



A Gap Analysis of the UrBIN Pilot Project Watershed

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A GAP ANALYSIS OF THE UrBIN PILOT PROJECT WATERSHED

FINAL REPORT

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EXECUTIVE SUMMARY

The Urban Biodiversity Information Node (UrBIN) is a part of the National Biological Information Infrastructure (NBII) coordinated by the U.S. Geological Survey's Biological Resource Division (USGS-BRD). This project was initiated to compile information about biodiversity within the Hunting Creek watershed in Northern Virginia. The UrBIN Gap Analysis Project (GAP) was funded by the National Gap Analysis Program to provide additional biodiversity information from the information compiled in UrBIN. Thus, the UrBIN GAP is a cooperative effort between the National Gap Analysis Project and the NBII UrBIN.

The major objective of this project was to apply Gap Analysis to the Hunting Creek watershed, a heavily urbanized area located in the Washington D.C. metropolitan area. The watershed includes portions of Fairfax County and the cities of Alexandria and Falls Church. Sub objectives of this project were (1) produce GIS-databases describing the actual land cover type, predicted distributions of terrestrial vertebrates, and land management status at a target scale of 1:24,000, (2) identify land cover types and terrestrial vertebrate species that currently are not represented or are underrepresented in areas managed for biodiversity (i.e., "gaps"), and (3) facilitate cooperative development and use of information so that institutions, agencies, and private land owners may be more effective stewards of natural resources. This project is a preliminary step toward the more detailed efforts and studies needed for long-term planning for biodiversity within Virginia's increasingly urban landscape.

We used a modified Anderson (1976) level 1 classification scheme and mapped the area to 5 general classes (forest, residential, developed, park/field, and open water). Mapping was done using TNT-MiPS image processing software. An ISODATA unsupervised classification was performed on the 6 bands of imagery. The resulting clusters were then assigned a land cover classification by interpreting a false color-infrared RGB display of the same Landsat ETM imagery. We assessed the accuracy of the classification by comparing pixel values with a random sample of 258 points referenced to digital aerial photography. The overall map accuracy was 72.7% (kappa 0.602).

We created predicted distributions for 228 vertebrate species (23 amphibians, 32 reptiles, 25 mammals and 148 birds) known or likely to be present within the watershed. Information on wildlife habitat relationships was largely obtained from BOVA, a computerized fish and wildlife information system developed cooperatively by the VDGIF and the Fish and Wildlife Information Exchange in Blacksburg, Virginia (now a division of the Conservation Management Institute). Each predicted species distribution is a function of 1 or more GIS layers, including land cover, wetlands (NWI) and various layers created from these, such as distance to water, or forest patch size. Individual species' biology dictated which and how many layers were used for each model.

Because of the urbanized nature of the study area, traditional gap stewardship properties such as wilderness areas, national forests, and national parks, do not apply. What undeveloped land remains is typically municipal parkland. We therefore used county and city parklands as a surrogate for important conservation lands (status 1). These properties comprise approximately 6% of the watershed area.

Of the 228 species modeled in UrBIN GAP, about three-quarters (167/228) of the species had between 10% and 50% of their predicted distribution within status 1 lands. Approximately 5% (11/228) of species have less than 1% of their predicted distribution within status 1 lands, and only 6% (13/228) of species have more than 50% of their predicted distribution within status 1 lands.

We identified species that may be vulnerable based upon the size of their predicted distribution within the watershed and the portion of the distribution found on status 1 lands. We considered species with a moderate or restricted distribution in the watershed with low representation on status 1 lands to be at greater risk. We found that most species are represented more than expected on status 1 lands. No amphibians or reptiles, and only 2 mammals, are represented less than expected on status 1 lands. Most birds are also represented more than expected. Given the heavily urbanized nature of the watershed, we believe that these results suggest that many species are present within the watershed only because of the refuge that parks provide, and that many species likely had larger distributions prior to urbanization. In support of this, many species found in greater proportion on status 1 lands require larger areas of contiguous forest or areas buffered from development, and within the study area only parks provide these requirements. With the exception of status 1 lands, nearly all developable lands have been utilized for residential or industrial purposes.

These results emphasize the importance that parks may play in species conservation within the watershed. Without these refuges some species may be lost from the watershed. Most of the status 1 areas within the watershed are managed for recreation rather than biodiversity, and the potential for increasing biodiversity protection within the watershed is therefore great.

1. INTRODUCTION

How This Report is Organized

This report is a summation of a scientific project. While we endeavor to make it understandable for as general an audience as practicable, it reflects the complexity of the project it describes. The organization of this report follows the general chronology of project development, beginning with the production of the individual data layers and concluding with analysis of the data. It diverges from standard scientific reporting by embedding results and discussion sections within individual chapters. This was done to allow the individual data products to stand on their own as testable hypotheses and provide data users with a concise and complete report for each data and analysis product.

This report contains both new text and sections taken from the Gap Analysis Final Report template used by the National Gap Analysis Program. We gratefully acknowledge all those who contributed in its writing.

We begin with an overview of the Gap Analysis Program mission, concept, and limitations. Finally, we introduce this project and briefly describe the study area.

The Gap Analysis Concept in the UrBIN Context

The mission of the Gap Analysis Program is to prevent conservation crisis by providing conservation assessments of biotic elements (plant communities and native animal species) and to facilitate the application of this information to land management (Klopfer and McClafferty 2001). Although this idea can be applied in an urbanized landscape, the opportunities are few and the expense is high. With limited resources available to land management entities within this landscape, management of biodiversity is often a by-product to more pressing social needs.

However, it is of interest to all parties to examine what remains in the urbanized landscape. Just as it would be ludicrous to assume biodiversity is unchanged when the greater landscape changes from natural types to a built environment, so too is it unreasonable to assume that species numbers drop to near zero. This project will provide information as to which species are likely to persist in the urban landscape and which will likely disappear, thereby further delineating which species are “gap species” in the original spirit of the word.

In UrBIN GAP, we feel it is less useful to follow the objectives expected of regional or state projects but adhere closely to the premise of the program. By utilizing the same basic steps, we are able to not only identify which species are likely to disappear from the Hunting Creek watershed (if indeed they remain) but also gain insight into the importance of remaining lands to biodiversity across broader regions.

Introduction – UrBIN GAP

Development, and the resulting loss of natural habitat, is the greatest threat to wildlife biodiversity. However, the loss of native diversity is not complete, and many species may persist in an urban landscape if their basic habitat needs are met, or they can successfully adapt to the changing environment.

Often, municipal agents are tasked with balancing economic development, quality of life, and environmental quality. This is increasingly difficult when one directive is directly counter to another. It is useful for these agents to have some information on what wildlife resource remains in their landscape, and to know where these resources are concentrated. This allows for more effective decision-making in the face of many, often conflicting, interests.

This information is difficult to obtain. With limited resources allocated to project review and municipal management, detailed surveys of biodiversity are impractical. A reasonable alternative is species distribution modeling. This allows for spatial representations based on information that is much easier and less expensive to compile and work with. The resulting predicted distributions can illustrate the likely presence of species within a given area with relative accuracy.

This type of analysis has been used successfully by the USGS National Gap Analysis Program to assess biodiversity for many states, regions, and waterways in the continental US. This same protocol is also being used in Canada, Mexico, and other places. The basic concept behind Gap Analysis is that species (and their habitat) can be modeled accurately over large areas, and the resulting distributions can be quantified in terms of the amount of a species distribution in “protected” status. Hence, species not found on existing protected lands (called “stewardship lands”) would be designated as “gap” species, since managers have little ability to implement management activities to affect the species (either positively or negatively).

