather conditions (USFWS 1999). Harp traps or mist netting at cave entrances is used during the fall, since bats tend to forage around the entrances to caves from late September to early October prior to hibernation. Unless in an area with a high amount of activity, the same site should not be sampled more than once, since bats have avoided nets on the second night. Radiotelemetry may also be used in tracking movements and foraging ranges. Additional information on survey techniques and time frames may be obtained from the USFWS.

United States Fish and Wildlife Service contact:

Carlo Popolizio, U.S. Fish and Wildlife Service, New Jersey Field Office, 927 N. Main Street, Bldg D, Pleasantville, New Jersey 08232. (609) 646-9310 ex. 34.

Regulatory Guidelines:

Area of Documentation: As noted above, the Landscape mapping designates all forested habitat contiguous within a 2 km (1.2 mi) radius from the hibernaculum as critical habitat. Recommendations received from the USFWS are such that projects within 8.3 km (5 mi) of a hibernaculum have the potential to adversely affect habitats used by this species. As a result, the Department will establish a two-tiered protection strategy for the Indiana bat.

Principally, wetlands within 8.3 km (5 mi) from the hibernaculum will be considered as documented habitat that, if suitable, will warrant an exceptional resource value classification. This distance represents a conservative 5.8 km (3.5 mi) dispersal/roosting radius from the over-wintering cave and an additional 2.5 km (1.5 mi) of foraging radius for adults and juveniles. Additional forested habitat identified on the Landscape mapping as Indiana bat habitat will be considered on a case-by-case basis for an exceptional resource value classification as our understanding of these animals' habits and habitat use improves. Such habitats will, however, be subject to certain timing restrictions discussed in the *Comments* section below.

Suitable Habitat: When assessing whether or not an area is suitable for Indiana bat habitat, it is necessary to examine the quantity and quality of contiguous habitat, the percentage of canopy cover, the presence and quality of a stream/riparian or open water habitat and the definition of the flight corridor. The following conditions are ideal in terms of foraging areas and roost sites. However, it is possible for suitable sites to not meet all of these criteria.

1. Hibernacula

M. sodalis prefer medium-sized caves with large, shallow passageways or those with configurations that allow for the maintenance of a cool, stable microclimate that enables hibernating bats to maintain a low metabolic rate and conserve fat reserves. During midwinter, ideal conditions inside caves include an average temperature of 37-43°F (Evans et. al. 1985) and a relative humidity of 74% (Barbour and Davis 1969; USFWS 1999).

2. Roost Sites

Certain conditions must also be considered in determining which trees are appropriate roost sites. These include the species of tree, whether the tree is dead or alive, the quantity of loose or peeling bark, the amount of direct sunlight the tree receives, and its proximity to other trees, water sources and foraging areas (USFWS 1999). Tree species include, but are not limited to, those identified above under the "Foraging and Roosting Habitat" discussion. Optimal densities of roost trees (> 9 inches dbh) are 27 trees per acre in upland habitats and 17 trees per acre in floodplain habitats. Lower densities of potential roost trees (Garner and Gardner 1992) or smaller diameter trees (Rommee et al. 1995) can also provide suitable habitat. Trees that face east-southeast and south-southwest are favored for maternity roosts because they receive adequate sunlight to warm maternity roosts, which is important for the development of young. Maternity roosts are generally close together (within a few meters of each other), although some are several kilometers apart. Additional criteria on the characteristics of suitable forest stands for roosting can be found in Garner and Gardner (1992).

3. Foraging

Overall, ideal summer foraging habitat is characterized by deciduous forest with at least 30% cover, permanent or semi-permanent water available within a 1 km (0.63 mi) radius and suitable roost trees located within a 0.4 km (0.25 mile) radius. However, deciduous forest with at least 5% cover can also provide suitable habitat and, as noted above, bats may also forage over vernal pools, early successional clearings, along the borders of croplands, along wooded fence-rows, and open pastures.

Rationale:
Since M. sodalis is known to make extensive use of floodplain and wetland forest for foraging and roosting and also to return to the same roost sites each year, preserving this habitat is critical to the survival of this species (USFWS 1999). It is important to note that, due primarily to their age, individual roost trees are ephemeral in nature and there is a need to protect additional contiguous forest to maintain roost site longevity. Bats prefer mature forests with mostly closed canopies for primary roost sites and insect foraging. They also prefer trees that are close to

intermittent streams. The presence of small permanent and seasonally ponded (vernal) stillwater habitats within upland forests present an ideal forage-rich ecotone. Identifying wetlands which feature suitable roosting or foraging habitat for this species as being of exceptional resource value will serve to protect critical wetlands and adjacent upland habitat for the Indiana bat.

Comments:
The USFWS recommends a seasonal restriction, from April 1 to November 15, during which the clearing of suitable upland or wetland forest roost or foraging habitat would be prohibited. For regulatory purposes, the Department will apply this condition to permitted projects within all habitat blocks shown as Indiana bat habitat on the Department's Landscape maps. Noncontiguous forest fragments, forested areas with open canopies, open pastures and areas close to paved roads are not ideal as roost sites. While some studies have concluded that reproductive females avoid paved roads (Garner and Gardner, 1992), other researchers have noted that distance to a paved road is not a reliable parameter for the measure of the overall suitability of a habitat for the Indiana bat (USFWS 1999; MacGregor pers. comm. in USFWS 2000; McKenize pers. comm. in USFWS 2000). Still, because of the potential mortality resulting from bat/vehicle interactions, it is important to provide a buffer from highways and other paved roads. *M. sodalis* also uses areas of forest for alternate roost sites and riparian forest and stream corridors for travel and foraging. More research is needed to determine specific summer roost requirements, migration, and foraging habits, for both males and females, and reasons for their decline.

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Name: Northern Long-eared Bat (*Myotis septentrionalis*)

Status: Federally endangered, State endangered

New Jersey Distribution:

There are 12 documented Northern Long-eared Bat hibernacula across Hunterdon, Morris, Passaic, Sussex, and Warren Counties. Additionally, there are in excess of 260 documented occurrences in Atlantic, Bergen, Burlington, Camden, Cape May, Gloucester, Hunterdon, Mercer, Monmouth, Morris, Ocean, Passaic, Salem, Somerset, Sussex, and Warren Counties, with more being discovered as surveys are conducted across the state. Overall, Northern Long-eared Bat can potentially occur in suitable habitats throughout the entire state.

Description:

Northern Long-eared Bat are medium-sized bats, ranging from 5 to 8 grams in weight with an average body length of 77 to 95mm (USFWS 2013). Female conspecifics tend to be larger and heavier than males. The bats' pelage and membranes are light brown, with ears extending past the nose when oriented forwards (Caceres & Barclay 2000). Northern Long-eared Bat have developed longer tails and wider wing spans for maneuvering at low speeds in cluttered landscapes (Caceres & Barclay 2000).

Habitats and Life History:

Northern Long-eared Bat inhabit a variety of deciduous, coniferous, and mixed forest types across their range and require distinct habitat features for winter hibernation and for summer roosting and foraging. The characteristics of these seasonal habitats and their importance to Northern Long-eared Bat are described below.

Winter Hibernation: Hibernacula used by Northern Long-eared Bat include caves, abandoned mines, and, to a lesser extent, features like abandoned railroad tunnels, buildings, attics and basement crawl spaces. These winter refuges provide relatively stable above-freezing temperatures of 32 to 48°F and high humidity, allowing the bats to minimize energy demands from thermoregulation (USFWS 2013, Dowling & O'Dell 2018).

Males and females begin arriving at hibernacula in late summer, with fall swarming and mating activities peaking in August and September (Caceres & Barclay 2000, USFWS 2013). During this time, the bats may use hibernacula as night roosts (Agosta *et al* 2005). Northern Long-eared Bat have been found to remain active later in the fall than other *Myotis* species (Agosta *et al* 2005) and may not settle into hibernacula until late October or November (Caceres & Barclay 2000, USFWS 2013).

Northern Long-eared Bat are often found within deep cracks and crevices in the ceilings and walls of hibernacula with only their noses and ears exposed (USFWS 2013). They have also shown a preference for hibernating in higher humidity and cooler temperature microclimates than little brown bats (*Myotis lucifugus*) (Caceres & Barclay 2000, USFWS 2013). In New Jersey, Northern Long-eared Bat have historically been documented in relatively low numbers within hibernacula – typically 15 or fewer individuals per site – with the exception of one large, abandoned mine where a pre-white-nose syndrome survey tallied 135 individuals among more than 27,000 little brown bats and other cave-hibernating species (NJDEP Fish and Wildlife Biotics Database 2021). In Bucks County, PA, 881 northern long-eared bats were documented at single large mine in 2004 (USFWS 2013). It is noted that hibernacula surveys may under-represent this species due to their tendency to roost in deep crevices (USFWS 2013).

Individual northern long-eared bat will return to the same hibernacula but not always in sequential seasons (Caceres & Barclay 2000). Unlike other species, Northern Long-eared Bats frequently move between hibernacula during the winter (Caceres & Barclay 2000, USFWS 2013). The reason for this behavior is unknown. Dietary studies have reported that cave-hibernating bats do eat insects during winter emergences, highlighting the importance of managing surrounding landscapes to support insect prey (Bernard et al. 2021).

Roosting and Maternity Habitat: In March or April, Northern Long-eared Bat emerge from hibernation and migrate between 8 and 270 km (5-168 mi) to their summer habitats (Caceres & Barclay 2000) in forested settings (Owen *et al.* 2003, Henderson & Broders 2008). During the active season, males and non-reproductive females roost singly or in small groups of fewer than 10 individuals, while reproductive females form maternity colonies that can vary widely in size, usually ranging between 30-60 individuals pre-white-nose syndrome (Caceres & Barclay 2000, USFWS 2014) but now likely feature smaller numbers. These reproductive females give birth, usually synchronously, to a single pup each in early summer (Caceres & Barclay 2000, Arnold 2007, USFWS 2013).

Northern Long-eared Bat seek shelter mainly in tree cavities, crevices and beneath loose bark (Carter & Feldhamer 2005, Foster & Kurta 1999, Lacki & Schwierjohann 2001, Menzel *et al* 2002, Perry & Thill 2006, Timpone *et al* 2010, Burrell & Bergeson 2022). The bats roost in a variety of tree species and tree sizes relative to their availability on the landscape (Britzke *et al* 2015), highlighting the species' opportunistic and flexible nature (Henderson *et al* 2008). Among their documented roost trees are black oak *(Quercus velutina),* northern red oak *(Quercus rubra),* silver maple *(Acer saccharinum),* American beech *(Fagus grandifolia),* sugar maple *(Acer saccharum),* sourwood *(Oxydendrum arboretum),* and shortleaf pine *(Pinus echinata)* (USFWS 2013); black locust *(Robinia pseudoacacia)* (USFWS 2013, Gorman *et al.* 2022), green ash *(Fraxinus pennsylvanica)* (Foster & Kurta 1999); pin oak (*Quercus palustris),* American elm *(Ulmus americana),* cottonwood (*Populus deltoids),* honey locust *(Gleditsia triacanthos),* shagbark hickory (*Carya ovata*), and shellbark hickory (*Carya laciniosa*) (Timpone *et al* 2010); white birch (*Betula papyrifera*) black spruce (*Picea mariana*), and balsam fir (*Abies balsamea)* (Parks & Broders 2012); and sassafras (*Sassafras albidum*) (Britzke *et al* 2015, Silvis *et*

al 2015). Northern Long-eared Bat have been found to use live roost trees 11-53% of the time (USFWS 2013), including thin-barked live trees (Carter & Feldhamer 2005), which may reflect roost availability and competition with sympatric bat species (Perry & Thill 2007, USFWS 2013, Burrell & Bergeson 2022).

Northern Long-eared Bat roosts can vary considerably in canopy cover, distance above ground, and stem diameter (Lacki *et al* 2009). Northern Long-eared Bat have been found to prefer crevices and cavities of small diameter trees 88.6% more than Indiana bats (Lacki *et al* 2009), though roost trees tend to be slightly taller and in plots with more snags than available on average (Burrell & Bergeson 2022). Maternity colonies are generally in more open areas than male roost sites (Perry & Thill 2007, USFWS 2013), such as in canopy gaps (Johnson *et al* 2009), and lactating females choose significantly larger-diameter trees than non-reproductive females (Park & Broders 2012). Reproductive females also require broader areas of suitable habitat (Broders *et al* 2006) offering a large network of roost sites to suit their dynamic needs (Garroway & Broders 2007), underscoring the importance of maintaining a variety of suitable roost trees for this species (Garroway & Broders 2007, Garroway & Broders 2008, Henderson & Broders 2008). For example, warmer sun-exposed roosts are selected to speed gestation and increase lactation, while cooler roosts can reduce the bats' energy costs by promoting torpor or delay parturition until environmental conditions are more favorable (Garraway & Broders 2008, Henderson & Broders 2008).

Northern Long-eared Bat change roosts every 2-5 days (Foster & Kurta 1999, Caceres & Barclay 2000, Lacki & Schwierjohann 2001, Carter & Feldhamer 2005), with six to 2,000 meters or more between roosts (Arnold 2007, Caceres & Barclay 2000, Timpone *et al* 2010). Members of a colony may roost in separate trees on a given day in a fission-fusion social dynamic (Garroway & Broders 2007). Maternity colonies show fidelity to roosts within (Timpone et al. 2010) and between seasons, suggesting that even the removal of roost trees during fall or winter "safe dates" may increase stress and energy demands on returning females searching for suitable roosts (Arnold 2007).

Numerous studies have found Northern Long-eared Bat to roost more commonly in bottomland/floodplain forests (Carter & Feldhamer 2005, Foster & Kurta 1999, Timpone *et al* 2010, Arnold 2007) or in wetlands where the bases of roost trees are submerged in water, favoring snag creation (Foster & Kurta 1999, Burrell & Burgeson 2022). Timpone *et al* (2010) tracked Northern Long-eared Bat in Missouri and found that, although the study site was 90% upland habitat, 85% of roosts were in riparian forest. Similarly, studies in Illinois, Indiana and Michigan found that Northern Long-eared Bat preferred roosting in floodplain and riparian forest when both upland and lowland habitats were available (Carter & Feldhamer 2005, Burrell & Bergeson 2022, Foster & Kurta 1999). For reproductive females especially, having access to a variety of roosts adjacent to foraging habitat and near water can minimize energy demands associated with travel between sites (Henderson & Broders 2008).

Home Range: Radio-tracked females have had home ranges of 19-172 ha (Lacki *et al* 2009), with an average of around 65 ha (USFWS 2013). The typical summer home range

is within 4.8 km (3 mi) from a capture location or within 2.4 km (1.5 mi) of a roost (USFWS 2014).

Migration: Northern Long-eared Bat generally migrate 48-80 km (30-50 mi) between their summer home ranges and winter hibernation sites, but migrations of 8-270 km (5-168 mi) have been documented (USFWS 2014, Carceres & Barclay 2000). Northern Long-eared Bat breed in late summer and fall but delay fertilization until their emergence from hibernation in spring.