The techniques used to synthesize predicted species models and project them on the landscape can be used in the urban situation to show where species are expected to occur, and from that estimates of biodiversity can be obtained. These data could then be used to show managers where areas of high biodiversity are located within their municipality and how valuable individual parcels are to the whole area. The contributions of specific parks, natural areas, or other non-developed areas can be evaluated as a function of the whole area of interest, allowing managers to make more informed decisions about development.

Another advantage to completing a Gap Analysis for an urban landscape is that it allows us to examine the post-development landscape and the importance of protected land to diversity. Often, Gap Analysis identifies the sites that require the most protection, whereas developed landscapes contain little remaining land of significant biodiversity conservation value. So, the benefit of completing a Gap Analysis in these types of landscapes is that we can quantify the biodiversity preservation result of protecting tracts of natural habitat from further development.

Study Area – Hunting Creek Watershed

The purpose of this investigation was to complete a Gap Analysis for the Hunting Creek watershed. This area includes Holmes and Tripps Run, Cameron Run, Hunting Creek, and Lake Barcroft watershed located in Arlington, Falls Church, and Fairfax County region of Northern Virginia (Figure 1-1). This 29,000-acre watershed was investigated as part of the UrBIN pilot study. This watershed has predominantly developed land areas dissected with major roads and industrial centers. Scattered throughout the landscape are forested parks, natural areas, wetlands, and other vegetated open spaces (Figure 1-2). Even though this area is largely urbanized, there are several areas that are likely to provide sufficient habitat for a suite of species. Our goal is to identify these areas through the Gap Analysis process and assess their value to the overall biodiversity network.

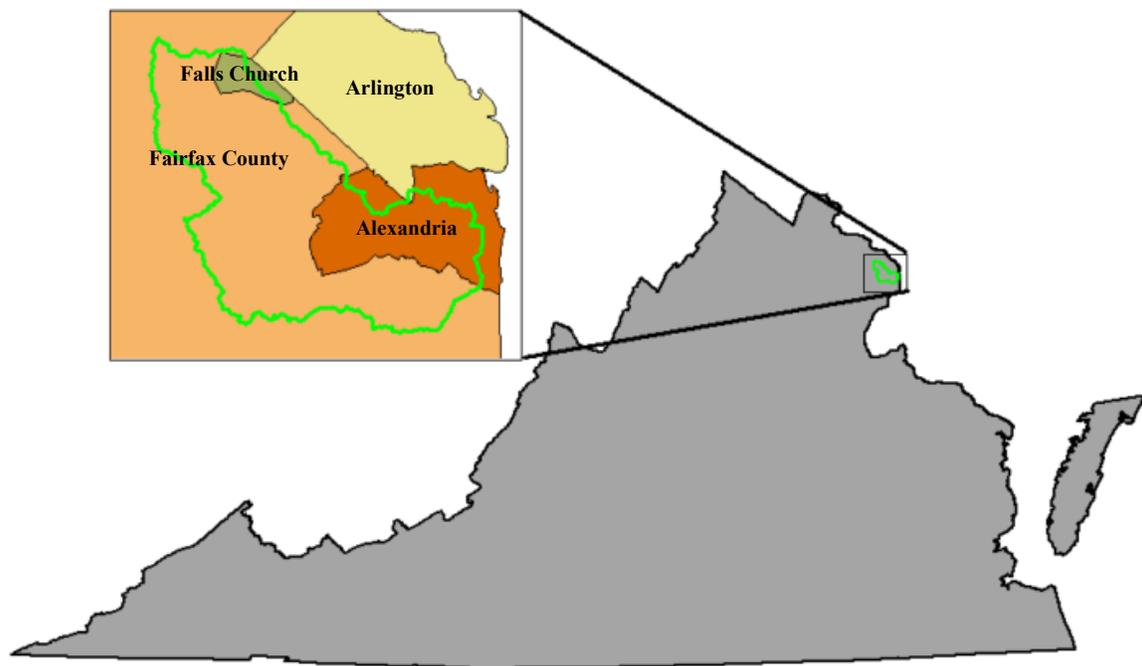


Figure 1-1. The study area is located in Northern Virginia and is comprised, in part, by Fairfax County, the city of Falls Church, and the city of Alexandria.



Figure 1-2. The color-infrared digital orthoquad (1998) shows the interspersion of residential areas with forested parks and impervious surfaces.

2. LAND COVER CLASSIFICATION AND MAPPING

Introduction

A prerequisite for creating potential species distribution maps is a habitat surface. This layer must match species models in order to provide the spatial context in which to depict the predicted distribution.

The appropriate habitat surface will have selected characteristics judged to be most adequate for the modeling task. These characteristics fall into two general categories of thematic and spatial characteristics. For the UrBIN GAP, we first had to identify the desired level of spatial and thematic accuracy, and then create the habitat surface from the many geospatial layers available to us. We then created each spatial layer within the appropriate context of the actual species models developed concurrently.

Methods

Mapping Standards, Data Sources, and Land Cover Classification:

The target mapping scale for the UrBIN GAP effort was 1:24,000. This scale is much greater than that of previous gap investigations in Virginia. The scale of the VA-GAP was 1:100,000 (Klopfer and McClafferty 2001) with a minimum mapping unit of 30 m; matching the pixel resolution of the available Landsat TM imagery. We chose to use Landsat ETM imagery for this project, which also has a pixel resolution of 30 m. This level of detail is necessary to incorporate the fine-scale landscape heterogeneity of the urban-suburban area in which this study was conducted. Although this level of detail is prone to some thematic error, we felt the benefits outweighed the costs.

A basic land-use land cover map is integral to any Gap Analysis effort, and the UrBIN GAP is no exception. Most Gap Analysis projects have utilized remotely sensed imagery to provide current, accurate base information with which to synthesize habitat surfaces. Our imagery was taken in October of 2001 during the leaf-off time period. This imagery was provided to us in a georectified format through the Multi-Resolution Landscape Characteristics Consortium 2000. The UrBIN watershed is located entirely within the row 15, path 33 image (Figure 2-1).

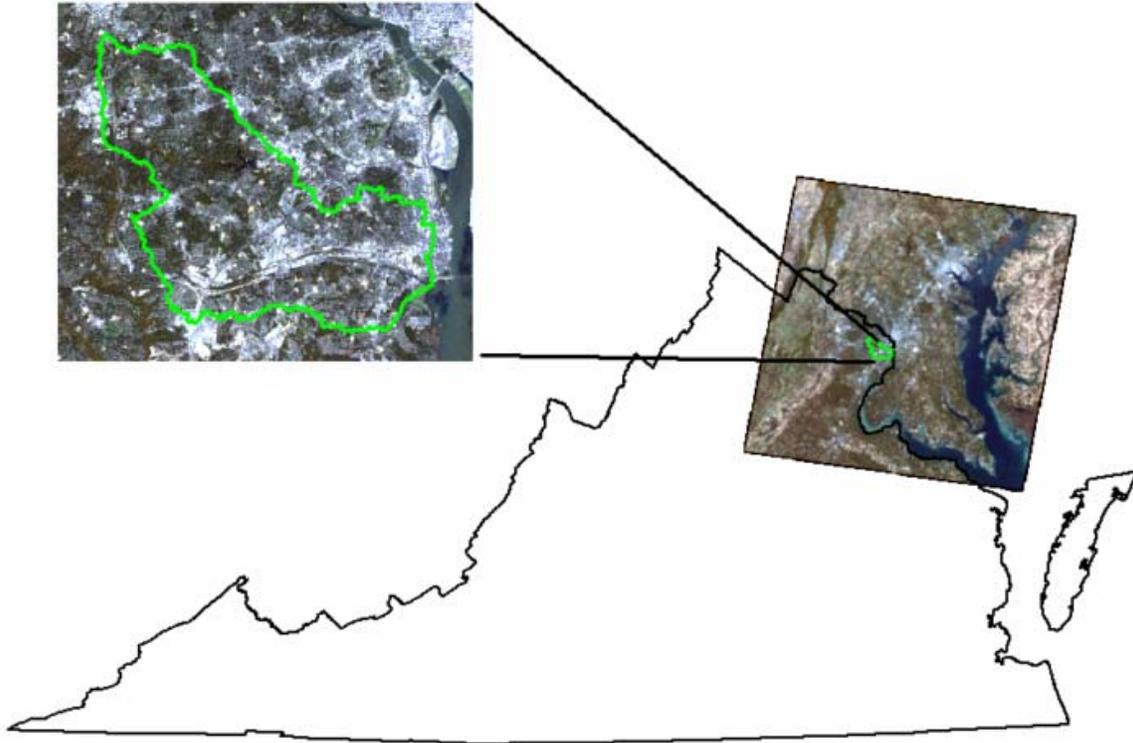


Figure 2-1. True-color image composite of Landsat ETM path 15 row 33 used for UrBIN GAP.