Foraging: Northern Long-eared Bat are insectivores that use echolocation as well as passive listening to forage for prey by hawking (hunting in flight) and by gleaning (taking insects from foliage). This allows for a broader diet than bats that only use hawking, since some insects can detect the echolocation of aerial hawking bats (Caceres & Barclay 2000). By using shorter duration and broader frequency calls, Northern Long-eared Bat also have increased maneuverability to forage in highly cluttered environments (Broders *et al* 2004, Henderson & Broders 2008). Their diets are opportunistic and only limited by the size of prey, which include lepidoptera (moths/butterflies), coleoptera (beetles), neuroptera (lacewings), diptera (true flies), hemiptera (true bugs), homoptera (leafhoppers), and hymenoptera (wasps etc.) (Caceres & Barclay 2000).

Peak foraging times correspond with peak insect activity, during the 2-5 hours following sunset and before sunrise (Caceres & Barclay 2000, USFWS 2013). Most foraging occurs 1-3 m (3-9 ft) above the ground but below the canopy (USFWS 2013). Northern Long-eared Bat are more frequently found foraging in interior forests (Caceres & Barclay 2000, Broders *et al* 2006, Thorne *et al.* 2021) and around small ponds, forest-covered streams, forest edges, roads, and corridors (Brack *et al.* 2022, Caceres & Barclay 2000, Francl 2008, Henderson & Broders 2008, Owen *et al* 2003) compared to open areas and clear-cuts (Hogberg *et al* 2002, Patriquin & Barclay 2003, Carter & Feldhamer 2005, Broders *et* al 2006, Yates & Muzika 2006). By centering their activities along water features and corridors, Northern Long-eared Bat reduce the energetic demands of navigating through complex forest settings (Owens *et al* 2003) while having access to drinking water and higher concentrations of insect prey (Francl 2008, Henderson & Broders 2008).

Northern Long-eared Bat have been found to be ubiquitous at vernal pools and capable of foraging over pools of all sizes (Francl 2008). In a West Virginia study, most Northern Long-eared Bat captures were from upland ephemeral pools (Owens *et al* 2003), and in Massachusetts they were most common in forest patches featuring ephemeral pools and along wooded streams (Brooks and Ford 2005, Broders *et al* 2006). In the New Jersey Pinelands, prior to the onset of white-nose syndrome in 2009, Northern Long-eared Bat were consistently the most frequently caught bat in hardwood/Atlantic white cedar (*Chamaecyparis thyoides*) swamps and associated lowland forest over a ten-year study at the Atlantic City Airport (pers. comm. Lance Risley). Northern Long-eared Bat caught in mist nets along a creek corridor demonstrated high site fidelity, with over 90% of recaptures being caught at the exact same net location as prior capture (pers. comm. Lance Risley).

Habitat Modification: Northern Long-eared Bat are largely considered a forest-adapted species and are sensitive to the effects of forest fragmentation, as evidenced by the roosting and foraging habits described. In New Jersey, Northern Long-eared Bat occur in the large core forests of northern New Jersey and the Pinelands. However, there are also many records from more fragmented locations across New Jersey's landscape.

For bats in a fragmented landscape, availability of roosts may be a critical limiting resource (Henderson & Broders 2008), and removal of suitable roost trees may have significant effects on reproductive females - who require 3.4 times more foraging area than males (Broders *et al* 2006, Henderson *et al* 2008) - as the added pressure to find suitable roosts increases the cost of reproduction (Arnold 2007, Henderson *et al* 2008). Studies of urban-adjacent Northern Long-eared Bat populations have shown that the species can occur within urbanized environments when suitable habitat exists (Burell & Burgeson 2022, Gorman *et al.* 2022, Thorne *et al.* 2021), with forest patch size being a strong factor in their distribution and success (Henderson & Broders 2008, Thorne *et al.* 2021). In New Jersey, Northern Long-eared Bat populations have been found to occupy forest patches as small as approx. 90 ha (222 acres).

Outside of large forest complexes, several Northern Long-eared Bat sightings come from riparian corridor habitats through urbanized landscapes in various parts of the state, including Atlantic, Burlington, Camden, Gloucester, Mercer, Middlesex, Monmouth, Ocean, Passaic, and Salem Counties (NJDEP Fish and Wildlife Biotics Database 2021). In almost all cases, the urban-adjacent habitats occupied by Northern Long-eared Bat are not isolated but are connected with other core forest habitats via wooded riparian buffers and other as-yet undeveloped corridors illustrated in NJDEP Fish and Wildlife's Connecting Habitat Across New Jersey (CHANJ) mapping tool (accessed on January 31, 2023), underscoring the importance of forest habitat connectivity corridors for this species.

For example, from 2016-2021 at least seventeen northern long-eared bats were submitted to the NJ Department of Health's Rabies Lab because of possible exposure to people or pets inside homes or other buildings (NJDEP Fish and Wildlife Biotics Database 2021). Most of these locations fall either within or a short distance outside of narrow CHANJ-mapped habitat corridors (NJDEP Fish and Wildlife CHANJ Web Viewer, accessed on January 31, 2023), suggesting that where adequate habitat and habitat connectivity "run out," northern long-eared bats are more apt to seek out suboptimal alternative roosts. Compared to Northern Long-eared Bat occurrences in tree roosts, those found inside human residences or roosting on structures have been proximate to more highly fragmented patches of forest, generally less than approx. 75 ha (185 acres) in size, and/or stream corridors with approx. 90-450 (300-1,500 ft) buffer width or less. Conversely, a cluster of Northern Long-eared bat locations in northwestern Burlington, Camden, and Gloucester counties where active season sightings and a roost location occur within a highly urbanized landscape. Sightings here are associated with small stream corridors and isolated forest patches otherwise cut off from more prime habitat associated with the Pinelands National Reserve suggesting that bats are not precluded from roosting or

foraging in patchy forest/narrow stream corridor habitat in a highly urbanized area of the landscape.

Overall, these data suggest that a habitat protection strategy which seeks to minimize impacts to core forest habitat and maintain stream corridor integrity and connectedness would best protect the necessary roosting and foraging habitat for Northern Long-eared Bat in New Jersey.

Survey Methodology: Summer Presence/Absence Surveys: Surveys may be conducted from May 15 to August 15 and should follow the U.S. Fish and Wildlife Service Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines: http://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html

The fall swarming/foraging period begins in mid-August and extends into mid-November, depending on annual local weather conditions (USFWS 2013). Harp trapping or mist-netting at hibernaculum entrances may be done during the fall since bats tend to forage around the entrances prior to hibernation. Unless in an area with a high amount of bat activity, the same site should not be sampled more than one night consecutively, or even seasonally, since bats have avoided nets on the second night. Radiotelemetry may also be used to track movements and foraging ranges.

Additional information on survey techniques and time frames may be obtained from the U.S. Fish and Wildlife Service or NJDEP Fish and Wildlife:

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Regulatory Guidelines:

Area of Documentation: Principally, Northern Long-eared Bat habitats mapped in Landscape Project Version 3.3 and subsequent amendments that have a feature label of "Hibernaculum," "Maternity Colony" or "Roost Site" will be considered to meet the exceptional resource value classification requirement of documentation due to their importance to the species. Habitats mapped under the "Active Season Sighting" or "Inactive Season Sighting" feature label will also be considered documented because of their likely proximity to roost sites and the importance of foraging habitat to reproductive success and to preparation for/recovery from hibernation but individual sites will be evaluated on a case-by-case basis.

Suitable Habitat: When assessing whether an area is suitable habitat for Northern Long-eared Bat, it is necessary to examine the quantity and quality of contiguous habitat, the presence and quality of a stream/riparian area or open water habitat, including vernal pools, and the distance from known occurrences such as capture locations. The following conditions are ideal in terms of foraging areas and roost sites; however, it is possible for suitable sites to not meet all these criteria:

1. Hibernacula

Northern Long-eared Bat hibernacula includes caves, abandoned mines, and, to a lesser extent, features like abandoned railroad tunnels, buildings, attics and basement crawl spaces. These winter refuges provide relatively stable above-freezing temperatures of 32 to 48°F and high humidity, allowing the bats to minimize energy demands from thermoregulation (USFWS 2013, Dowling & O'Dell 2018). Specifically, Northern Long-eared Bat are often found within deep cracks and crevices in the ceilings and walls of hibernacula with only their noses and ears exposed (USFWS 2013). They have also shown a preference for hibernating in higher humidity and cooler temperature microclimates than little brown bats (*Myotis lucifugus*) (Caceres & Barclay 2000, USFWS 2013).

2. Roost Sites

Roost selection is opportunistic, and Northern Long-eared Bat have demonstrated flexibility in roost tree size, type and species (see Habitats and Life History: Roosting Habitat). Northern Long-eared Bat roost mainly in crevices, cavities, hollows, and under exfoliating bark in live or dead trees of ≥3 in dbh (USFWS 2014), frequently within cluttered forest environments and at varying heights above the ground. In areas with both upland and lowland habitats, Northern Long-eared Bat display preference for roost sites in riparian zones and bottomland/floodplain forests (Carter *et al* 2005, Foster & Kurta 1999, Timpone *et al* 2010, Arnold 2007) or in wetlands where the bases of roost trees are submerged in water, favoring snag creation (Foster & Kurta 1999, Burrell & Burgeson 2022).

While roost trees are generally selected relative to their abundance on the landscape (Britzke *et al* 2015), they tend to be slightly taller and in plots with more snags than available on average (Burrell & Burgeson 2022). Radio-telemetry studies have found Northern Long-eared Bat using some species more than expected, including green ash and pin oak snags (Carter & Feldhamer 2005, Foster & Kurta 1999), sassafras (Britzke *et al* 2015, Silvis *et al* 2015), balsam fir (Broders & Park 2012), and black locust snags (Johnson *et al* 2009, Menzel *et al* 2002, Gorman *et al* 2022), or less than expected, such as sugar maple (Britzke *et al* 2015), sweetgum snags (Carter & Feldhamer 2005), and American elm (Foster & Kurta 1999) relative to availability.

In general, maternity colonies are in more open areas than male roost sites (Perry & Thill 2007, USFWS 2013), and lactating females choose significantly larger-diameter trees than non-reproductive females (Park & Broders 2012). Maternity colonies of Northern Long-eared Bat are more common in intact forests with more clutter and decay and in

bottomland forests compared to Indiana bat maternity colonies, and they use a greater variety of trees, including thin-barked live trees (Carter & Feldhamer 2005).

Foraging

Northern Long-eared Bat are insectivores that both hawk and glean a variety of insect groups and may only be limited by prey item size. Individuals are frequently found foraging in interior forests (Caceres & Barclay 2000, Broders *et al* 2006, Thorne *et al.* 2021) and around small ponds, forest-covered streams, vernal (ephemeral) pools of all sizes, and corridors (Brack *et al.* 2022, Caceres & Barclay 2000, Francl 2008, Henderson & Broders 2008, Owen *et al* 2003). As with other bat species, riparian zones are considered critical resource areas for Northern Long-eared Bat because they support higher concentrations of prey, provide drinking water, and act as unobstructed commuting corridors (Francl 2008, Henderson & Broders 2008).

Special Considerations: Habitat patches valued by the "Active Season Sighting" and "Inactive Season Sightings" feature label largely consist of positive identifications of Northern Long-eared Bat from mist-netting captures, opportunistic sighting reports (including NJ Department of Health Rabies Lab records) and, to a lesser extent, acoustic bat surveys. When evaluating habitat valued by these designations, the Department will make case by case determinations based on associated sightings and habitat quality. The Department may also request presence/absence surveys in mapped "Active Season Sighting" wetlands and/or for projects with suitable foraging or roosting wetland habitats that will result in the clearing of 10 or more acres of suitable habitat (including uplands) in jurisdictional areas within the Northern Long-eared Bat's New Jersey range.

The Department may also impose tree clearing restrictions under the following conditions:

1. Tree removal within jurisdictional areas between ¼ mi and 5 mi (0.4 – 8.3 km) of a hibernaculum is subject to a 4/1 to 11/15 timing restriction (*i.e.* clearing may only occur during the bats' inactive season, from 11/16 to 3/31);

2. Any permitted clearing of suitable roosting habitat within jurisdictional areas is subject to a 4/1 to 9/30 timing restriction (*i.e.* clearing may only occur from 10/1 to 3/31).

Rationale: A review of Landscape Project mapping for the Northern Long-eared Bat reveals that 71,190 acres of wetland habitat occur within the species' overall mapped habitats, approximately 99% of which are wooded wetlands. In addition, existing records show 25 out of 55 (45%) roost trees occurred in wetland areas and 38 out of 159 (24%) documented sightings come from wetland habitats. Many of the roost tree species used by Northern Long-eared Bat are species which occur in wetlands or wetland buffers in New Jersey. Northern Long-eared Bat site fidelity and tendency to switch roosting and maternity colony sites many times during a single active season emphasize the importance of protecting contiguous forest to protect roosting and breeding Northern Long-eared Bat. Given this species' strong preference for bottomland, floodplain and

riparian forest habitats, vernal pools and other wooded wetlands, designating wetlands which feature suitable roosting or foraging habitat for this species as being of exceptional resource value will serve to protect critical wetland and adjacent upland habitat for the Northern Long-eared Bat.

Comments:

The USFWS may require tree clearing timing restrictions over a broader range of New Jersey than presented in the Landscape Project Mapping. It is recommended that applicants consult the USFWS New Jersey Field Office for additional information. https://www.fws.gov/office/new-jersey-ecological-services

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Species: **Odonates**

Status: **State Endangered**

Gray Petaltail (*Tachopteryx thoreyi*)

Threatened

Banner Clubtail (*Gomphus apomyius*)
Brook Snaketail (*Ophiogomphus aspersus*)
Harpoon Clubtail (*Gomphus descriptus*)
Kennedy's Emerald (*Somatochlora kennedyi*)
Robust Baskettail (*Epitheca spinosa*)
Superb Jewelwing (*Calopteryx amata*)

Gray Petaltail (*Tachopteryx thoreyi*)

New Jersey Distribution: Reported sporadically from the highlands, ridge & valley, and northern piedmont; counties Bergen, Passiac, Sussex and Morris.

Description: Gray Petaltails are a large (2.8-3.0 inch), dull gray and black dragonfly. Key identifying characteristics include well separated eyes and long, parallel-sided stigma on the wing (see Barlow et al. 2009 for additional details). Larvae feature short, thick and hairy seven-jointed antennae, quadrate form of the prementum and strongly angulated side margins of the abdominal segments (Needham et al. 2000).
Habitat: Gray Petaltails are commonly associated with mucky seepage areas in mature forests or mossy, wooded fens (Dunkle 2000; MDNR no date; KDWPT 2011). In New York, gray petaltails are found in rocky gorges and glens featuring deciduous or mixed forests (NYNHP 2011). New Jersey sites were forested and typified by an understory dominated by skunk cabbage (*Symplocarpus foetidus*) and ferns. (Barlow et. al. 2009). Unlike many other Odonates, larvae of the gray petaltail are not found in open water but rather in the groundwater-fed mud and associated vegetation of these headwater habitats. Adults occur in nearby forest, where males may fly up and down tree trunks or sunny openings and may also defend territories while seeking foraging females (MDNR no date; DANRD 2005).