The watershed area was buffered by 1 km in order to avoid edge-effects in proximity functions, and the resulting polygon was used to cut out the study area from each band of raw imagery. We elected to use a relatively simple land cover classification system for this project. We used a modified Anderson (1976) level 1 classification scheme and mapped the area to 5 general classes (Table 2-1).

Mapping was conducted using TNT-MiPS (MicroImages, Inc., 11th Floor - Sharp Tower, 206 South 13th Street, Lincoln NE 68508-2010, USA) image processing software. An ISODATA unsupervised classification was performed on the 6 bands of imagery. The resulting clusters were then assigned a land cover classification by interpreting a false color-infrared RGB display of the same Landsat ETM imagery (Figure 2-2).

Table 2-1. Land cover classes used in the URBIN GAP and their descriptions.

| Class Name | Class Description |
|------------------------|---|
| Predominantly Forested | This class is predominantly covered by relatively continuous forest canopy. May include residential areas with heavy tree cover. |
| Residential | A mixed class of structure, open/lawn, and woody vegetation found in close proximity (often < 100m) from each other. Also includes some impervious surface. |
| Developed | Areas largely covered by impervious surfaces. This class includes parking lots, industrial areas, and travel corridors. |
| Open/Groomed/Field | Areas dominated by herbaceous vegetation; usually highly managed (includes golf courses, cemeteries, and school grounds). |
| Open Water | Areas dominated by surface water; includes ponds, lakes, and wider open-canopy rivers |

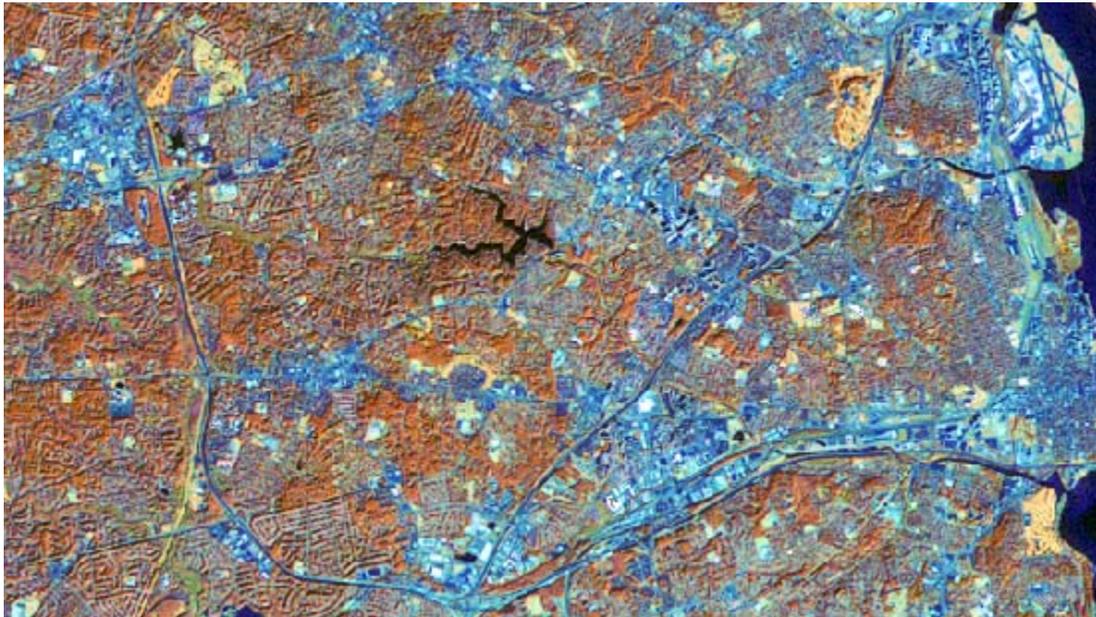


Figure 2-2. Color-infrared composite of Landsat ETM imagery used to guide the landcover classification. Lake Barcroft appears as a black-body, while forest canopy appears as various shades of red and developed areas are clearly identified in blues. Note that the resolution of the imagery is sufficient to recognize strips of trees found in residential developments.

The final land cover map consisted of 5 distinct classes (Figure 2-3). These represented various levels of vegetated coverage and development. Although the land cover class is important, we required additional information for our species modeling efforts. Spatial characteristics such as patch size and juxtaposition are equally important to predict whether a species can exist on a specific parcel of land. In order to create the most accurate distribution models, we derived several spatial layers from the final landcover map. The ancillary spatial datasets derived from the land cover map are described in detail in Chapter 3 (Distribution Modeling).

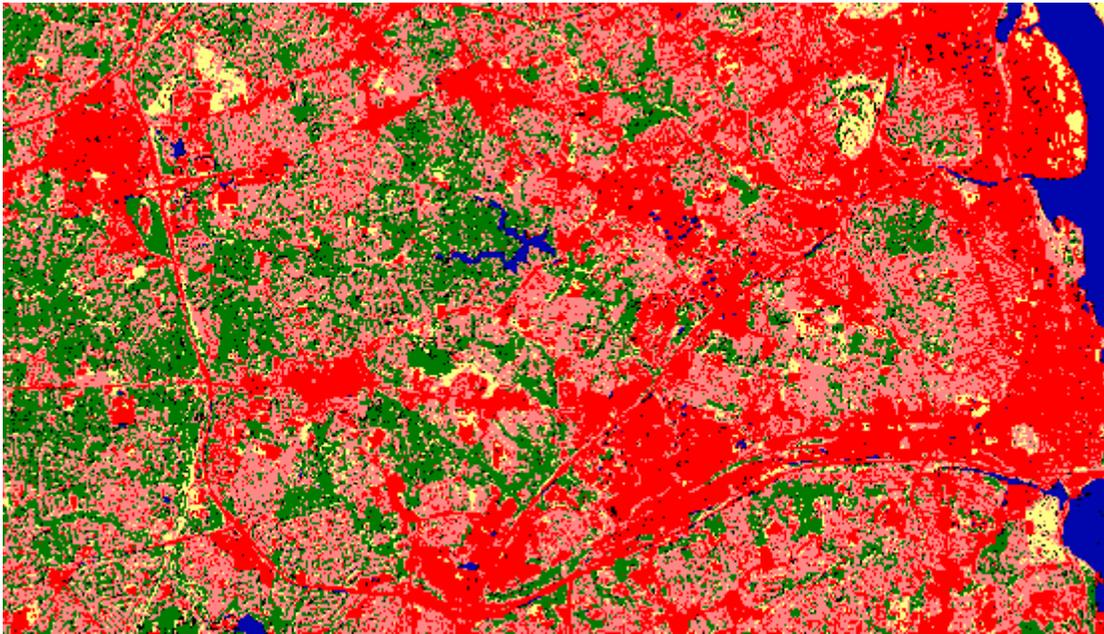


Figure 2-3. Final classified image with land cover classes for forest (green), residential (pink), developed (red), and open/field (yellow).