Survey Guidance: In New Jersey, gray petaltails have most often been reported from early June to late July. Adults are much more easily identified than larval forms. In suitable habitat, tree trunks can be checked for flying or perching males looking for mates. The species has also been known to land on people clad in brown or gray clothing. Often found in association with Tiger Spiketails (*Cordulegaster erronea*) and Southern Pygmy Clubtails (*Lanthus vernalis*) (Barlow et al. 2009).

Banner Clubtail (*Gomphus apomyius*)

New Jersey Distribution: This species is known to occur in core coastal plain habitats in New Jersey, outside of northern Monmouth and southern Cape May counties.

Description: Banner Clubtails feature a green face without black markings, aqua blue eyes and a brown thorax with light green frontal stripes and brown shoulder stripes (see Barlow et al. 2009 for additional details).

Habitat: In New Jersey, this species is associated with tea-colored, acidic streams with sandy substrates and large accumulations of organic debris (Barlow et al. 2009). In Mississippi, Banner Clubtail habitat is described as small to medium streams with cool water and a sandy/gravel substrate (Haysophill no date).

Survey Guidance: In New Jersey, Banner Clubtails emerge in late April through early May. Adults are active from mid-May through mid-July (Barlow et al. 2009). Species may be observed perching on over-hanging stream-side vegetation or patrolling over water. Males are more commonly observed than females. They are often found in association with Sparkling Jewelwing (*Calopteryx dimidiate*), Blackwater Bluet (*Enallagma weewa*) and Lancet Clubtail (*Gomphus exilix*).

Brook Snaketail (*Ophiogomphus aspersus*) New Jersey Distribution: This riverine-associated dragonfly has been found along the Whippany River in Morris County, the Musconetcong River in Warren and Hunterdon Counties, and the Wallkill River and Flatbrook watersheds of Sussex County.

Description: The Brook Snaketail is a medium-sized dragonfly (1.8-1.9 inches) with bright apple-green coloration and black markings. The thorax has frontal stripes and is mostly green laterally; legs are black and yellow. The abdomen is black and has a bright yellow arrow-shaped dorsal marking (see Barlow et al. 2009 for additional details).

Habitat: In general, Brook Snaketails are associated with clear, sand bottomed streams or rivers with intermittent rapids that are adjacent to woodland riparian habitat (MNHESP 2008a, Paulson 2009). In New York, Brook Snaketails are also associated with rocky substrate streams (NYNHP 2011). In New Jersey this species inhabits clean, relatively quiet or slow-moving streams with an abundance of sandy sediments, and mud banks where the larvae will emerge (Barlow no date Barlow et. al 2009). Individual populations of Brook Snaketail are referred to as colonies due to the limited amount of appropriate habitat in our area. Unlike more common or generalized species, breeding is restricted to relatively small sections of the rivers and streams they inhabit.

Survey Guidelines: In New Jersey Brook Snaketails emerge in the second or third week of May, with adults remaining active through the first week of July. They are most active between 8am and 11am and, for adults, after 6pm. Streamside vegetation, twigs and snags are preferred perch sites (Barlow et al. 2009). They are often associated with the

Harpoon Clubtail (*Gomphus descriptus*) and River Jewelwing (*Calopteryx aequabilis*). They are also documented to share stream habitat requirements with the federally endangered Dwarf Wedgemussel (*Alasmidonta heterodon*); whom they were found to co-exist with it at two locations in New Jersey (Barlow no date).

Harpoon Clubtail (*Gomphus descriptus*)

New Jersey Distribution: This species is only known to the Flatbrook and Paulins Kill River watersheds in Sussex County.

Description: Harpoon Clubtails have a plain gray-green face and eyes that range in color from pale to deep aqua blue or green. The thorax is brown with two pale hook or L-shaped frontal stripes and wide dark brown shoulder stripes. The sides are mostly yellow or green and are divided by two dark brown stripes. The abdomen is mostly black with yellow or green lateral markings (see Barlow et al. 2009 for additional details).

Habitat: In Massachusetts, Harpoon Clubtails inhabit clear, cold-water streams with intermittent sections of rocks and rapids. Pools with accumulated sand or gravel are used by nymphs for burrowing (MNHESP 2008b). In New Jersey, the species appears to show a distinct preference for stream segments with fine-sand substrates (Barlow et al. 2009). Adults may also use surrounding fields and forest clearings for foraging and stream side vegetation and rocks for breeding season perches MNHESP 2008b).

Survey Guidelines: In New Jersey, Harpoon Clubtails emerge during the first week of May and remain active until late June. The peak abundance period appears to be late May to mid-June (Barlow et al. 2009). During this period, adults can best be observed around flowing sections of stream habitats over the water or perched in streamside vegetation or on in-stream rocks.

Kennedy's Emerald (*Somatochlora kennedyi*)

New Jersey Distribution: This species is only known to the Pequest River watershed in Sussex County.

Description: Kennedy's Emerald is a relatively small (1.9-2.1 inches) species with green eyes, a metallic bronze and green thorax and a narrow dark abdomen. Wings are clear except for an amber basal spot on the hind wings (see Barlow et al. 2009 for additional details).

Habitat: In Massachusetts, the species has been found to inhabit small streams and red maple (Acer rubrum) swamps (MNHESP no date). This species has been reported from scattered Adirondack bogs or fens in New York (Donnelly and Novak 2006). In New Jersey, the Kennedy's Emerald is only known to occur within cold water limestone fens and bogs (Barlow et al. 2009). The species is reported to use Shrubby Cinquefoil (*Pentaphylloides floribunda*) and other vegetation for perching.

Survey Guidelines: In New Jersey, Kennedy's Emerald adults have been reported as early as May 31 with a peak abundance in late June (Barlow et al. 2009). In Massachusetts, the species is reported from late May into early July (MNHESP no date). The flight season in Wisconsin is late May to late August with a peak in June (WDNR 2011). Kennedy's Emeralds may be observed perched on wetland vegetation or hovering where they have been reported to pivot in order to observe surrounding areas. The species is also reported to hang vertically from tree and brush branches when not foraging (MNHESP no date).

Robust Baskettail (*Epitheca spinosa*)

New Jersey Distribution: All records for this species in New Jersey have been generated from within the coastal plain counties of Atlantic, Camden, Cumberland, Gloucester, Ocean and Salem. New Jersey is at the northern extreme of this species' range.

Description: The Robust Baskettail features metallic green eyes, a wide, un-tapered abdomen and a thorax with a dense coating of white hair. The species is medium (1.7-1.8 inches) in size (see Barlow et al. 2009 for additional details).

Habitat: In general, the Robust Baskettail occurs in floodplain swamps, marshes adjacent to rivers or streams or woodland ponds (Barlow et al. 2009; Paulson 2009). This species is probably less common in the open water of lakes and ponds (LeGrand No Date). In a study of emergence sites in South Carolina, Worthen (2010) determined that Robust Baskettail larvae favored Water Tupelo (*Nyssa aquatica*), Swamp Tupelo (*N. biflora*) and Green Ash (*Fraxinus pennsylvanica*) bark over trees featuring either flakier or smoother bark for emergence. Adults may feed along forest edges and fields.

Survey Guidelines: Robust Baskettails have been observed as early as mid-April and remain active until Mid-May (Barlow et al. 2009). Males will often fly slow, fluttering patrols during the breeding season.

Superb Jewelwing (*Calopteryx amata*)

New Jersey Distribution: The known range of this species is limited to the Flat Brook drainage in Sussex County.

Description: The Superb Jewelwing is a fairly large (2-2.2 inch) damselfly. The head, thorax and abdomen are a brilliant metallic green. Males have clear wings with a brown tip on the hindwings; females have amber-to-clear wings with a small white pseudostigma on each wing (American Insects 2011).

Habitat: In New Jersey, Superb Jewelwings are associated with clean, fast-moving streams with dense surrounding forest and abundant aquatic vegetation (Barlow et al. 2009). Both sexes make extensive use of stream-side vegetation where they may perch on alders (*Alnus* spp.) or other herbaceous species (American Insects 2011; Paulson 2011).

Survey Guidelines: In New Jersey, Superb Jewelwing adults are active from June through mid-July, when they can be observed chasing each other during territorial disputes (males) or perched on stream-side vegetation in sun-lit openings. In New York, associated odonate species include Brook Snaketails (*Ophiogomphus aspersus*), Extra-striped Snaketail (*Ophiogomphus anomalus*), Pygmy Snaketail (*Ophiogomphus howei*) and Maine Snaketail (*Ophogomphus mainensis*) (NYNHP 2011).

Regulatory Guidelines:

1. Area of documentation: Area of documentation: For Version 3.3, contiguous habitat patches associated with known sightings as described in Appendix II and V of the Landscape Project Map document. See "New Jersey Division of Fish and Wildlife. 2017. New Jersey's Landscape Project, Version 3.3. New Jersey Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program" for more details.

2. Suitable habitat: Refer to the habitat discussions provided above. For stream-associated species the documented stream itself and adjacent emergent, scrub-shrub or forested wetlands will be evaluated.

Rationale:

All of the Odonate species discussed above are dependent on "clean" water for their existence. In addition, most species are documented to use stream-side vegetation during emergence or for resting, foraging and, in some cases, these areas are components of breeding territories. In addition, adjacent forest, and occasionally fields, may be used directly by several species for foraging and/or play a secondary role in maintaining core habitat water quality. The designation of wetlands directly associated with core stream or pond habitats as being of exceptional resource value will provide primary protection to habitat critical for "breeding, resting or feeding" for most of the above referenced species. In addition, the establishment of 150ft wetland transition areas will serve to protect secondary forest or field habitat and serve to minimize secondary impacts to water-body hydrology and water quality. In the case of the Gray Petaltail, the designation of seepage wetlands as being of exceptional resource value and the establishment of 150ft transition areas will directly protect core habitat and also minimize secondary impacts to water quality and the hydrological regime of the species' seepage wetland habitat.

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Name: ***Aeschynomene virginica*** **(L.) Britton, Sterns & Poggenb. (Sensitive Joint-Vetch)**

Status: **Federally threatened.**
State endangered.

New Jersey Distribution:
The Natural Heritage Program maintains extant element occurrence records for *Aeschynomene virginica* along the Wading River in Burlington County and the Manumuskin River in Cumberland County. However, herbarium records exist for *A. virginica* in Atlantic, Burlington, Camden, Cape May and Salem Counties of the State (NJNHP Database 2009), and botanists familiar with the species agree that more populations likely exist in New Jersey.

Description:
A. virginica is an annual legume that reaches a height of one-to-two meters (3.28-6.56 ft) (USFWS 1992b). The plant typically features a single main stem that may branch near the top. Stems, petioles, and seed pods all exhibit weak bristles (Gleason and Cronquist 1991). Leaves are oddly-pinnate (compounded) and are 2-12 cm (0.8-4.8 in) long. Each leaf consists of 31-57 leaflets, which are between 0.8-2.5 cm (0.16-1 in) long and 0.2-0.4 cm (0.08-0.16 in) wide (USFWS 1992b). The irregular small yellow flowers are streaked with red veins and grow in racemes. Flowering usually begins in late July and continues through September while fruiting usually begins in August and continues until the first frost (USFWS 1992a). The fruit resembles a pea-like pod with four to ten segments and is also bristly (Tiner 1987).

Habitat:
Throughout its range, *A. virginica* occurs across a gradient of fresh-to-oligohaline tidal river marshes (Beldon and van Alstine 2003). Plants have been reported along creek banks, interior marsh plains, and marsh-upland ecotones (Tyndall 2011, USFWS 1995). This species typically grows on organic mucky soils, but has also been reported as growing on sandy to gravely shores as well as banks of drainage ditches (Fansworth 2010).

A. virginica typically occurs as patches (subpopulations) amongst herbaceous marsh vegetation communities where seeds from the previous season have settled. Associated vegetation typically includes *Zizania aquatica* (wild rice), *Amaranthus cannabinus (*tidal-marsh water-hemp*), Bidens laevis* (smooth beggartick), *Sium suave* (water parsnip), *Peltandra virginica* (arrow-arum), and *Polygonum punctatum* (dotted smartweed) (Ferren 1976, D. Kunz, personal observation 2011). Woody vegetation including *Rosa palustris* (swamp rose), *Alnus serrulata* (hazel alder) and *Cephalanthus occidentalis* (common buttonbush), among others, have been associated with *A. virginica* near upland/wetland ecotones. Table 1 contains a larger list of associated plant species.

Survey Methodologies:
Surveys for *A. virginica* should be performed by botanists or professionals that can demonstrate extensive knowledge of and experience working with the species. Surveys for this species may be required by the Division where suitable habitat is present on site and there are records for the species within the same or an adjacent tidal system (*i.e.* at the HUC 11 scale). When surveys are required for the species, documenting the absence of *A. virginica* from a site should include a

minimum of 3 surveys evenly spaced throughout the flowering period. In situations where *A. virginica* is documented on site, monitoring may be required for multiple years (see Discussion) in order to demonstrate that the species or its habitat will not be impacted by the proposed activities.

Table 1. Plant species associated with *Aeschynomene virginica*.

Scientific Name and Authority	Common Name
Alnus serrulata (Aiton) Willd.	Smooth Alder
Amaranthus cannabinus (L.) J.D. Sauer	Tidalmarsh Amaranth
Apios americana Medik.	Groundnut
Bidens laevis (L.) Britton, Sterns & Poggenb.	Smooth Begger's Tick
Bidens cernua L.	Nodding Beggartick
Carex stricta Lam.	Tussock Sedge
Cephalanthus occidentalis L.	Common Buttonbush
Cicuta maculata L.	Water Hemlock
Cinna arundinacea L.	Sweet Woodreed
Dulichium arundinaceum (L.) Britton	Threeway Sedge
Echinochloa walteri (Pursh) A. Heller	Coastal Cockspur Grass
Hibiscus moscheutos L.	Rose Mallow
Hypericum mutilum L.	Dwarf St. Johnswort
Impatiens capensis Meerb.	Jewelweed
Juncus acuminatus Michx.	Tapertip Rush
Kosteletzkya virginica (L.) C. Presl ex A. Gray	Seashore Mallow
Leersia oryzoides (L.) Sw.	Rice Cutgrass
Lobelia cardinalis L.	Cardinalflower
Oxypolis rigidior (L.) Raf.	Stiff Cowbane
Peltandra virginica (L.) Schott	Arrow-Arum
Polygonum arifolium L.	Halbeard-leaf Tearthumb
Polygonum hydropiperoides Michx.	Mild Water-pepper
Polygonum punctatum Elliott	Dotted Smartweed
Polygonum sagittatum L.	Arrow-leaf Tearthumb
Pontederia cordata L.	Pickerel Weed
Rosa palustris Marsh.	Swamp Rose
Sagittaria latifolia Willd.	Broadleaved Arrowhead
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla	Softstem Bulrush
Scutellaria lateriflora L.	Blue Skulcap
Sium suave Walter	Water Parsnip
Spartina cynosuroides (L.) Roth	Big Cordgrass
Typha angustifolia L.	Narrowleaved Cattail
Zizania aquatica L.	Annual Wildrice

(Ferren 1976, Ferren and Schuyler 1980, Bruderle and Davison 1984, Tyndall *et al.* 1996, Tyndall 2011, Kunz, D. M. personal observation 2011; taxonomy follows USDA Plants Database, accessed February 2012).