Key large-scale landscape water features were largely unavailable from the Landsat imagery. These include small holding ponds, wetlands, and streams with obvious wildlife potential that were not well represented in the final land cover map. We elected to use the available 1:24,000 National Wetlands Inventory (NWI) (U.S. Fish and Wildlife Service) for the study area to identify these small wetland and open water areas. This dataset was rasterized to match the land cover map and was used only in the species modeling stage of the project. We also created proximity data layers derived from the wetland layer that included wetland size and proximity to wetland (see Distribution Modeling).

Results and Discussion

The land cover map provided the basic information necessary to complete the species modeling activities. Many similar mapping efforts attempt to classify land cover to a finer thematic resolution by attempting to identify dominant species within the vegetation community. Although this type of mapping can be useful, we did not require that level of thematic detail for the UrBIN GAP. There are few cases of species requiring such specific floristic detail in this watershed, and the costs of producing such a map for those species far outweighs the available time and funding resources. It is also preferable to have a less-detailed but more thematically accurate map.

It is important to note that the purpose of the land cover map was for input for species distribution modeling. Species models require spatial representations of habitat, and land cover alone cannot account for all the information necessary to define habitat. Although we attempted to include other important components of habitat (e.g., edge, patch size, etc.) we can never truly capture all the information driving species habitat. The scale is too small for that sort of operation. We can, however, make general inferences about what habitat characteristics are likely found within, or are intrinsic to, these more general land cover classes.

The heterogeneity of the suburban-urban landscape within the watershed makes mapping difficult. Much of the landscape is in the residential class (Table 2-2), which is spectrally heterogeneous within itself. Since much of the landscape is heterogeneous considerable spectral mixing is expected and generalizations of this pattern (i.e., through filtering or smoothing) would only introduce more spatial and thematic error. For these reasons we chose to work with the resulting land cover map without generalization.

Table 2-2. Summary of area and composition of the UrBIN GAP study area.

| Land Cover Class | Area (ha) | % Of Watershed |
|-------------------------|------------------|-----------------------|
| Forest | 2,996 | 25.5 |
| Residential | 4,593 | 39.2 |
| Developed | 2,654 | 22.6 |
| Open/Field | 1,409 | 12.0 |
| Water | 79 | 0.7 |
| Total | 11,731 | |

Accuracy Assessment

Introduction:

GAP land cover maps are primarily compiled to answer the fundamental question in Gap Analysis: what is the current distribution and management status of the major natural land cover types and wildlife habitats? Besides giving a measure of overall reliability of the land cover map for Gap Analysis, the assessment also identifies which general classes or which regions of the map do not meet the accuracy objectives for the Gap Analysis

Program. Thus the accuracy assessment identifies where additional effort will be required when the map is updated. We report the results of the accuracy assessment, believing that the map is the best map currently available for the project area.

The purpose of accuracy assessment is to allow a potential user to determine the map's "fitness for use" for their application. It is impossible for the original cartographer to anticipate all future applications of a land cover map, so the assessment should provide enough information for the user to evaluate fitness for their unique purpose. This can be described as the degree to which the data quality characteristics collectively suit an intended application. The information reported includes details on the database's spatial, thematic, and temporal characteristics and their accuracy.

Assessment data are valuable for purposes beyond their immediate application to estimating accuracy of a land cover map. The reference data are therefore made available to other agencies and organizations for use in their own land cover characterization and map accuracy assessments. The data set will also serve as an important training data source for later updates.

Even though we have reached an endpoint in the mapping process where products are made available to others, the Gap Analysis process should be considered dynamic. We envision that maps will be refined and updated on a regular schedule. The assessment data will be used to refine GAP maps iteratively by identifying where the land cover map is inaccurate and where more effort is required to bring the maps up to accuracy standards. In addition, the field sampling may identify new classes that were not identified at all during the initial mapping process.

Methods:

The accuracy of the land cover map was assessed by comparing pixel values with a random sample of points referenced to digital aerial photography (USGS DOQQ 1998). A total of 519 points were evaluated. Points were overlaid onto the photographic image, and each point was classified based on the land cover class depicted in the image. Sample points within heterogeneous land cover or within 30 m of the edge of different habitat types were excluded from analyses. Points were then overlaid onto the land cover map, and their corresponding pixel values were extracted. These points were placed into a contingency table and several measures of accuracy were calculated.

Results:

The results of the accuracy assessment are provided in Table 2-3. Of the 519 points in the set, 258 were used in this assessment, and all cover types had a minimum of 16 assessment points. The overall map accuracy was 72.7% (kappa 0.602). Consumer's accuracy ranged from 37.0-83.5%. Producer's accuracy ranged from 62.5%-92.9%. The highest producer's accuracy was observed in the High Development cover type; 52 of 56 (92.9%) reference pixels were correctly classified for this type. The highest consumer's accuracy (83.5%) was observed in the Residential cover type.

Table 2-3. Contingency table and accuracy assessment for the land cover map.

| Reference image | Classified image | | | | Totals | PA (%) | EO (%) | EC (%) |
|-----------------|------------------|-------------|------------------|------------|--------|--------|--------|--------|
| | Forested | Residential | High Development | Open/field | | | | |
| Forested | 38 | 13 | 7 | 2 | 60 | 63.3 | 36.7 | 35.0 |
| Residential | 21 | 86 | 6 | 13 | 126 | 68.3 | 31.7 | 13.5 |
| High Develop | | 2 | 52 | 2 | 56 | 92.9 | 7.1 | 30.4 |
| Open/field | | 2 | 4 | 10 | 16 | 62.5 | 37.5 | 106.3 |
| Totals | 59 | 103 | 69 | 27 | 258 | | | |
| CA (%) | 64.4 | 83.5 | 75.4 | 37.0 | | | | |

Percent Correct = 72.7%

Kappa = 0.602

Note. CA, consumer's accuracy; PA, producer's accuracy; EO, errors of omission; EC, errors of omission.

Limitations and Discussion

The methods employed by the research team proved appropriate for land cover mapping at this scale. Furthermore, we achieved a suitable level of classification accuracy, given the objectives of this project, and the difficulties imposed by a heterogeneous urban landscape. However, the classification of some cover types was notably more accurate than others, and this discrepancy deserves some discussion. In particular, the user's accuracy for the Open/Field class is much lower than other classes, even though the producer's accuracy for this class is comparable to others. Much of this error is due to an apparent misclassification of Residential as Open/Field; 13 of 17 errors in occurred in this way (Table 2-3). This misclassification is understandable, because many residential areas are a mix of housing, shrubs/trees, and grass lawns. The spectral signatures of Open/Field and grass lawns were nearly identical. Thus, residential areas with large grassy areas (i.e., several separate lawn areas immediately adjacent to one another) may have occasionally been misclassified as Open/Field.

Ideally accuracy assessment should be accomplished with a reference image acquired at the exact same time as the classified image. In reality, however, these two data sources rarely correspond temporally. In this study, we used the best available data -- a reference image from 1998 and Landsat data from 2001 to produce the land cover map. As a result, we believe the true accuracy of the land cover map is higher than reported here. In support of this, we observed several clusters of High Development on the land cover map that appeared to be forest on the reference map. These clusters of misclassified pixels are very likely the result of development between 1998 and 2001. We observed similar discrepancies between Open/Field and High Development. Table 2-3 illustrates these relationships.

Our accuracy assessment was able to provide reasonable estimates of map class accuracy. Some classes still need improvement. We believe this map is sufficient to provide a habitat surface with which to model species predicted distributions. In fact, the majority

of the species macrohabitat information that we required for this project is more general than what is available here. Therefore, the land cover map may be more functionally accurate than the accuracy assessment indicates. We believe our objective has been successfully achieved.

3. PREDICTED ANIMAL SPECIES DISTRIBUTIONS AND SPECIES RICHNESS

Introduction

All species range maps are predictions about the occurrence of those species within a particular area (Csuti 1994). Traditionally, the predicted occurrences of most species begin with samples from collections made at individual point locations. Most species range maps are small-scale (e.g., >1:10,000,000) and derived primarily from point data to construct field guides that are suitable, at best, for approximating distribution at the regional or county level for example. The purpose of the GAP vertebrate species maps is to provide more precise information about the current predicted distribution of individual native species according to actual habitat characteristics within their general ranges and to allow calculation of predicted area of distributions and associations to specific habitat characteristics.

Typical GAP maps are produced at a nominal scale of 1:100,000 or better and are intended for applications at the landscape or "gamma" scale (heterogeneous areas generally covering 1,000 to 1,000,000 hectares and made up of more than one kind of natural community). Because of the uniqueness of this project, we have created maps at a larger scale. However, applications of these data to site- or stand-level analyses (site--a microhabitat, generally 10 to 100 square meters; stand--a single habitat type, generally 0.1 to 1,000 ha; Whittaker 1977, see also Stoms and Estes 1993) will likely reveal the limitations of this process to incorporate differences in habitat quality (e.g., understory condition) or necessary microhabitat features such as standing dead trees.

Gap Analysis uses the predicted distributions of animal species to evaluate their conservation status relative to existing land management (Scott et al. 1993). However, the maps of species distributions may be used to answer a wide variety of management, planning, and research questions relating to individual species or groups of species. In addition to the maps, great utility may be found in the consolidated specimen collection records and literature that are assembled into databases used to produce the maps. Perhaps most importantly, as a first effort in developing such detailed distributions, they should be viewed as testable hypotheses to be confirmed or refuted in the field. We encourage biologists and naturalists to conduct such tests and report their findings in the appropriate literature and to the Gap Analysis Program such that new data may improve future iterations.

Previous to this effort there were no maps available, digital or otherwise, showing the likely present-day distribution of species by habitat type across their ranges. Because of this, ordinary species (i.e., those not threatened with extinction or not managed as game animals) are generally not given sufficient consideration in land-use decisions in the

context of large geographic regions or in relation to their actual habitats. Their decline, because of incremental habitat loss can, and does, result in one threatened or endangered species "surprise" after another. Frequently, the records that do exist for an ordinary species are truncated by state boundaries. Simply creating a consistent spatial framework for storing, retrieving, manipulating, analyzing, and updating the totality of our knowledge about the status of each animal species is one of the most necessary and basic elements for preventing further erosion of biological resources.

Methods

Mapping Standards and Data Sources:

We began this process by obtaining the Biota of Virginia (BOVA) database, a computerized fish and wildlife information system developed cooperatively by the VDGIF and the Fish and Wildlife Information Exchange in Blacksburg, Virginia (now a division of the Conservation Management Institute). BOVA contains information on the status, life history, habitat requirements and distribution of over 650 vertebrate species and subspecies. An example species profile is given in Appendix A. We used the BOVA database to identify species known or likely to exist within the watershed. For purposes of this project we modeled only mammals, amphibians, reptiles, and birds, and we excluded accidental or extinct species. In addition, we excluded some species that are likely extremely rare due to inadequate habitat or due to habitat that could not be accurately modeled at the scale of this study. Species that are likely present in the watershed but not modeled are presented in Appendix B. In total, we modeled 228 species, including 148 birds, 32 reptiles, 23 amphibians, and 25 mammals (Appendix C).

Both breeding and non-breeding birds were included in an effort to capture the cumulative diversity within the watershed. However, because of the migratory nature of many birds, we treated breeding, resident, and wintering birds separately. Breeding birds were those that regularly breed within the watershed, but winter elsewhere (including many Neotropical migrants). Resident birds breed and winter within the watershed and wintering birds are generally present only during the non-breeding season. Furthermore, because of the unique habitat requirements of waterfowl, we treated non-breeding waterfowl as a separate group. We used results from the Audubon Society's Christmas Bird Count at Fort Belvoir (approximately 3 miles in distance) to identify species that are likely to winter within the watershed. Species observed 8 of the last 12 years (1990-2001) were considered to winter within the study area.

In addition to BOVA, we acquired a National Wetland Inventory (NWI) coverage (1:24,000) for the study area. The NWI coverage contains information on the location, extent, and characteristics of wetland and deepwater habitats within the watershed.

Wildlife Habitat Relationships:

Information on wildlife habitat relationships was largely obtained from BOVA, which contains habitat codes that could be linked to the NWI map and the land cover map. These habitat relationship fields are the result of extensive literature reviews and expert

analyses prior to the initiation of this project. Many habitat classes in BOVA were more specific than were available for this project. For instance, BOVA distinguishes between deciduous forest, evergreen forest, and mixed forest habitat types, but the land cover map used in part to create distributions in this project had only 1 forest class. Likewise, BOVA contains information regarding species habitat associations with wetland habitat types that were sometimes more specific or general than the NWI map. In these cases, we used appropriate published material to help discern wildlife habitat relationships, and habitat translations from BOVA to terrestrial land cover codes and NWI wetland types were accomplished manually. Supplementary references are given in Table 3-1.

Based on information in BOVA and elsewhere we created a species by land cover type matrix and a species by wetland type matrix. Each table was populated with 1s and 0s representing potentially suitable/not suitable habitat types for each species and habitat combination. This process was carried out for each species group. These tables were the foundation upon which models were developed, but nearly all species required additional modeling effort, described below.

Table 3-1. References used (in addition to BOVA) to develop predicted species distribution models. Full citations are presented Literature Cited.

| Group | Reference |
|--------------|---|
| Amphibians | Petranka (1998) Martof et al. (1980) |
| Reptiles | Mitchell (1994) Martof et al. (1980) |
| Birds | Hamel (1992) |
| Mammals | Burt and Grossenheider (1980) Schwartz and Schwartz (1981) |

Distribution Modeling:

Each predicted species distribution is a function of 1 or more GIS layers, including land cover, wetlands (NWI) and various layers created from these, such as distance to water, or forest patch size. A complete list of layers used in the species modeling process is presented in Table 3-2. Individual species' biology dictated which and how many layers were used for each model. In general, however, we used a parsimonious modeling approach, and developed each model with the fewest number of variables required to produce a reasonable predicted distribution.

For each species, based on its' unique biological requirements, a Boolean expression was developed that describes which layers and operations were used to create that species' predicted distribution. A GIS computer program was then developed to read this expression and create species models in batch mode. This approach has great utility in that models are easily interpreted and readily modified, if necessary. Expressions used to create models are presented in Appendix C and supplementary modeling information is presented in Appendices D-F

Specific notes on birds:

Models attempt to identify likely *breeding* habitat for Breeding and Resident Birds. Thus, although some species, such as the Red-tailed Hawk, may forage extensively throughout the watershed, we have identified only those areas where the species is likely to nest. We feel that this approach is more useful than simply highlighting the entire watershed. As described above, we used information presented in BOVA and Hamel (1992) to discern wildlife habitat relationships. For species requiring forest interior conditions or areas of extensive forest, we used minimum tract size values from Hamel (1992). However, because there are few large forest patches within the study area and using values in Hamel (1992) tended to produce distributions of no or very limited extent, even for species known to occur, we modified values in the following way: values between 100 and 999 ha were rounded down to 100 ha, and values greater than 1000 ha were rounded down to 1000 ha. Using this approach we feel we made a reasonable compromise between over- and under- predicting species' distributions.