Surveys should be performed by way of a flat bottom boat (*i.e.* not a kayak or canoe) in which the surveyor is able to safely stand-up and view the marsh plain with binoculars (Tyndall 1996). Surveys conducted by boat should be performed within two hours of high tide (*i.e.* a four-hour window) so as to maintain an elevated line-of-sight across the marshplain. Surveys may also be

performed on land from an elevated vantage point directly adjacent to the site (*e.g.* a road embankment, bridge or building) using binoculars when appropriate (*e.g.* small sites). Because *A. virginica* is often associated with soft, mucky substrates, penetrable to the knee or waist, surveys by foot should be avoided to preclude impacting the species or its habitat. Botanists are encouraged to follow the Department's "Suggested guidelines for conducting endangered, threatened, or rare plant surveys" located in Appendix II.

Office of Natural Lands Management Contact:

Office of Natural Lands Management, Natural Heritage Database.
(609) 984-1339.

Regulatory Guidelines:

1. Area of Documentation: Wetlands or a wetland complex documented in the New Jersey Natural Heritage Program database. This determination may include contiguous wetland habitat upstream and downstream of the documented population as well as freshwater wetlands adjacent to tidal wetlands.

2. Suitable Habitat: Suitable habitat for *A. virginica* consists of fresh to oligohaline tidal wetlands featuring a species composition consistent with or similar to the species identified in Table 1.

Comments:
Due to its association with tidal systems, *A. virginica* habitat is primarily situated seaward of the Upper Wetland Boundary Line in New Jersey; an area regulated pursuant to the Wetlands Act of 1970 (N.J.S.A. 13:9A), Coastal Area Facility Review Act (CAFRA) (N.J.S.A. 13:19), and Section 404 of the Clean Water Act. Because of this, few wetlands featuring *A. virginica* will fall under the jurisdiction of the Freshwater Wetlands Protection Act (FWPA) (N.J.S.A. 13.9B). If a wetland featuring suitable habitat is not mapped on the 1977 Tidelands Basemaps, it will be regulated under the purview of the FWPA Rules. In such cases, the extent of wetland habitat designated for an exceptional resource value classification will vary due to site-specific characteristics of the habitat present, including the vegetation community, human or natural intrusions or disturbances, and the history, if available, of the species at that location. As a result, each wetland classification will be established on a case-by-case basis by the Department after an office and/or field evaluation of these characteristics. When feasible, the Department will attempt to reconfirm the presence of the species known historically (*e.g.* last observed > 20 years ago) from an area prior to establishing a regulatory designation.

Rational:
Threats to the species include shoreline stabilization projects, channel dredging, waterfowl impoundments, road construction, commercial or residential development, filling of wetlands, competition from the non-indigenous *Phragmites australis* and groundwater withdrawal projects (USFWS 1992a). Sedimentation and reduced water quality may lead to conditions which favor more competitive perennial species over *A. virginica* and lead to the displacement of the species from existing habitats (USFWS 1995). Factors identified as critical to the preservation of local

populations of this species include the protection of documented habitat from direct impacts, maintenance of existing water quality, the establishment of sufficient upland buffers (Bruderle and Davison 1984) and the ability of its populations to migrate landward as sea-level rises (Tyndall 2011). The designation of freshwater wetlands associated with documented populations of this species as being of exceptional resource value may provide additional protection from both direct and indirect impacts to *A. virginica* and establish 150-foot standard transition areas adjacent to these habitats to mitigate secondary impacts.

Discussion:
The New Jersey Natural Heritage Program Database maintains nine overall records for *A. virginica* in the State. However, only two of those records are believed to be extant: one on the Manumuskin River (last observed 2011); and the other on the Wading River (last observed in 1984). To date, there has been only one documented range-wide survey for *A. virginica* in New Jersey since its listing. This survey, reported by Hill (1992), encompassed ten river systems and identified suitable habitat in all but one. Regrettably, it failed to locate any additional occurrences of the species and was limited to only one single growing season. Despite these findings, local botanists believe that *A. virginica* is likely present, though elusive, in other tidal freshwater river systems of the State (Ferren and Schuyller 1980, Hill 1992, David Snyder NJNHP, personal comm.). Cover by taller associated vegetation, inaccessibility of tidal-freshwater marshes for surveying, and a lack of consistent annual surveys are attributed to the small number of extant occurrences in New Jersey. The present understanding of this species would clearly benefit from a multi-year survey of select river systems.

A. virginica is typical of other tidal-freshwater annuals that have long been documented to exhibit large fluctuations in population size including ephemeral disappearances from year to year (Tyndall 2011, Griffith and Forseth 2002, Baldwin *et al.* 2001, Leck and Simpson 1995, Odum 1988, Simpson *et al.* 1983, Shreve *et al.* 1910). Thus, low census numbers or the absence of the species previously documented on a particular site does not necessarily indicate that a population is in decline or has become extirpated (Tyndall 2011).

In 1995 the USFWS Recovery Plan suggested that *A. virginica* was "generally found on substrates that are sparsely vegetated due to natural disturbances caused by storms, ice scour, accreted sediment or muskrat eat-outs." However, after monitoring two populations of *A. virginica* on an annual basis over an 18-year period in Maryland, Tyndall (2011) observed the species occurring regularly amongst its seemingly more competitive associates and was rarely restricted to disturbed patches. Tyndall (2011) suggests that earlier descriptions by the USFWS (1995) of the species and its habitat may have been extrapolated from subjective observations.

On a final note, *A. virginica* is morphologically similar to Indian Joint-vetch *(A. indica)* and Zigzag Joint-vetch *(A. rudis)*. *A. indica* is a problematic agricultural pest plant of southeastern North America. *A. rudis* appears to be less problematic but also associated with anthropogenic disturbances in the southeastern portions of North America. Unfortunately, the name *A. virginica* continues to be miss-applied in peer-reviewed agricultural literature, despite a study by Carulli and Fairbrothers (1988) that demonstrated significant allozymic distinctions and the inability of the three species to hybridize with one another. A taxonomic manual should be

referenced to distinguish between the three species: Weakley's "Flora of Southern and Mid-Atlantic States" (2011) is recommended.

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Name: *Helonias bullata* L. (Swamp Pink)

Status: Federally threatened.
State endangered.

New Jersey Distribution:

Helonias bullata is documented in a variety of geomorphic settings across an extensive geographic range, from northeastern Georgia, and historically to Staten Island, NY. In New Jersey, *H. bullata* is documented in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer (historic), Middlesex, Monmouth, Morris, Ocean, and Salem Counties. The State features approximately 61% of the world's population of this species, which is most abundant on the Atlantic Coastal Plain (USFWS 2008). Stone (1911) described *H. bullata* as one of the most characteristic plants of the southern half of New Jersey. The species' northern most limit appears to be the terminal moraine of the Wisconsin Glacier. This is represented by two records: one historic occurrence from Morris County, NJ in the Highlands physiographic province; and one historic record on the glaciated coastal plain of Staten Island, NY (D. Kunz, personal observation 2011). *H. bullata* is not documented in the Piedmont physiographic province throughout its range (USFWS 2008).

Description:

H. bullata is a perennial herb characterized by an evergreen basal rosette that emanates from a spreading tuberous rhizome. Leaves are elongate-spatulate to oblanceolate with an acute tip, and they exhibit parallel veines and entire margins. Leaves measure between 9-25 cm (4-10 in) in length and 2-4 cm (0.8-1.6 in) in width (USFWS 1991). In early spring (mid-to-late April) a scape with few scale-like leaves may protrude from the center of the rosette attaining a height of 30 cm to 1 m (12-36 in) (Gleason and Cronquist 1991). The inflorescence consists of 30-50 pink flowers with blue anthers in a single terminal raceme. Most plants do not flower every year. During winter, the leaves of *H. bullata* lie flat or slightly raised from the ground and may be obscured by leaf litter (Torok, L. S., personal observation 1996). New growth in the spring is generally bright green and shiny. Leaves often turn a maroon-red color in the winter.

Habitat:

Perhaps the most important factor affecting the occurrence of *H. bullata* is the hydrologic regime of the wetlands that it occupies. Throughout its range, *H. bullata* is associated with forested headwater complex (<4th order) riverine wetlands (*sensu* Brooks *et al.* 2011) exhibiting perennial saturation and slow, lateral movement of groundwater. Rawinski and Cassin (1986) observed the species restricted to groundwater-influenced seepage swamps that are rarely, if ever, inundated by floodwaters. Sutter (1982) found the water table in these habitats to be at or very near the surface and to fluctuate only slightly during spring and summer months.

The soils where *H. bullata* is found tends to be very high in organic matter, mucky and acidic; pH has been reported within the range of 3.5 to 5.7 (Scagnelli 2006, Peterson 1992, Sutter 1982).

Depth of organic soil ranges from relatively thin (1-5 cm) (Sutter 1984) to very deep (>1 m) (Laidig *et al.* 2009).

Hummock and hollow micro-topography are a common characteristic of many *H. bullata* populations. In a study of two populations situated in undeveloped headwaters of the New Jersey Pinelands, Laidig *et al.* (2009) found that rosettes were most abundant between 5 and 10 cm above the two-year median water level. Similarly, rosettes were generally situated on the uppermost portions of hummocks. Rosettes also occupy mineral soil flats on the periphery of populations. However, these peripheral rosettes are often smaller and less abundant presumably because they are more vulnerable to herbivory by white-tailed deer (*Odocoileus virginianus*) (D. Kunz, per. observation 2011, Kelly, J. F. personal communication 2011).

H. bullata occurs in open-to-closed canopy deciduous- or evergreen-dominated forested wetlands. In New Jersey, the species is commonly associated with *Acer rubrum* (red maple), *Nyssa sylvatica* (black/sour gum), *Chamaecyparis thyoides* (Atlantic white cedar), and *Pinus rigida* (pitch pine) dominated forests (Johnson 1990; Peterson 1992). Associated understory species include *Clethra alnifolia* (sweet pepperbush), *Kalmia latifolia* (mountain laurel), *Magnolia virginiana* (sweetbay magnolia), *Ilex opaca* (American holly), *Orontium aquaticum* (golden club), *Carex folliculata* (long sedge), *C. atlantica* (prickly bog sedge), *C. collinsii* (Collins sedge), *Symplocarpus foetidus* (skunk cabbage), *Vaccinium* spp. (blueberry), *Smilax rotundifolia* (greenbriar), and *Sphagnum* spp. (sphagnum moss). At least one northern New Jersey site features *Picea mariana* (black spruce) and *Larix laricina* (American larch). A range-wide list of associated vegetation can be found in Table 1.

Survey Methodologies:

Surveys for *H. bullata* should be performed by botanists or professionals that can demonstrate extensive knowledge of and experience working with the species. While the species is identifiable year-round, it is best to perform surveys in the early spring (April 15th through May 15th) when the species flowers and early fall (September 1st through October 15th) when the species is in full foliage. Caution should be used if surveys are attempted outside of the above survey windows. In the fall and throughout winter, leaf litter and snow may cover rosettes. During the late spring and summer months, associated vegetation (*e.g.* skunk cabbage) may obscure plants. Botanists are encouraged to follow the Department's "Suggested guidelines for conducting endangered, threatened, or rare plant surveys," located in Appendix II.

Office of Natural Lands Management Contact:

Office of Natural Lands Management, Natural Heritage Database.
(609) 984-1339.

Table 1. Plant species associated with *Helonias bullata*.

Scientific Name	Common Name
Acer rubrum L.	Red Maple
Alnus serrulata (Aiton) Willd.	Red Alder
Symphyotrichum puniceum (L.) Á. Löve & D. Löve var. *puniceum*	Purple-stemmed Aster
Eurybia radula (Aiton) G.L. Nesom	Rough-leaved Aster
Carex atlantica L.H. Bailey	Prickly Bog Sedge
Carex collinsii Nutt.	Collin's Sedge
Carex folliculate L.	Long Sedge
Carex muricata L.	Lesser Prickly Sedge
Chamaecyparis thyoides (L.) Britton, Sterns & Poggenb.	Atlantic White Cedar
Clintonia borealis (Aiton) Raf.	Yellow Clintonia
Coptis trifolia (L.) Salisb.	Gold Thread
Equisetum sylvaticum L.	Woodland Equisetum
Ilex ambigua (Michx.) Torr.	Carolina Holly
Ilex verticillata (L.) A. Gray	Winterberry
Kalmia latifolia L.	Mountain Laurel
Larix laricina (Du Roi) K. Koch	American Larch
Lindera benzoin (L.) Blume	Spicebush
Lycopus virginicus L.	Virginia Bugleweed
Magnolia virginiana L.	Wweetbay Magnolia
Nyssa sylvatica Marsh.	Black Gum
Orontium aquaticum L.	Golden Club
Osmunda cinnamomea L.	Cinnamon Fern
Picea mariana (Mill.) Britton, Sterns & Poggenb.	Black Spruce
Picea rubens Sarg.	Red Spruce
Pinus rigida Mill.	Pitch Pine
Pinus strobus L.	White Pine
Rhododendron arborescens (Pursh) Torr.	Smooth Azalea
Rosa palustris Marsh.	Swamp Rose
Sambucus nigra L. *ssp. canadensis* (L.) R. Bolli	Elderberry
Sphagnum L. spp.	Sphagnum Moss
Symplocarpus foetidus (L.) Salisb. ex Nutt.	Skunk Cabbage
Tsuga canadensis (L.) Carrière	Eastern Hemlock
Viburnum nudum L.	Possumhaw
Vaccinium corymbosum L.	Highbush Blueberry

(USFWS 1991, D. Kunz, personal observation 2011; taxonomy follows USDA Plants Database, accessed February 2012).

Regulatory Guidelines:

1. Area of Documentation: Wetlands or a wetland complex known to feature a documented occurrence of the species. This determination will include contiguous wetland habitat upstream and downstream of the documented population.

2. Suitable Habitat: Suitable habitat for *H. bullata* consists not only of the wetland habitat occupied by the species, but also additional habitat necessary to preserve the subtle hydrologic regime and vegetative community structure characteristic of the habitat occupied by the species. To this end, suitable habitat will also include:

a. contiguous upstream/downstream wetland habitat to a distance sufficient to ensure that the existing hydrologic regime is maintained. This determination will be made on a case-by-case basis regardless of changes in vegetation; and
b. the extent of contiguous upstream/downstream wetland habitat featuring a vegetative community composed associated plant species described above.

Comments:

In situations where two or more distinct populations occur along a single stream corridor/wetland complex, the Department will consider the habitat in between the farthest upstream and downstream extent of the species as documented habitat. The criteria for suitability described above will be applied to the farthest upstream and downstream plants to ensure overall protection of the entire population.

For each known location of *H. bullata*, the extent of wetland habitat designated for an exceptional resource value classification will vary due to site-specific characteristics of the habitat present, including vegetation community, human or natural intrusions or disturbances, and the history, if available, of the species at that location. When feasible, the Department will attempt to reconfirm the presence of the specific plant species known historically (e.g. last observed > 20 years ago) from an area prior to establishing a regulatory designation.

Also, due to the sensitivity of headwater habitats to perturbations of various forms, the Department strongly discourages direct discharge of stormwater into those habitats. In addition, the USFWS may request upland buffers of greater than 150 feet in situations where they believe the species may be adversely impacted by a particular development. Dodds (1996) suggested that buffers as wide as 95 meters (300 feet) may be required to minimize a variety of primary and secondary impacts resulting from upland development.

Rationale:

Various studies have documented alteration and degradation of wetland communities in developed watersheds (Conner *et al.* 1981; Ehrenfeld 1983; Ehrenfeld and Schneider 1991, Laidig and Zampella 1999, Boggs and Sun 2011). More specifically, Windham and Bredan (2000) found that *H. bullata* was most abundant in sub-watersheds with low proportions of urban land cover and higher proportions of forest cover. Gordon (1989) documented the cumulative impacts of soil erosion and the subsequent invasion of aggressive weed species on four historic

New Jersey *H. bullata* wetlands. Peterson (1992) indicated that populations in "impacted" sites featured fewer and smaller plants, higher levels of mortality, and lower levels of new seedlings when compared to populations in more "pristine" environments. Additionally, *H. bullata* populations are highly susceptible to activities that lower the water table. In at least two instances, the hydrology of *H. bullata* populations was altered following activation of adjacent municipal water wells: (1) Borough of Berlin Well 12 / Clay Hole population (NJDEP 2004); and, (2) Randolph Township / Ironia population (now extirpated) (Snyder, D., personal communication 2009).

The greatest threats to *H. bullata* in New Jersey appear to be alterations to the hydrology of wetlands it inhabits and excess herbivory by deer. Alterations to the hydrology of wetlands supporting *H. bullata* can occur when the headwaters of these habitats are converted to impervious (or less-pervious) surfaces (Windham and Breden 2000). When this happens, precipitation that previously infiltrated the soil is redirected to surface run-off. This hydrologic alteration can lead to localized drawdown of water tables and adjacent groundwater fed wetlands. If surface run-off (*e.g.* stormwater) is directed into *H. bullata* habitats, it further degrades the wetland through either sedimentation, erosion, or both (Gordon 1989). Similarly, regional drawdown of the Kirkwood-Cohansey aquifer resulting from residential groundwater withdrawals presents a credible threat to *H. bullata* populations situated at aquifer discharge points (Laidig *et al.* 2009).

Additional threats to *H. bullata* include alterations to soil water chemistry from urbanization, sedimentation from off-site erosion and stormwater runoff, illegal filling of wetlands, and trampling of plants by humans living in close proximity to populations. Since inception of the Freshwater Wetlands Protection Act, the authors have observed decreases in population size of multiple wetlands and in some cases extirpation, particularly where stormwater outfalls have been constructed upstream. An increase in the State's deer population and concentration of the population to forested corridors in residential communities where *H. bullata* occurs has become a significant threat to the species (Kunz, D. M., personal observation 2011).

Based on these findings, effective long-term protection of *H. bullata* populations requires not only the protection of the immediate habitat around the plants, but also the drainage areas upstream of where they occur (*sensu* Gordon 1989, Whindam and Breden 2000). Similarly, permitting stormwater outfalls downstream of *H. bullata* populations must also be closely scrutinized to prevent hydrologic alterations to the system. The establishment of exceptional resource value wetlands (and their resultant 150 foot transition areas) up- and downstream of the population is necessary to ensure that:

1. Modifications to the existing hydrologic regime of the wetland system are minimized;
2. Impacts to the vegetation community surrounding the plants are minimized;
3. Indirect impacts of development (e.g. sedimentation, dumping, alteration of hydrology, trampling etc.) upon the species and their habitat are minimized; and,
4. Suitable habitat for expansion of the existing population remains available.

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Torok, Larry S., Research Scientist, NJDEP, WLM, Division of Watershed Protection and Restoration, Trenton, NJ.

Name: ***Isotria medeoloides*** **(Pursh) Raf. (Small Whorled Pogonia)**

Status: Federally threatened.
State endangered.

New Jersey Distribution:

Historic records for *I. medeoloides* exist for Bergen, Hunterdon, Passaic and Sussex counties in New Jersey. However, most of these occurrences have since been destroyed or have not been verifiable in recent years. Presently, the species is documented extant at only two locations in Sussex County.

Description:

The small whorled pogonia is a perennial herb standing between 3-30 cm (1.2-5 in) in height. The stem is glaucus (appearing grayish-green due to a thin waxy covering) and is glabrous (hairless). A whorl of between 4-6 (usually five) leaves occurs near the top of the stem but below the flower. Leaves are generally also glaucus, slightly oblong and between 2.5-8.25 cm (1-3.5 in) in length. Flowers are zygomorphic (asymmetrical), solitary or paired, greenish-yellow in color and about 1.75-2.5 cm (0.5-1 in) in length. In New Jersey, stems emerge between late April and early May. Flowering occurs in June.

Two similar woodland forbs with whorled leaves are *Isotria verticilata* (large whorled pogonia) and *Medeola virginiana* (Indian cucumber root); both species are more common. *I. verticilata* is distinguishable by its more purplish stem and sepals, darker green leaves, elongated flower stalk, and larger sepals. *M. virginiana* is distinguishable by its more wiry and tomentose (wooly hair) stem, its two whorls of leaves (they are lower, longer and more numerous), its 6 tepaled actinomorphic (symmetrical) dangling yellow flowers, and purple to black fruits. Surveyors should reference regional taxonomic manuals to distinguish the species.

Habitat:

Habitats occupied by *I. medeoloides* are generally described as dry-mesic to wet-mesic featuring intermittent streams and acidic, sandy loam soils (Stewert 1978; Keenan 1988, Mehrhoff 1989a). Soils are commonly underlain by a fragipan, which restricts downward movement of water and encourages overland flow (Vitt 1991, Ware 1991, Mehrhoff 1989a, Rawinski 1986). Slopes are reported to range between 0-30% and are often south- or southeast-facing, particularly toward the northern extent of its range (Mehrhoff 1989a, Rawinski 1986). Two microhabitats have consistently been reported where the species is found: the upper-most rivulets which give rise to small intermittent streams; and deposits of water-sorted leaf debris along "braided" stream channels (Rawinski 1986). Using a GIS, Sperduto and Congalton (1996) developed a chi-squared based predictive model for *I. medeoloides* that incorporated slope, soils with pan layers, and Landsat imagery. They reported 78% success from their model and were able to locate 9 previously undocumented populations in New Hampshire and Maine.

I. medeoloides populations are generally associated with mixed deciduous or mixed evergreen/deciduous forest communities. The species has been observed in successional, second growth and mature forest communities (Rawinski 1986). Associated vegetation is also rather ubiquitous throughout northeastern forests of North America and reveals limited if any indicator species (Mehrhoff 1989a). A listing of plant species typically associated with *I. medeoloides* is provided in Table 1.

The two remaining sites in New Jersey are typified by second-growth mixed evergreen/deciduous forests over Swartswood gravelly loam (Radis 1987). Associated vegetation included *Pinus strobus* (white pine), *Acer rubrum* (red maple), *Quercus alba* (white oak), *Carpinus caroliniana* (ironwood), and resprouting *Castanea dentata (*chestnut), *Thelypteris noveboracensis* (New York fern), *Osmunda cinnamomea* (cinnamon fern), *Lycopodium obscurum* (ground pine), , *Viburnum acerifolium* (maple leaf viburnum), *Cornus florida* (flowering dogwood), *Trientalis borealis* (star flower), *Chimaphila maculate* (spotted wintergreen), and *Podophylum peltatum* (mayapple).

Other factors thought to affect the occurrence of *I. medeoloides* include vegetative density, light, and moisture. Mehrhoff (1980) suggested that dense cover or increased competition from herbaceous associates may have resulted in the decline of some *I. medeoloides* populations. However, a study by Brumback and Fyler (1984) reported, "there seems to be no correlation between herbaceous cover" (competition) "and reproductive class... While it may be true that dense herbaceous cover could certainly limit the size of *I. medeoloides*, in our study several blooming plants appeared in over 60% herbaceous cover."

On the related topic of light, some researchers have suggested that increased light may affect plant vitality (D. Raynor pers. comm. in Rawinski 1986; W.E. Brumback pers. comm. in Rawinski 1986). Conversely, Rawinski (1986) believed that population size is largely dependent on the extent and quality of suitable soils rather than overstory density and basal area or light conditions. However, a recent experiment Brumback et al. (2011) suggests otherwise. Brumback et al. (2011) selectively removed 25% of the basal area of canopy trees present in a declining *I. medeoloides* population, thereby effectively doubling the amount of light reaching the forest floor. In response to the canopy clearing, they reported a doubling in the number of *I. medeoloides* stems over a ten year period, while the adjacent control site population continued to decline. This study is consistent with earlier observations of increases in population size following gypsy moth defoliation (Brackley 1985) and a study by Mehrhof (1989) which found a positive correlation between light levels and population size. The influence of soil moisture on *I. medeoloides* is probably relatively minor though Homoya (1977) reported drought stress to cause dormancy in the species. Brumback et al. (2011) also identified herbivory by *Odocoileus virginianus* (white-tailed deer) as a potential threat to the *I. medeoloides.*

Unfortunately, there have been few ecological studies of *I. medeoloides* since the species was downlisted from endangered to threatened in 1994 (USFWS 2008).

Survey Methodologies:

Surveys for *I. medeoloides* should be performed by botanists or professionals that can demonstrate extensive knowledge of and experience working with the species. *I. medeoloides* is identifiable from late May to mid-September. Where the species has been previously documented, surveys may need to be conducted over a series of years to clearly establish its absence. *I. medeoloides* has been documented to remain dormant for at least two years (W.E. Brumback pers. comm. in Rawinski 1986) and Mehrhoff (1989b) reported that all verified records of dormancy in *I. medeoloides* were for less than three years and that longer periods of dormancy were unlikely. Botanists are encouraged to follow the Department's "Suggested guidelines for conducting endangered, threatened, or rare plant surveys," located in Appendix II.

Office of Natural Lands Management Contact:

Office of Natural Lands Management, Natural Heritage Database.
(609) 984-1339.

Regulatory Guidelines:

1. Area of Documentation: The area of documentation for *I. medeoloides* will be determined based on an assessment of the acreage supporting plants and additional surrounding habitat necessary to support wetland microclimate and hydrology. Larger habitat blocks will be considered in situations where several populations occur within a particular vegetative community. Due to the dormancy characteristic of *I. medeoloides*, it may be necessary to perform surveys for up to three consecutive years on or in the vicinity of known occurrences of the species if it has not recently been observed and if the habitat remains suitable (see *Survey Methodologies* discussion).

2. Suitable Habitat: Wetland habitats which feature a vegetation community largely composed of the species and characteristics described above will be considered as suitable habitat.

Comments:

I. medeoloides is listed as a facultative upland species on the National List of Wetland Plants (Lichvar and Kartesz 2009). Therefore, not all habitats featuring this species may meet the definition of a freshwater wetland. For each known location of *I. medeoloides*, the extent of wetland habitat designated for an exceptional resource value classification will vary due to the site specific characteristics of the habitat present, including vegetation community, human or natural disturbances, and the history, if available, of the species at that location. As a result, each wetland classification will be established on a case–by-case basis by the Department after an in-office and field evaluation of these characteristics. When feasible, the Department will attempt to reconfirm the presence of the specific plant species known historically (e.g. last observed > 20 years ago) from an area.

Rationale:

Wetland habitats featuring *I. medeoloides* are typified by sloping topography and soils which create intermittent surface water drainage features. Ensuring the continuation of these conditions is critical to maintaining existing populations. Rawinski (1986) suggested preserve design should focus on protecting upslope habitats as well as adjacent buffer areas to preserve forest microclimate conditions. The designation of wetlands upslope and around known locales of *I. medeoloides* as being of exceptional resource value will serve both of these purposes.

Table 1. Plant species associated with *Isotria medeoloides*.

Scientific name	Common name
Overstory	
Acer rubrum L.	Red Maple*
Acer saccharum Marsh.	Sugar Maple
Betula papyrifera Marsh.	Paper Birch
Pinus strobus L.	White Pine
Fagus grandifolia Ehrh.	Beech
Populus grandidentata Michx.	Big-toothed Aspen
Quercus alba L.	White Oak
Quercus prinus L.	Chestnut Oak
Quercus rubra L.	Red Oak*
Tsuga canadensis (L.) Carrière	Eastern Hemlock
Understory	
Acer pensylvanicum L.	Striped Maple
Amelanchier arborea (Michx. f.) Fernald	Service Berry
Carpinus caroliniana Walter	Ironwood
Clethra alnifolia L.	Sweet Pepperbush
Hamamelis virginiana L.	Witch Hazel
Viburnum acerifolium L.	Maple Leaf Viburnum
Gound cover	
Aralia nudicaulis L.	Wild Sarsaparilla
Botrychium virginianum (L.) Sw.	Rattlesnake Fern
Chimaphila maculata (L.) Pursh	Spotted Wintergreen
Clintonia umbellulata (Michx.) Morong	White Clintonia
Dennstaedtia punctilobula (Michx.) T. Moore	Hay Scented Fern
Gaultheria procumbens L.	Wintergreen/Eastern Teaberry
Lycopodium obscurum L.	Ground Pine
Maianthemum canadense Desf.	Canada Mayflower
Medeola virginiana L.	Indian Cumcumber Root
Mitchella repens L.	Partridgeberry
Podophyllum peltatum L.	Mayapple/Mandrake
Osmunda cinnamomea L.	Cinnamon Fern
Thelypteris noveboracensis (L.) Nieuwl.	New York Fern

Source: (Mehrhoff 1989a, Rawinski 1986).
* Observed in all 14 vegetation plots recorded by Mehrhoff (1989a) of extant and extirpated populations.

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Name: ***Rhynchospora knieskernii*** **Carey (Knieskern's Beaked-Rush)**

Status: **Federally threatened.**
State endangered.

Distribution:

Historically, *Rhynchospora knieskernii* was endemic to the greater New Jersey Pinelands ecosystem and two locations in Delaware (Sorrie and Weakley 2001); however, it is now believed to be extirpated in Delaware (USFWS 1992). Today, it remains extant at 45 locations within Monmouth, Ocean, Atlantic, Burlington and Camden counties of New Jersey (USFWS 2008).

Description:

R. knieskernii is a member of the sedge family (Cyperaceae) in a genus commonly referred to as the beaked-rushes, or more appropriately, the beaksedges. The common name refers to the long-tapering beak-like tubercle (appendage) extending from their fruiting bodies. The species is a cespitose (tufted or clumped), short-lived perennial that grows to 60 cm (24 in) in height with short, narrow, linear leaves approximately 1-2 mm wide (< 1/128 in) (Gleason and Cronquist 1991). The flowers are numerous and occur in small clusters (glomerules). Fruiting occurs from July through September and may persist into the winter months (USFWS 1992). Correct identification of *Rhynchospora* spp. requires the use of a dissecting microscope capable of 40x magnification, a taxonomic manual and considerable botanical knowledge and experience, particularly with the Cyperaceae family of plants.