Results

A total of 228 predicted species distributions were synthesized including 148 birds, 23 amphibians, 32 reptiles, and 25 mammals (Figure 3-1 to Figure 3-3 for sample distributions). Maps of all predicted species distributions are available online at <http://dc-urbanbiodiversity.nbio.gov/gap.html>

Species Richness

GAP has often been associated with the mapping of species-rich areas or "hotspots." Richness maps identify where the same numbers of elements co-occur in the same geographic locations. (In the case of our data, where numbers of animal species are mapped for the same grid cells.) These are color coded or shaded in intensity from the highest numbers of co-occurrence (richness), to the lowest. While we continue to perform this useful pattern analysis, it is only one of many that may be conducted using the data. Richest areas may or may not indicate best conservation opportunities. They may occur in already protected areas or may represent mostly already protected species or those not at risk. Still, they are often a useful starting point to examine conservation opportunities in combination with other analyses described in this report's "Introduction" and in the "Analysis" sections. We also believe they may be useful for other rewarding applications such as identifying places of interest for wildlife observation and study.

Richness is depicted for all species and by species groups. The highest diversity observed for any pixel was 167 species (73% of all species modeled) and the mean value was 32 species (14%). The most diverse areas tended to be larger forested tracts, particularly palustrine forest, and riparian areas. Diversity patterns were different across taxa, but somewhat predictable. Predicted mammal and breeding bird diversity was highest in forested areas, whereas amphibian diversity was predicted greatest in and near wetlands. Likewise, we predicted that heavily developed areas support the fewest number of species.

Limitations and Discussion

The species models created for this project the result of a first attempt to extend existing knowledge about the wildlife to an urban landscape. This is also the first attempt to conduct multi-species watershed level distribution modeling in Virginia. It is important to note that this technique is particularly suited to some species and insufficient for others. Many species require habitat features that could not be mapped, so their actual presence within predicted distributions likely is overestimated or underestimated. Structural characteristics of mapped habitats are not incorporated directly into these models. Thus, the distributions for species requiring habitat features such as high stem densities under a forest canopy (such as some small mammals), or the availability of vernal pools (some amphibians) or tree cavities (some birds/mammals) are likely overestimated. Similarly, highly mobile species and habitat generalists may be underestimated. We can better predict species occurrence with improvements in both species habitat data and tools for mapping habitat features.

It must be emphasized that one goal of this project was to identify areas that are likely to be rich in species, but not necessarily areas important to species at risk. Therefore, endangered, game, exotic, and common species receive equal, simple presence/absence designations. It may be of interest to future efforts to *a priori* select certain species for representation based on a non-biological or ecological criterion.

Overall, this project was successful in synthesizing useful, reasonably accurate information about the diversity of terrestrial vertebrates within an urban landscape. At minimum, we have exposed the need for more comprehensive work.

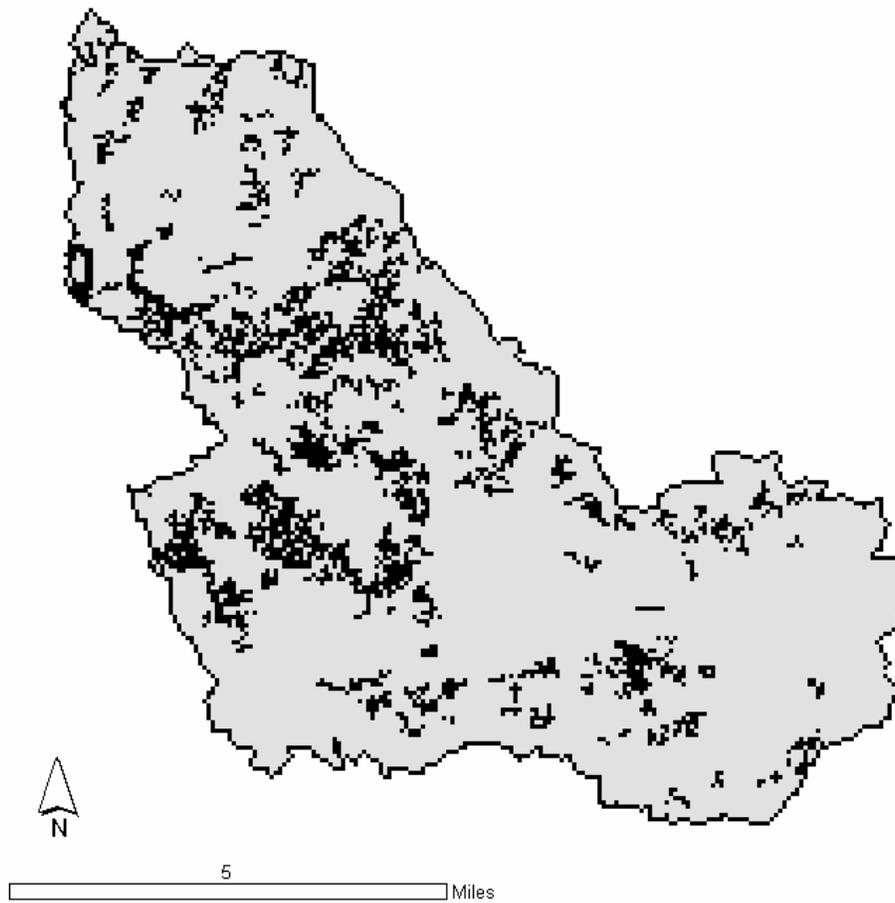


Figure 3-1. Sample predicted distribution of wood thrush (*Hylocichla mustelina*) within the watershed. The black area depicts the predicted distribution.

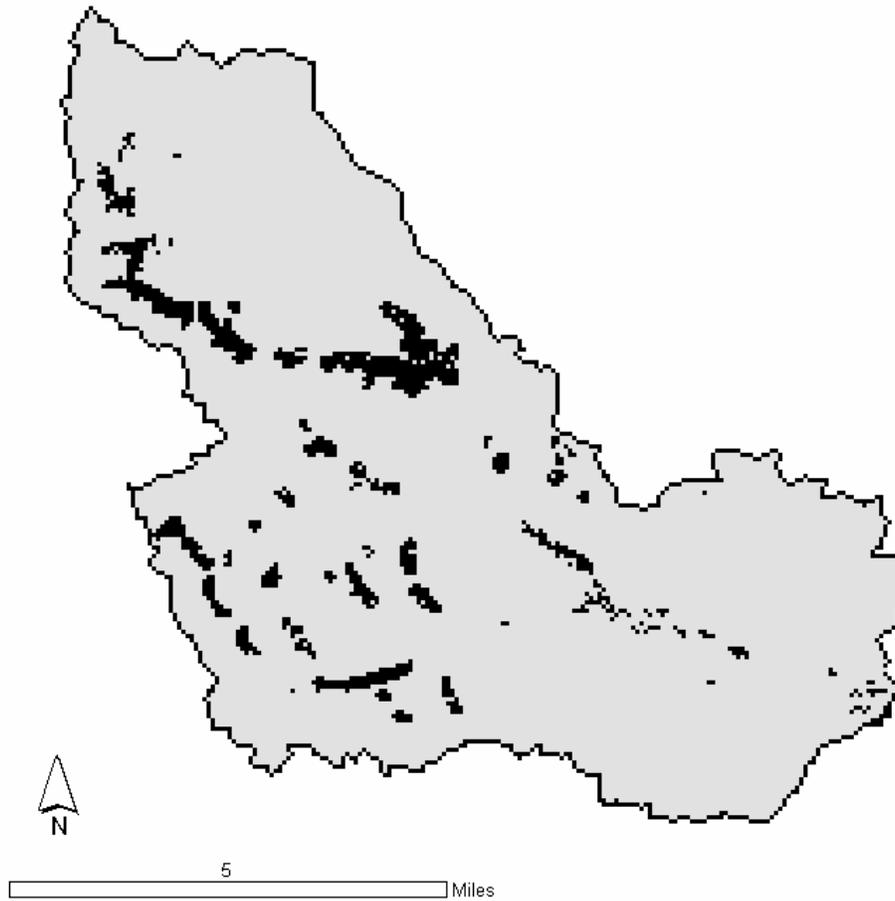


Figure 3-2. Sample distribution of the red-spotted newt (*Notophthalmus viridescens*) within the watershed. The black area depicts the predicted distribution.