Habitat:

R. knieskernii is a sun-loving obligate hydrophyte (Lichvar and Kartesz. 2009) that thrives in open, sparsely vegetated herbaceous wetlands of the greater New Jersey Pinelands ecosystem (USFWS 1992). The species was first documented as occurring on exposed bog-iron deposits in floodplains of Pinelands streams and was believed restricted to this habitat (Stone 1911). However, more recent surveys have demonstrated that the species occupies a broader range of habitats, particularly disturbed areas (Gordon 1993, Arsenault 1995, Obee 1995, Gordon 1996). It appears most competitive in early stages of plant community succession at these sites, but gradually declines because of increased shade by species that are slower to establish (Obee 1995).

R. knieskernii can be found in a variety of hydrogeomorphic wetland settings including natural depressions, anthropogenic impoundments, lacustrine fringes, low-gradient coastal plain floodplains and seepage slopes (*sensue* Brooks *et al.* 2011). Disturbances are often anthropogenic in origin and include abandoned borrow pits, unmaintained road shoulders associated with seepage slopes, off-road-vehicle tire ruts, edges of potholes and utility rights-of-way.

Soils where the species occurs are typically acid, clayey to loamy, and are nutrient poor; however, on a few occasions soils were described as sandy peat or gravely sand (Gordon 1993, 1996). Gordon (1993, 1996) employed a soil/habitat model in which he searched cleared sites mapped as Mullica sandy loam soil. While he experienced remarkable success implementing this model, records for *R. knieskernii* in the Natural Heritage Database (2009) are also mapped: Atsion, Downer, Manahawkin, Matawan, Lakehurst, Berryland, Fallsington, Woodstown and Hammonton series (NRCS 1999).

Nearly all occurrences of persistent *R. knieskernii* populations are subject to a fluctuating hydrologic regime. Periodic water-level fluctuations may act as a surrogate for disturbance, and thus select for *R. knieskernii* by preventing the establishment of seemingly more competitive pioneer species; *sensu* van der Valk's (1981) environmental sieve model. Hydrologic fluctuations can also greatly influence population size. Gordon (1996) performed surveys during a drought in 1995 where he observed the species in considerably greater abundance, occupying depressions that were normally inundated but had drawn down.

R. knieskernii is typically associated with sparsely vegetated herbaceous/grassland plant communities and progressively less so with successional scrub/shrub communities. It most frequently associates with *Rhynchospora capitellata* (brownish beaksedge), *Muhlenbergia uniflora* (Fall dropseed muhly), *Aristida longespica* (slimspike threeawn), *Panicum verrucosum* (warty panicgrass), *Drosera filiformis* (thread-leaved sundew), and *Drosera intermedia* (spoonleaf sundew). These species have been observed at greater than 40% of the populations and subpopulations reported by Gordon (1993), Arsenault (1995), Obee (1995), Gordon (1996) (Table 1). Additionally, it is not unusual for *R. knieskernii* to be associated with other rare species tracked by the Natural Heritage Program. These species and their relative frequency of association with *R. knieskernii* are as follows: *Muhlenbergia torreyana* (New Jersey muhly), 30%; *Gentiana autumnalis* (Pine Barren gentian), 27%; *Rhynchospora pallida* (pale beaksedge), 18%; *Juncus caesariensis* (New Jersey rush), 11%; *Lobelia canbyi* (Canby's lobelia), 11%; *Rhynchospora cephalantha* (bunched beaksedge), 7%; *Narthecium americanum* (bog asphodel), 5%; *Schizaea pusilla* (curly grass fern), 5%; *Agalinis faciculata* (beach false foxglove), 2%; and *Calamagrostis pickeringii* (Pickering's reed bent-grass), 2% (not all rare associates were abundant enough to be included in Table 1) (Gordon 1993, Arsenault 1995, Obee 1995, Gordon 1996).

Survey Methodologies:

Surveys for *R. knieskernii* should be performed by botanists or professionals that can demonstrate extensive knowledge of and experience working with the species. The fruiting window (*i.e.* the most appropriate time of year to identify the species) for *R. knieskernii* extends from July through September (USFWS, no date). Documenting the absence of *R. knieskernii* from a site that is currently documented for the species will require a minimum of three surveys evenly spaced throughout the fruiting window. Surveys for the species performed during the winter or spring will not be considered acceptable by the Department. Botanists are encouraged to follow the Department's "Suggested guidelines for conducting endangered, threatened, or rare plant surveys," located in Appendix II.

Table 1. Plant species frequently associated with *Rhynchospora knieskernii*.

Scientific name	Common name	Relative Frequency (%)
* *Rhynchospora capitellata* (Michx.) Vahl	brownish beaksedge	59
Muhlenbergia uniflora (Muhl.) Fernald	smoke grass	52
Aristida longespica Poir.	slimspike three-awn	48
Panicum verrucosum Muhl.	warty panicgrass	48
Drosera filiformis Raf.	threadleaf sundew	43
Drosera intermedia Hayne	spoonleaf sundew	43
Calamovilfa brevipilis (Torr.) Scribn.	pine barren sandreed	36
Andropogon virginicus L.	broomsedge bluestem	34
Hypericum gentianoides (L.) Britton, Sterns & Poggenb.	Orange Grass	32
* *Muhlenbergia torreyana* (Schult.) Hitchc.	pine barren smokegrass	30
Amphicarpum purshii Kunth	blue maidencane	27
* *Gentiana autumnalis* L.	pine barren gentian	27
Lobelia nuttallii Schult.	Nuttall's lobelia	27
Hypericum canadense L.	Canadian St. John's wart	23
Andropogon glomeratus (Walter) Britton, *Sterns & Poggenb.*	bushy bluestem	20
Panicum virgatum L.	switchgrass	20
* *Rhynchospora pallida* M.A. Curtis	pale beaksedge	18
Cyperus dentatus Torr.	toothed flatsedge	16
Rhynchospora alba (L.) Vahl	white beaksedge	16
Euthamia caroliniana (L.) Greene ex Porter & Britton	slender goldentop	14
Rhexia virginica L.	Virginia meadow beauty	14
Rhynchospora gracilenta A. Gray	slender beaksedge	14
Schizachyrium scoparium (Michx.) Nash	little bluestem	14
Scleria minor W. Stone	slender nutrush	14
* *Juncus caesariensis* Coville	New Jersey rush	11
Juncus canadensis J. Gay ex Laharpe	Canada rush	11
Juncus pelocarpus E. Mey.	brownfruit rush	11
* *Lobelia canbyi* A. Gray	Canby's lobelia	11
Lyonia mariana (L.) D. Don	staggerbush	11
Rhynchospora chalarocephala Fernald & Gale	Loosehead beakedsedge	11
Xyris difformis Chapm.	bog yelloweyed grass	11

Relative frequency is calculated as the number of co-occurrences of a species with *R. knieskernii* divided by the number of populations/subpopulations of *R. knieskernii* sampled (n = 44), multiplied by 100. Associated species data were compiled from Gordon (1993), Arsenault (1995), Obee (1995), and Gordon (1996).

* Indicates a species is tracked by the New Jersey Natural Heritage Program due to rarity.

Office of Natural Lands Management Contact:

Office of Natural Lands Management, Natural Heritage Database.
(609) 984-1339.

Regulatory Guidelines:

1. Area of Documentation: Wetland or wetland complex known to feature a documented occurrence of the species or which is required for its continued existence.

2. Suitable Habitat: Suitable habitat for *R. knieskernii* includes both unaltered and anthropogenically altered wetlands that are situated in the greater Pinelands ecosystem (McCormick and Forman 1979) and feature multiple plant species frequently associated with it (refer to Table 1).

Comments:

For each known location of *R. knieskernii*, the extent of wetland habitat designated for an exceptional resource value classification will vary due to site-specific characteristics of the habitat present including the plant community, existence of a disturbance regime, and the history, if available, of the species at that location. As a result, each wetland classification will be established, on a case-by-case basis, by the Department following an evaluation of these characteristics. When feasible, the Department will attempt to reconfirm the presence of the specific plant species known historically (*e.g.* last observed > 20 years ago) to an area prior to establishing a regulatory designation.

Due to its endemic association with the greater New Jersey Pinelands ecosystem, the majority of known *R. knieskernii* populations are located within the geopolitical "Pinelands Area" boundary. Therefore, in most instances these populations will be regulated under the Pinelands Comprehensive Management Plan pursuant to the Pinelands Protection Act (N. J. S. A. 13:18A). Any populations not regulated pursuant to the Pinelands Protection Act within the Pinelands Area or situated outside of "Pinelands Area" will be regulated pursuant to the Freshwater Wetlands Protection Act (FWPA) (N.J.S.A. 13.9B), for which this document applies.

Due to *R. knieskernii's* adaptation to disturbance, management agreements with landowners may be an effective mitigation tool for minimizing impacts resulting from regulated activities in surrounding wetlands and/or transition areas (Kolaga and Schuyler 1993). At sites that are succumbing to the competitive effects of plant community succession, mitigative strategies may be considered to enhance populations. Such mitigative strategies may include the clearing woody vegetation, prescribed burning, or gentle unearthing of the seed bank (Kolaga and Schuyler 1993, Yurlin 1998). Such management agreements, if permitted by the Department, should be performed by professionals who are experienced with rare plant conservation, propagation and management strategies.

Rationale:

The known remaining global population of Knieskern's beaked-rush consists of approximately 45 element occurrences wholly contained within the greater Pinelands ecosystem of New Jersey (*sensu* McCormick's 1957 map of the Pinelands ecosystem (McCormick and Forman 1979)). The species is threatened by hydrological alterations, plant community succession following disturbance and various human-related activities (*e.g.* dumping, off-road vehicle use, landscaping or development). Classification of wetlands supporting *R. knieskernii* as of exceptional resource value prevents direct impacts from affecting the species. Furthermore, the imposition of a wetland transition area prevents or minimizes hydrologic alterations, invasion by more aggressive plant species and various other anthropogenic impacts.

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APPENDIX

APPENDIX I
Protocol for Reporting and 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:
   a) Did the sighting occur within the known range of the species?
   b) Did the sighting occur in the known/recognized habitat for the species
   c) Is the species easily identified, or is it often confused with another?
   d) Did anyone else confirm the sighting, or can someone else vouch for the observer's identification skills?
   e) Do we have first-hand knowledge of the observer's identification skills?
   f) Did the observer include a photograph?
   g) 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.)
5. If uncertainty remains about the validity of the sighting, the observer is interviewed by the ENSP biologist.
6. If sufficient information accompanies the sighting report the record is either accepted or rejected by an ENSP biologist.
7. 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. 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. 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. ENSP GIS staff digitizes the sighting location and prepares the data in a

standardized format to enter into the Biotics database. ENSP staff perform a quality check of the documentation, mapping and data entry before the record is complete and filed.

For additional information on how wildlife and endangered or threatened species sightings are received or can be submitted, please go to:

https://dep.nj.gov/njfw/conservation/reporting-rare-wildlife-sightings/

APPENDIX II

Suggested Guidelines for Conducting Endangered, Threatened, or Rare Plant Surveys
New Jersey Department of Environmental Protection
Division of Land Use Regulation
Prepared by David M. Kunz

Purpose of endangered, threatened or rare plant/community surveys.
In rare instances (*e.g.* 0.03% of applications), the Division of Land Use Regulation (DLUR) may require a floristic survey be performed to determine the presence or absence of a regulated endangered, threatened or rare plant species on an applicant's site. Floristic surveys are only necessary in instances when the Natural Heritage Database contains a record for such plant species on or directly adjacent to an applicant's site and a DLUR botanist is unable to perform a survey.

What defines an endangered, threatened or rare plant/community?
The State of New Jersey recognizes endangered, threatened, or rare (hereafter listed) plant species according to various environmental regulations. Of the 2,134 plant species native to New Jersey, 6 species are listed as either endangered or threatened pursuant to the federal Endangered Species Act of 1973 (U.S.C. § 1531 et seq.), and 339 species are recognized as endangered pursuant to the New Jersey Endangered Plant Species List, N.J.A.C. 7:5C. In the overlapping portion of the CAFRA Area and the Pinelands National Reserve, 25 additional plants identified in the Pinelands Comprehensive Master Plan, N.J.A.C. 7:50 are regulated as well. Within the Highlands Preservation Area, the Highlands Water Protection and Planning Act Rules, N.J.A.C. 7:38, regulates all listed plant species and rare ecological communities tracked by the State's Natural Heritage Program.

Who is qualified to perform rare plant/community surveys?
Surveys should be performed by botanists (*i.e.* individuals who are able to apply botanical vernacular and use a taxonomic manual to properly identify vascular or non-vascular plant species). Botanists should be capable of identifying any plant species found to occur on a particular site or know how to contact the proper authority to confirm identities of plants that are particularly difficult to identify. Botanists should also be proficient with floristic survey methodologies and familiar with listed plant species tracked by the New Jersey Natural Heritage Program and their reporting procedure. The skills described above require considerable training and practice. Applicants are cautioned that experience limited only to using popular field guides to identify dominant vegetation for the purpose of wetland delineations is not sufficient to perform floristic surveys. Many listed plant species are not described in such field guides because of their rarity.

Applicants are encouraged to contact local universities with botany or plant biology programs, herbaria, regional botanical societies/clubs or natural resource conservation organizations to locate individuals qualified to perform floristic surveys. Some examples include:

Flora of New Jersey Project
Philadelphia Botanical Club
New York Botanical Garden
Torrey Botanical Society
Brooklyn Botanical Garden
Academy of Natural Sciences of Philadelphia

Suggested protocol for floristic surveys:

1. Obtain a list of rare, threatened or endangered plant species with the potential to occur on or near the applicant's site by submitting a data request to the Department's Natural Heritage Program.
2. Identify the area to be surveyed on a map or aerial photograph and communicate this area to DLUR prior to surveying to ensure that it is sufficient to satisfy its interest.
3. All persons performing the survey should be familiar with the endangered, threatened or rare plant(s) in question. Taxonomic references and peer-reviewed literature are the most reliable sources of information. Caution should be used when using the internet for identification purposes as there is not an established peer-review system for posting information on the internet.
4. A floristic survey comparable to a "timed meander search" (Goff et al. 1982) should be employed and the results demonstrated on a corresponding species list and species/time curve. All species of plants present in the survey should be identified to the taxonomic level at which its regulatory status can be determined. For example, in some cases taxa will need to be identified to subspecies or variety.
5. Surveys should be designed so that targeted habitats within the project area are surveyed at an appropriate time of year for each species in question. Surveys should be performed only when each species in question exhibits the proper characteristics to identify it to the specific epithet, subspecies or variety. In many cases this will require the plant to be in flower or fruit.
6. Surveys should be performed between 1 and 3 times during the appropriate season(s) depending upon the nature of each species in question. For example, woody perennial species will generally only require a single survey during an appropriate time of year. The flowering/fruiting period of herbaceous annual and perennial plant species can vary based on climate related phenomenon. It is ideal to survey at the beginning, middle, and end of each species flowering/fruiting period.

Plant survey reports should include:

1. The name, title, affiliation, address and qualifications of the botanist primarily responsible for the survey, as well as the names and titles of all other persons participating in the survey.
2. Description of the survey methodology.
3. Detailed location maps. The report should include a large scale survey map either hand drawn or overlaid on a recent aerial photograph identifying each area/habitat surveyed. A 1:24,000 scale USGS Topographic location figure identifying the project location should also be included.
4. The acreage of the surveyed area.
5. The taxonomic reference(s) used to identify plant species and which reference the nomenclature in the species list follows.
6. A list of all plant species and the time slot in which they were documented relative to the duration curve. 5-10 minute intervals is preferred.
7. A plot of the plant species duration curve.
8. A brief description of habitats onsite including vegetation (dominant species), hydrology, soils, presence of invasive species, natural and/or anthropogenic disturbance, and name(s) of natural communities (see Breden et al. (1989) for consistency).
9. The date and time of the survey (including total number of hours spent by each person surveying).
10. The number of observers present on the site at any one time, including their location on the site relative to one another. This may be specified on the location map.
11. Site conditions during the survey, such as precipitation, temperature, recent leaf fall, snow cover, evidence of fire or drought etc. should be noted.
12. If the survey reveals the presence or evidence of, a listed plant species, the following should be included in the report:
    i. a copy of the Natural Heritage Rare Plant Species Reporting Form submitted to the New Jersey Natural Heritage Program.

ii. photographs of one or more individuals from the population illustrating the overall plant and the key diagnostic features used to determine the specific epithet when ever possible. A camera equipped with a macro lens may be necessary. It's recommended that a photographer's "gray card" be placed behind specimens to distinguish the species from other vegetation and to attain accurate exposure. Voucher specimens should only be collected from the applicant's site when population numbers support the practice (*i.e.* > 100 individuals), and should be limited.

Acknowledgments

The plant survey guidelines outlined above were modeled after survey protocols devised by the Washington State Natural Heritage Program, State of California Department of Fish and Game, Alberta Native Plants Council, Canada and Saskatchewan Conservation Data Center, Canada. The New Jersey Office of Natural Lands Management provided critical review of this document.

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APPENDIX III

SELECTED HOME RANGE DATA FOR ENDANGERED OR THREATENED SPECIES

BLUE-SPOTTED SALAMANDER / TIGER SALAMANDER

TABLE ONE: Summary of dispersal movements and home-range sizes for various *Ambystoma* species.

Location	Home Range	Distance	Source
New York		111 meters (364 ft)	Madison in Clark 1990 **!**
South Carolina	0.12-7.6 meters (0.5-25 ft)	162 meters (531 ft)	Semlitsch 1983 **!**
South Carolina	0.02-23 m(2) (0.1-75 ft)	81-261 meters (265-856 ft)	Semlitsch 1981 *****
South Carolina		12-67 meters (40-220 ft)	Semlitsch 1981 **$**
?		150 m (aver.) (492 ft)	Douglas and Monroe 1981 **#**
?		250 m (aver.) (820 ft)	Douglas and Monroe 1981 **@**
Indiana		195 m (aver.) (640 ft)	Williams 1973 ^
Missouri		172 m (max) (564 ft)	Sexton et al. 1986 ^
Tennessee		600 m+ (1968 ft)	Biedermann 1988 **!**

TABLE ONE cont.: Summary of dispersal movements and home-range sizes for various *Ambystoma* species.

Location	Home Range	Distance	Source
Massachusettes		174 m (avg) (570 ft)	Honman and Windmiller 1999 %
		200 m (max) (656 ft)	Windmiller 1996 %
		250+ m (max) (820+ ft)	Regosin et al., 2005 %

! Tiger salamander (*Ambystoma tigrinum tigrinum*)
***** Mole salamander (*Ambystoma talpoideum*)
$ Juvenile mole salamander
# Spotted salamander (*Ambystoma maculatum*)
@ Jefferson's salamander (*Ambystoma jeffersonianum*)
^ Marbled salamander (*Ambystoma opacum*)
% Blue Spotted Salamander (Ambystom alaterale)

Home-Range / Movement: While home-range data is lacking for blue-spotted salamanders, various studies of other *Ambystoma* have identified movement patterns. *Ambystoma* dispersal movements and home-range sizes are summarized in Table One. The listed home-range figures address habitat use after a post-breeding dispersal from the breeding pond. Blue-spotted salamanders have been observed in excess of 30 meters (98.4 feet) from suitable breeding ponds in Troy Meadows (L. Torok, pers. comm.). Another study of a tiger salamander population in Tennessee showed dispersal movement of a great distance. A possible explanation for Biedermann's results (1988) is that the studied breeding pond was surrounded by cultivated fields.

BOG TURTLE

Home-Range / Movement: A summary of bog turtle home-range / movement data is provided in Table Two. It should be noted that the following data are based on limited sample sizes and various techniques. Accordingly, while the data provide some measure of habitat requirements for the species, they cannot be used as a definitive representation of the species' spatial habitat requirement. Within the listed home-ranges, turtles make use of both upland and wetland areas. In Delaware, Arndt (1977) recorded bog turtles in meadows, on the road (deceased), and in ferns and brush bordering meadows. Zappalorti and Zanelli (1978) reported a small percentage of the bog turtles that they found crossing dry land. In Maryland, Chase et al. (1989) did not encounter bog turtles outside of the wetland transition zone, however, they indicated that "...the substrate may range from wet to dry pockets...Some areas may be seasonally or intermittently flooded," (pg. 359).

TABLE TWO: Home-range estimates for the bog turtle. (# = males @ = females)

Location	Home Range	Source
Pennsylvania	mean 1.33 ha# 3.32 ac. mean 1.28 ha@ 3.2 ac.	Ernst 1977
Pennsylvania	max. 0.121ha# 0.302 ac. max. 0.943ha@ 2.36 ac.	Barton 1957
Maryland	max. 0.24ha# 0.6 ac. max. 0.086ha@ 0.22 ac.	Chase et al. 1989
New York	2-3 ha (5-6.5 ac.)	Breisch 1986 1986

Due to the successional nature of bog turtle habitat, it has been suggested that conservation efforts should focus on maintaining wetland networks to allow movement, gene-flow between otherwise disjunct populations, and emigration into areas of suitable habitat from degrading habitats (Kiviat 1978; Chase et al. 1989). Linear distances travelled by bog turtles include 200 m (656 ft) and 225 m (738 ft). One pair of bog turtles studied in New York moved between 750 and 850 m (2460-2788 ft), from one meadow to another (A. Breisch, pers. comm.). Habitats transversed also included a red maple swamp and a beaver dam.

WOOD TURTLE

TABLE THREE: Summary of wood turtle home-range / movement data.

Location	Home Range	Distance	Source
New York	#30-50m 98-164 ft	*1300-3250m 4264-10,660ft	Carroll and Ehrenfeld 1978
Pennsylvania	214-680m 703-2230ft		Stang 1983
Pennsylvania		"hundreds of meters."	Kaufmann 1992
New Jersey		915-1610m 3000-5280ft	Zappalorti 1984
New York	1.81 ha (aver) 4.52 acres .03 ha (max) .10 acres	700 m (max.) 2296 ft.	Burt and Collins, no date
Michigan and New Jersey		800m(max) 2625ft	Harding and Bloomer 1979
Canada	24.3 ha (aver) 60 acres 115 ha (max) 284 acres		Quinn and Tate 1991

resident turtles *displaced turtles

Home- Range / Movement: In addition to the data provided in Table Three above, wood turtle movements away from the breeding / wintering stream habitats have been shown to be highly variable. Several studies have determined that most non-aquatic wood turtle activities occur within 30 m (98 ft) to 40 m (130 ft) of the home stream (Brewster and Brewster 1991; Quinn and Tate 1991). Others have reported wood turtles moving upland as far as 100-400 m (340-1312 ft) (Ernst 1986).

TIMBER RATTLESNAKE

Home-Range / Movement: Movement data obtained from radio telemetry work in the New Jersey Pine Barrens established male activity ranges averaged 124 ha (306 ac), while female activity ranges averaged 14 ha (35 ac). The largest range documented was 150 ha (370 ac) (Zappalorti and Reinhart 1986). In New York, maximum dispersal distances were 2.8 km (1.7 mi) for males, 2.5 km (1.5 mi) for females. Gravid females remained within 400 m (1300 ft) of the den (Brown and MacLean 1983). R. Stechert (pers. comm.) reported that male rattlesnakes

moved an average linear distance of 3.3 km (2 mi), with non-gravid females moving up to 2.5 km (1.5 mi). The maximum recorded movement of gravid females was 1.8 km (1 mi).

LONG-TAILED SALAMANDER

Home- Range / Movement: No home range reported. Anderson and Martino (1966) report finding adult salamanders as much as 30 meters (98 feet) from water in the early spring. By late May most salamanders occurred along the water's edge, generally within 6.1 meters (20 feet).

PINE BARRENS TREEFROG

Home Range/Movement: Pine barrens treefrogs (*Hyla andersonii*) have been documented to disperse in excess of 100 meters (328 ft) from their breeding pond (Freda and Gonzalez 1986). Freda and Morin (1984) and Freda and Gonzalez (1986) detailed the movements of radio-isotope tagged treefrogs in New Jersey. The subject frogs generally remained within 70 m (230 ft) of their breeding pond. One tagged frog was located 102 m (335 ft) from the breeding pond while others were frequently heard in excess of 100 m (328 ft) from ponds during survey work.

Treefrog breeding populations are also dynamic within contiguous wetland complexes. The suitability of individual breeding sites, from one year to the next, is often a factor of annual rainfall, rate of vegetative succession, and period of wildfire occurrence (Freda and Morin 1984). Zappalorti (pers. comm.) indicated that breeding populations have appeared to colonize suitable habitats up to 0.85 kilometers (0.5 miles) from previously documented habitats during years when these habitats were not suitable. On-going studies at the Ocean County Community College wetland complex have demonstrated that breeding colonies may move throughout a wetland complex to colonize suitable breeding ponds (Connell 1991).

SOUTHERN (COPE'S) GRAY TREEFROG

Home-Range / Movement: There is little information concerning the home-range of the southern gray treefrog. R.T. Zappalorti (pers. comm.) recorded a southern gray treefrog call, 75 m (240 ft) from a confirmed breeding pond in Cape May. In Tennessee, male southern gray treefrogs moved linear distances of up to 0.43 km (0.25 mi) and one female moved 0.63 km (0.4 mi) between breeding ponds (Ritke et al. 1991). All sites were connected by natural stands of hardwood vegetation.

HENSLOW'S SPARROW

Home-range / Movement: Spatial requirements for the Henslow's sparrow revolve around territory size and minimum habitat requirements. Defended territories documented include an average of 0.3 ha (0.8 ac) in Michigan and 0.6 ha (1.5 ac) in Wisconsin (Robins 1971; Wiens 1969). Maximum territory sizes identified were 1.04 ha (2.6 ac) and 1.08 ha (2.7 ac), respectively. It should be noted that territory size is susceptible to seasonal and prey-base fluctuationss. It has also been suggested that Henslow's sparrow is an area-dependent species requiring fields between ten and 100 ha (25-250 ac) in size to support viable populations (Samson 1980). Studies from Illinois found the species to occur only in fields larger than 40 ha (100 ac) in size (J. Herkert 1994).

SHORT-EARED OWL

Home-Range / Movement: A summary of home range / territory data for the short-eared owl is provided in Table Four. Based on these data, Tate (1992) suggested that areas a minimum of 50 ha (125 ac) of low, open grasslands or similar habitat which featured abundant rodent populations warranted protection. It must be noted that the data provided above is based on diurnal activity and it has been suggested that nocturnal foraging may be more extensive (K.P. Combs in Tate 1992).

TABLE FOUR: Summary of short-eared owl winter and summer home-ranges.

Location	Size	Source
Massachusetts	51 ha. (25-98 ha.) 127.5 ac. (62.5-245 ac)	Holt and Melvin 1986; Tate and Melvin 1987, 1988; Combs and Melvin 1989
Scotland	18-156 ha	Lockie 1955
Manitoba, Canada	73.9 ha. (mean) 184.75 ac. 121.4 ha. (max) 303.5 ac.	Clark 1975
Scotland	85 ha. (25-242 ha.) ***** 212.5 ac (62.5-605 ac) 42-72 ha # 105-180 ac.	Village 1987

***** summer territory # winter territory

RED-SHOULDERED HAWK

TABLE FIVE: Home-range data for the red-shouldered hawk.

Location		Home range	Source
Kansas		72 ha. (180 ac.)	Fitch 1958
Michigan			
	1942 (aver.)	42 ha. (130 ac.)	Craighead and
	(max.)	107 ha. (269 ac.)	Craighead 1956
	1948 (aver.)	48 ha. (188 ac.)	
	(max.)	154 ha. (384 ac.)	
Missouri		108.9-127.6 ha. 272-319 ac.	Parker 1986
Maryland		399/434 ha. ***** 997/1085 ac.	Senchak 1991
		224/ 238 ha. **@** 560/595 ac.	
Southerwestern Ohio		90 ha. (233 ac.)# 189 ha. (467 ac.)+ 165 ha. (408 ac.)%	Dykstra et al. 2001
California		45.2 ha. (112 ac.) 69.2 ha. (171 ac.)	Bloom and McCarry 1996
* Male breeding/post-breeding		**@** Female breeding/post-breeding	# Breeding
+ Post-breeding		% Annual	

Home range / Movement: A summary of red-shouldered hawk home range data is provided in Table Five. There are two points of significance concerning these data. First, it must be noted that there is a general lack of home-range data for this species. Much of the data available discusses nesting pair densities and spatial separation within contiguous habitats. Various nesting densities reported include 1 pair per 48.7 ha (121.75 ac) in Maryland; 1 pair per 171 ha (427.5 ac) in New York; 1 pair per 645 ha (1613 ac) in Michigan and 1 pair per 360 ha (900 ac) in New Jersey (Stewert 1949; Crocoll and Parker 1989; Craighead and Craighead 1956; Bosakowski et al. 1991). Based on their data, Bosakowski et al. (1991) suggested a minimum "home-range" of a 0.8 km radius around red-shouldered hawk nests. Secondly, the data collected by Senchak (1991) indicated an increase in home-range size during the post-breeding season. Her findings support more casual observations made by other researchers (Craighead and Craighead 1956; R. Radis pers comm.).

NORTHERN HARRIER

Home-Range / Movement: Information regarding the northern harrier home-range and / or hunting range is sparse. Indications are such that the species will forage over a large area during the breeding season. It is important to note, that the availability of prey will greatly affect the amount of habitat that the species will use.

TABLE SIX: Hunting ranges for the northern harrier.