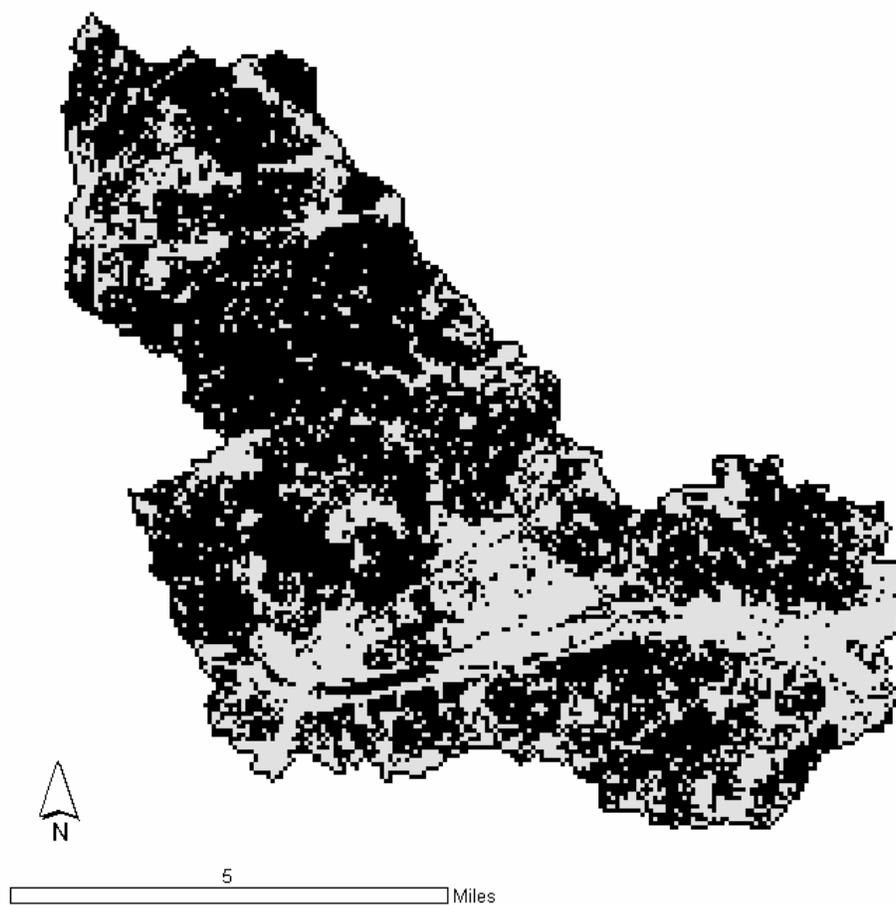


Figure 3-3. Sample distribution of the gray squirrel (*Sciurus carolinensis pennsylvanicus*) within the watershed. The black area depicts the predicted distribution.

Table 3-2. Description of variables used to creates species models. Individual models presented in Appendix C.

| Variable | Description |
|-----------------|--|
| LC_Code | Land cover. Values apply to final land cover map. 1 = Forested, 3 = Residential, 4 = Highly Developed, 5 = Field/Open |
| ForSize | A surrogate for minimum forest (land cover = 1) patch size, defined as the minimum number of contiguous (adjacent) forested pixels required to be potential habitat. 1 ha = 11 pixels. |
| ForEdge | Open areas (land cover = 5) adjacent to forested patches (land cover = 1) >1 ha (11 pixels). |
| ForBuff | Distance (m) from forest patches (ForSize). |
| ForMaj | Regions of high forest cover. Created using the ArcInfo command FOCALMAJORITY. Acceptable land cover codes within ForMaj regions are potential habitat. |
| OpenSize | A surrogate for minimum Open patch size. Defined as the minimum number of contiguous Open pixels (land cover = 5) required to be potential habitat. 1 ha = 11 pixels. |
| WetAreas | Suitable wetlands. Defined as suitable wetland type (from NWI) of the minimum size (m ²). Value from WetSize. |
| WetSize | Minimum wetland size (m ²). |
| ProxH2O | Distance (m) from suitable wetlands (defined by WetAreas), including wetland areas. |
| AdjH2O | Distance (m) from suitable wetlands (defined by WetAreas), not including wetland areas. |
| Industry | Regions of high development (land cover = 4). Created using the ArcInfo command FOCALMAJORITY. |

4. LAND STEWARDSHIP

Introduction

To fulfill the analytical mission of GAP, it is necessary to compare the mapped distribution of elements of biodiversity with their representation in different categories of land ownership and management. As will be explained in the Analysis section, these comparisons do not measure viability, but are a start to assessing the likelihood of future threat to a biotic element through habitat conversion--the primary cause of biodiversity decline. We use the term "stewardship" in place of "ownership" in recognition that legal ownership does not necessarily equate to the entity charged with management of the resource, and that the mix of ownership and managing entities is a complex and rapidly changing condition not suitably mapped by GAP. At the same time, it is typically necessary to distinguish between stewardship and management status in that a single category of land stewardship such as a national forest may contain several degrees of management for biodiversity.

However, this project is unlike typical GAP projects in that the study area is almost entirely urbanized. Consequently, traditional GAP stewardship properties such as wilderness areas, national forests, and national parks, do not exist within the watershed. Furthermore, there are relatively few privately owned conservation lands within the study area, and the specific locations for these parcels could not be obtained. Undeveloped land is typically municipal parkland, sometimes including school ball fields, golf courses etc. Although some of these properties may be of questionable conservation value, local agencies have control over their future use, and thus they provide some measure of conservation potential. For these reasons, in this analysis, we used only two stewardship categories: parklands (referred to as Status 1) and other (referred to as Status 2). Status 2 properties are nearly always commercial or residential developments.

Methods

Stewardship Mapping:

Stewardship maps were compiled entirely from existing digital maps obtained from cooperators. A minimum scale of 1:24,000 was targeted. We identified parkland from GIS coverages obtained from each of municipalities (cities of Alexandria and Falls Church, and Fairfax county) within the study area. Coverages were merged into a single spatial database for the study area and then rasterized. This raster coverage was used in all subsequent analyses.

Results

The Homes/Tripp Run watershed has relatively little land protected in the form of parkland (Figure 4-1), and virtually none in the form of national forests, wilderness areas, or other federal or state protected designations. Less than 6% of the land area exists in

status 1. Although there may be a limited number of landowners currently participating in habitat incentive programs and in other land conservation initiatives, they were not included in stewardship lands, as specific locations for those tracts were not available.