Location	Range (sq. km/sq. mi)	Reference
Europe	1.8-4.1 / 0.69-1.57 * < 1.0 / 0.38 #	Terschelling in Schipper 1977
Europe	7.2-12.3 / 2.77-4.73 * 0.8-5.4 / 0.31-2.07 #	Flevoland in Schipper 1977
Minnesota	2.6 / 1 #	Breckenridge 1935
Idaho	9.7-17.7 / 3.73-6.8 * 1.1 / 2.86 #	Martin 1987
Mass.	1.4-4.2 / 0.54-1.61 #	Serrentino 1987

* males # females

In Wisconsin, Hamerstrom et al. (1985) documented the relationship between vole populations and polygamous behavior in the harrier population that they studied. Craighead and Craighead (1956) identified "seasonal hawk ranges" for breeding raptors in Michigan. Their harrier data indicated an average range of 5.87 km^2 (2.26 mi^2) in 1942 and 2.08 km^2 (0.80 mi^2) in 1948. Hecht (1951) reported the species to defend an area with a 99 m (975 ft) radius around its nest in Canada. Northern harriers will also defend "territories" during winter, however, such areas are generally only used for hours or days (Bildstein and Collopy 1985).

SEDGE WREN

Home-Range / Movement: No data is available on home-range size for sedge wrens. Males defended territories an average of 1280 m^2 (4198 ft^2) in Minnesota (Burns 1982).

BALD EAGLE

Home Range/Movement: There is little information which clearly defines the home-range or movement patterns of breeding bald eagles. Frenzel (1983) reported home-ranges that averaged 660 ha (1650 ac) [range 325-1384 ha (813-3460 ac)] for eight pairs of eagles studies in Oregon. Haywood and Ohmart (1983) reported home-ranges of 64 km (2) [38.4 mi (2)] in Arizona. Many studies have investigated the relationship between disturbance factors and the distance from nesting or perching birds where these factors affect their behavior. In Canada, Leighton et al (1979) established bald eagle breeding areas as a 0.8 km (0.48 mi) radius around the nest and assumed that adult bald eagles, observed within 1.6 km (0.96 mi) of a nest, constituted a breeding pair. In their nesting habitat model for Maine, Livingston et al. (1990) defined the "nest area" as a 500 m (1640 ft) radius around the nest site and established the foraging area at a radius of 1.5 km (0.9 mi). Anthony and Isaac (1989) also defined the area within 1.6 km (0.96 mi) of the nest as breeding habitat in their research in Oregon.

Other studies have focused on various human activities and their impacts on bald eagle behavior. Anthony and Isaacs (1989) suggested variable buffers of 400 m (1312 ft), for roads, trails and boat launches, and 800 m (2624 ft), for human activities. In Florida, Wood et al. (1989) proposed a primary zone of 229 m (751 ft), for human disturbance, and a secondary zone, from 229 m to 457 m (1499 ft) away from the nest, for tree-cutting to be established during the breeding season where activities were prohibited.

In regard to the flushing of perched birds, various studies have analyzed the responses of bald eagles to various levels of disturbance. Factors influencing flush distance include type of disturbance, quality of habitat, quality of prey base, and eagle activity at the time of disturbance. In general, flushing responses of bald eagles to human disturbance (i.e. walking, shouting) have varied from 20 m (66 ft) to 540 m (1771 ft) (Stalmaster 1976; Nye 1977; Stalmaster and Newman 1978; Wallin and Byrd 1984). Flush responses to boat traffic varied from 40 m (131 ft) to 400 m (1312 ft), with slow moving crafts at the low end and faster, less consistent traffic towards the high (Jones 1973; Knight and Knight 1984; Wallin and Byrd 1984)

PIED-BILLED GREBE

Home-Range / Movement: Little information on the home-range or territory requirements of the pied-billed grebe is available. Glover (1953) reported that grebes defended an area within approximately 46 m (150 ft) of their nest and postulated that the species home-range was frequently about twice this size.

Another indicator of the pied-billed grebe spatial habitat requirement is the density of nesting, rather breeding, pairs in a wetland. Sealy (1978) reported one pair of grebes per pothole in Manitoba. Chabreck (1963) reported 1 nest per 0.75ha (1.8 ac) in Louisiana. Faaborg (1976) reported an average of one pair per 2.2 ha (5.5 ac) in wetlands studied in North Dakota. No grebes were identified in ponds less than 0.6 ha (1.5 ac) in this study. The impoundment studied by Forbes et al. in Nova Scotia featured densities of one nest per 1.25 ha (3.1 ac.) in 1982 and 1 nest per 0.56 ha (1.4 ac.) in 1983. Brown and Dinsmore (1986) found grebes to occur in five size classes of wetland ranging from less than one hectare (2.5 ac) to greater than 20 hectares (50

ac). A significant increase in the frequency of occurrence of pied-billed grebes, in wetland complexes greater than five hectares (12.5 ac) in size, led them to classify the species as area-dependent. Studies in Maine found grebes to occur only in wetlands greater than five hectares (12.5 ac) in size (Gibbs and Melvin 1990; Gibbs et al. 1991).

LONG-EARED OWL

Home-range / Movement: In the study done by Wijnandts (1984) in the Netherlands and in the study executed by Craig et al. (1988) in Idaho, the areas used by long-eared owls were variable. In Idaho, breeding owl home-ranges increased in size soon after the hatching of their progeny.

TABLE SEVEN: Summary of long-eared owl home-range data.

Location	Size (ha/ac)	Reference
Idaho	61.8 (40.6-83) ha ^ 154.5 (101.5-207)ac 144.3 (131.1-157.5)ha ***** 360 (327.8-393.7)ac	Craig et al. 1988
Wyoming	approx 55 ha (137 ac)	Craighead and Craighead 1956
Netherlands	aver. 2025 ha (5062 ac) range 1136-2560 ha 2840-6400 ac	Wijnandts 1984

^ Females/incubating-hatching
***** 12 days after hatching

Male owls in this study often utilized areas outside of the 3 km radio range so that a true indication of home-range was difficult to establish. In the Netherlands, the large home-ranges for over-wintering owls were further analyzed to reveal that 90% of owl activity took place between 22% and 31% of the owls' home-ranges. In spatial terms, owl activity was largely concentrated in areas between 350 ha (875 ac) and 700 ha (1750 ac) in size. Roosting site distance, which averaged 5.5 km (3.3 mi) from favored feeding areas, accounted for most of the additional acreage included in owl home-ranges.

AMERICAN BITTERN

Home-Range / Movement: Limited information exists on spatial habitat requirements of the American bittern. Sample nesting densities include: five nests in 0.25 square miles; two nests on five acres; five nests on 160 ha (402 ac); five nests on 64.8 ha(168 ac); and two nests on two hectares (five acres) (Bent 1929; Vesall 1940; Palmer 1962). Bitterns in Maine inhabitated wetlands ranging from less than one to greater than 25 hectares in size but were more abundant in larger wetland complexes (Gibbs et al. 1991).

Conversely, a study conducted in Iowa by Brown and Dinsmore (1986) did not find bitterns in marshes less than 11 ha (27.5 ac) in size, and, that study suggested the species to be area-dependent as well.

BOBOLINK

Home-Range / Movement: Limited data on territory size for bobolinks exists. In Wisconsin, territories ranged from 1.1 ha (2.7 ac) to 4.9 ha (12.1 ac.) and averaged 2.6 ha (6.5 ac) (Weins 1969). Whittenberger (1980) established territories of 0.74 ha (1.8 ac) in quality habitat and 1.45 ha (3.6 ac) in poor habitat.

The size of occupied suitable field habitat is an indicator of the spatial requirement of the bobolink. Study areas in New York were between 19 ha (47.5 ac) and 22 ha (55 ac) in size (Bollinger and Gavin 1989). Whittenberger's study site in Oregon as 27.3 ha (68.25 ac). Weins' (1969) Wisconsin site was 32.4 ha (80 ac) in size. No data is available on minimum habitat size required to support breeding bobolinks.

BLACK RAIL

Home-Range / Movement: It is uncertain, the amount of habitat required to support the black rail. Studies of freshwater habitat in Arizona identified home-ranges that averaged 0.43 ha (1.7 ac) with a core use of 0.1 ha (0.25 ac) (R. Flores in Davidson 1992). Estimated territory sizes in contiguous salt marsh habitats encompassed three hectares (7.5 ac) to four hectares (10 ac) in another study (J.S. Weske in Davidson 1992). Repking and Ohmart (1977) observed most activity to occur within an average of 23 m (75 ft) of an unvegetated water's edge (e.g. open water, roadway) and to be concentrated within a four meter (up to 13 ft) perimeter of the marsh. Kerlinger and Sutton (1988) suggested that black rail breeding colonies may be ephemeral, or "nomadic," and that large expanses of suitable habitat may be necessary to support healthy populations.

OSPREY

TABLE EIGHT: Distances traveled by osprey between the nest and foraging habitats.

Location	Distance travelled	Reference
Wyoming	4.5-6.5 km (2.7-3.9 mi)	Swenson 1981.
Michigan	< 6.4 km (3.8 mi)	Postupalsky 1977
California	1-10 km (0.6-6 mi)	Garber 1972
Montana	10+ km (6 mi+)	Klaver et al. 1982
Idaho	< 10 km (6 mi)	Van Daele and Van Daele 1982
Canada	< 12 km (7.2 mi)	Prevost 1977

RED-HEADED WOODPECKER

Home-Range / Movement: Little is known of the home-range requirements for the red-headed woodpecker. Documented densities of nesting pairs may provide the best indicator of the spatial requirements for the species. Graber et al. (1977) recorded nine to twelve birds per 40 ha (100 ac) in an Illinois bottomwood forest site. Also in Illinois, 28 birds were documented in a 40 ha (100 ac) shrub area (Graber and Graber 1963). Woodlots used for nesting in Virginia varied in from one-half of a hectare (1.2 ac) up to as much as twenty hectares (50 ac) in size (Connor 1976).

BARRED OWL

Home-Range / Movement: Dobkin and Laidig (1990) used 0.5 mi (275 ha) and 0.75 mi (530 ha) radius circles to distinguish barred owl territories in southern New Jersey. Continued work in southern New Jersey, which included sonographic analysis of vocalizations, suggested that

TABLE NINE: Summary of barred owl home-range data.

Location	Home Range	Source
Minnesota	228.6 ha (86.1-369 ha) 565 ac (213-912 ac)	Nicholls and Warner 1972
Minnesota	274-507.8 ha 676.7-1256.5 ac	Fuller 1979
Minnesota	274 ha (86-770) 676 ac (213-1903)	Nicholls and Fuller 1987
Michigan	118-282 ha (291-697ac)	Elody and Sloan 1985
Washington	218ha (545ac.) breeding 488ha (1220ac) non-breeding 526ha (1315 ac) annual	Hamer 1988
Saskatchewan	148 ha (371.5 ac) breeding 1234 ha (3085 ac) non-breeding 970.6 ha (2426 ac) annual	Mazur et al 1998
Charlotte, N.C.	118 ha (285 ac) breeding males 87 ha (210 ac) breeding-females	Harrold 2003
Virginia	567.8 ha (258.9-979.6 ha) 1402.7ac (639.5-2420 ac)	Hegdal and Colvin 1988

barred owl home ranges might be much larger than those found characteristically in other portions of the species' geographic range. This proposal was also partially due to the poor quality of the habitat and the heavy overlap of barred owl habitat with that of the Great horned owl (Laidig 1992; Laidig and Dobkin 1992). Barred owls may enlarge there home range outside of the breeding season (Elody 1983; Bosakowski et al. 1987, Hamer 1988; Mazur et al. 1998).

INDIANA BAT

Home-Range / Movement: Studies of the Indiana bat have demonstrated that the species will move around to different habitats based upon their seasonal needs. The movements include migration to summer maternity roosts, general roosts, and summer foraging grounds. In portions of the country, research indicates that bats travel significant distances north to summer roosts, although they may also move in other directions as well (U.S. Fish and Wildlife Service, 1999). In New Jersey, Indiana bats may remain in or around the hibernacula, disperse to summer roost sites in nearby woodlands, or perhaps travel greater distances.

In general, migration to hibernacula begins in August, with bats arriving late August into early September (Barbour and Davis 1969). Beginning in April, bats move to summer roosts, with females leaving first. In a Kentucky study, female bats dispersed between 6.4 km (4 mi) and 16 km (10 mi) from their hibernacula. Several studies reported that male bats moved between 4 km (2.5 mi) and 16 km (10 mi) from their hibernacula (USFWS 1999). In one Pennsylvania study, an old church building used as a primary summer was 2.4 km (1.4 mi) from the identified hibernacula (Hassinger and Butchkoski 2001). In the autumn, when the species swarms and mates, male Indiana bats roosted within 2.4 km (1.5 mi) of the hibernacula, in a Kentucky study (Craig Stihler in USFWS 1999), and within 5.6 km (3.5 mi) of the hibernacula, in a study from West Virginia (Kiser and Elliot 1996). Stihler (1996) reported males moved up to 4.2 km (3.5mi) between fall roost sites and their winter cave in West Virginia.

Once reaching their summer habitats, Indiana bats may forage over a variable area. Foraging ranges differ slightly between males and females, and are also dependent on reproduction and age of the creature. In Illinois, Garner and Gardner (1992) reported movements between 0.16mi and 1.63 mi (see Table 1). Post-lactating adult females exhibited the largest foraging range and preferred floodplain areas with closed (>80%) canopies. Hassinger and Butchkoski (2001) documented main foraging ranges of between 38.8 ha (99.5 ac) and 111.9 ha (284 ac) in Pennsylvania. A summary of other studies conducted throughout the United States is provided in Table Ten.

M. sodalis is known to have exceptional navigational skills. When 500 bats were released 200 miles north, south and west of a cave in Kentucky, two-thirds of those released to the north returned to the cave. Of those released to the south, one-third returned. This is an impressive figured when it is considered that the subjects were outside of their normal range and, therefore, in an unfamiliar area (Barbour and Davis 1969). The U.S. Fish and Wildlife Service (1999) recommends banding juveniles at summer roost sites so to provide information on movements and survival rates. They also suggest using a geographic information system, aerial photographs and National Wetland Inventory maps in order to identify and locate potential roost sites.

TABLE TEN: Foraging ranges of reproductively active adult female, adult male and juvenile *M. sodalis* in Illinois.

Repro. Condition Sex, and Age	Number Bats	Number Nights	Foraging Range (ha)	Distance, km (miles)
Adult-Pregnant	2	8	51.85	1.05 (0.66)
Adult-Lactating	5	16	94.25	1.04 (0.65)
Adult-Post Lact.	1	6	212.67	2.60 (1.63)
Juvenile-Nonrep.	2	3	37.00	0.25 (0.16)
MALE				
Adult-Nonrep.	2	6	57.33	0.56 (0.35)
Juvenile-Nonrep.	2	4	28.25	0.54 (0.34)
TOTAL	**14**	**43**		

** Distance, which refers to the mean distance from the roost to the geometric center of foraging range, is given in kilometers and miles.

TABLE ELEVEN: Foraging distances for Indiana bats.

Location	**Sex and/or Age**	# of **bats**	Distance (km/ **mi)**	**Study**
Kentucky	Males/females	14/1	max. 2.4 km (1.46 mi) +/- 0.15 km (0.25 mi)	Kiser and Elliot 1996
Missouri	Adults	6	max. 2 km (1.2 mi)	LaVal et al. 1977
Florida	Adults / Young	25 / 28	0.82 km (.49 mi)	Humphrey et al. 1995
Pennsylvania	Males / Females	1 / 7	max 3.6 km (2.2 mi)	(Hassinger and Butchkoski 2001)