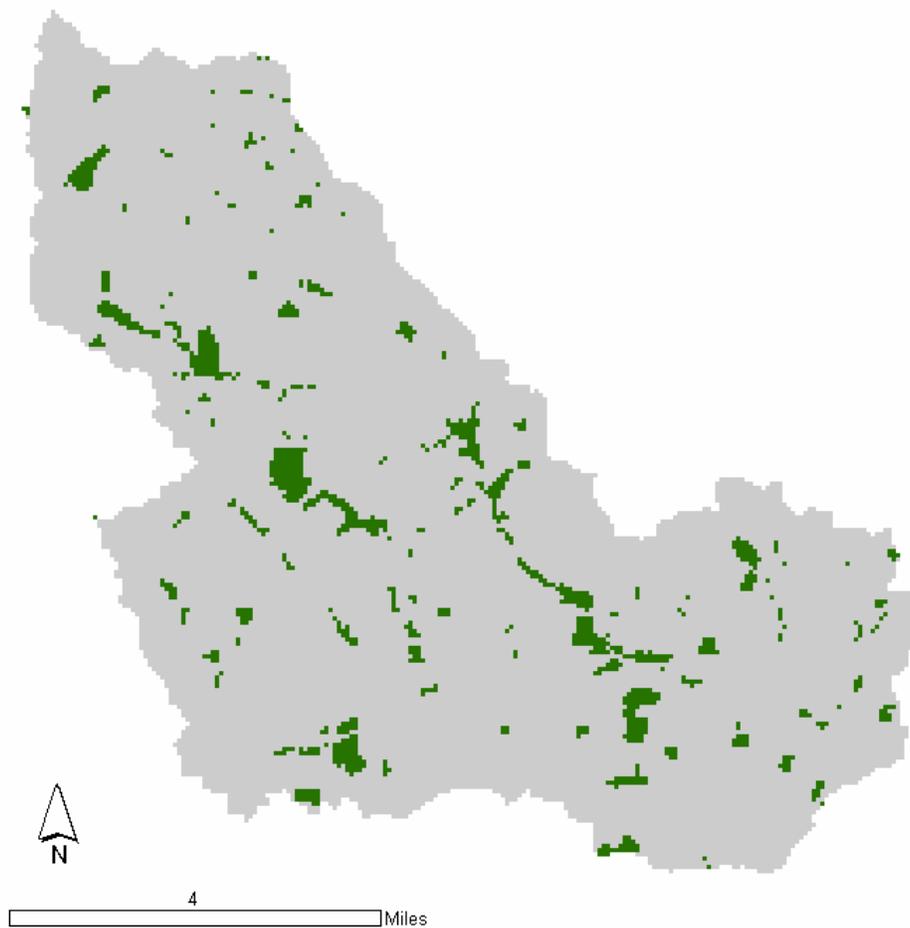


Figure 4-1. Map of status 1 areas (parklands) within the watershed. Approximately 6% of the watershed is composed of status 1 areas.

5. ANALYSIS BASED ON STEWARDSHIP AND MANAGEMENT STATUS

Introduction

This chapter describes the methods and results of the Gap Analysis as used by the Gap Analysis Program. As described in the general introduction to this report, the primary objective of GAP is to provide information on the distribution and status of several elements of biological diversity. Although GAP "seeks to identify habitat types and species not adequately represented in the current network of biodiversity management areas" (Gap Analysis Program 2000), it is unrealistic to create a standard definition of "adequate representation" for either land cover types or individual species (Noss et al. 1995). A practical solution to this problem is to report both percentages and absolute areas of each element in biodiversity management areas and allow the user to determine which types are adequately represented in natural areas. There are many other factors that should be considered in such determinations such as:

- 1) Historic loss or gain in distribution,
- 2) Nature of the spatial distribution,
- 3) Immediate versus long term risk, and
- 4) Degree of local adaptation among populations of the biotic elements that are worthy of individual conservation consideration.

Such analyses are beyond the scope of this project, but we encourage their application coupled with field confirmation of the mapped distributions.

Methods

The Gap Analysis is accomplished by first producing: maps of land cover (Figure 2-3), predicted distributions for selected animal species (see example Figure 3-1), and land stewardship and management status (Figure 4-1). Intersecting the land stewardship map with the predicted species distributions result in tables that summarize the area and percent of total mapped distribution of each species in different land stewardship and management categories. From these data, we can make observations as to which area of the watershed species diversity is highest and which habitats are most important to biodiversity.

Results

Predicted Animal Species Distributions Analysis:

A summary table is not provided due to the large number of species analyzed, but some generalizations and examples of species results by the various thresholds are provided below. The complete Animal Species Distributions Analysis Table found in Appendix G provides the area (in hectares) of the species' mapped distribution by management status and the percent of the species' total distribution in each category. An example record is presented in Table 5-1.

Table 5-1. Example of species distribution by status category.

| Num | Common Name | Scientific Name | Area (ha) | % in Gap 1 | % in Gap 2 |
|------------|------------------------|-----------------------------|------------------|-------------------|-------------------|
| 30002 | Lizard, northern fence | <i>Sceloporus undulatus</i> | 1978 | 12.6 | 87.4 |

A total of 228 species were cross-tabulated with the stewardship map to produce summaries of protection for each species (Appendix G). Species diversity for each group was calculated simultaneously with the individual distributions. About three-quarters (167/228) of the species have between 10% and 50% of their predicted distribution within status 1 lands (Table 5-2). Approximately 5% (11/228) of species have less than 1% of their predicted distribution within status 1 lands, and only 6% (13/228) of species have more than 50% of their predicted distribution within status 1 lands (Table 5-2).

Table 5-2. Percentage of each group with 0-1%, 1-10%, 10-50%, and >50% of their predicted distributions in Gap status 1 lands.

| Group | Total species | 0-1% | | 1-10% | | 10-50% | | >50% | |
|-----------------|----------------------|-------------|----------|--------------|----------|---------------|----------|----------------|----------|
| | | # | % | # | % | # | % | # | % |
| Amphibians | 23 | 0 | 0.0 | 1 | 4.3 | 21 | 91.3 | 1 | 4.3 |
| Reptiles | 32 | 0 | 0.0 | 0 | 0.0 | 30 | 93.8 | 2 | 6.3 |
| Mammals | 25 | 0 | 0.0 | 9 | 36.0 | 12 | 48.0 | 2 | 8.0 |
| Breeding birds | 48 | 6 | 12.5 | 4 | 8.3 | 30 | 62.5 | 8 | 16.7 |
| Resident birds | 60 | 4 | 6.7 | 16 | 26.7 | 40 | 66.7 | 0 | 0.0 |
| Wintering birds | 16 | 1 | 6.3 | 5 | 31.3 | 10 | 62.5 | 0 | 0.0 |
| Waterfowl | 24 | 0 | 0.0 | 0 | 0.0 | 24 | 100.0 | 0 | 0.0 |

Breeding birds were the group best represented in status 1 lands, with 8 of 48 (16.7%) species distributions >50% protected, followed by mammals (8.0%), reptiles (6.3%) and amphibians (4.3). However, breeding birds were also the group with the greatest number of species with <1% of their distribution in status 1 lands. No resident birds, wintering birds, nor waterfowl had >50% of their distributions in status 1 lands.

In order to accurately identify those species that are truly in need of protection in the watershed we must consider the size of their predicted distributions within the watershed. Species that are relatively widespread in the watershed but are not represented on status 1 lands may not require immediate conservation attention. We consider species with a moderate or restricted distribution in the watershed and with low representation on status 1 lands to be at greater risk. In an effort to more readily identify species that meet these criteria, we plotted the predicted distribution of each species as a percentage of the whole watershed (i.e., a value of 100% indicates a species found on every pixel in the watershed) versus the portion of the predicted distribution found on status 1 land as a percentage of all status 1 lands (i.e., a value of 100% indicates a species found on all 1 lands in the watershed) (see Figure 5-1 to 5-4). An equal value (represented by the diagonal line in the graphs) indicates that a species is represented in proportion to its distribution for the watershed. Note this analysis presumes that both habitats and stewardship lands are distributed equally and evenly across the watershed, and this assumption may not be met. This analysis does, however, frame the protection of each species within the context of its overall distribution. We did not choose a specific threshold for determining a distribution large enough to eliminate a need for conservation consideration.

As we are displaying a ratio here, any value of under-representation (i.e., beneath the diagonal line) indicates a possible lack of habitat protection regardless of the size of the distribution. In addition, species with restricted distributions may warrant protection above this level of proportional representation. The concerns for those species with wide distributions may not be as immediate, but they are indeed real.

Individual species are displayed as points on the graphs (Figure 5-1 to 5-4). Species found on or near the diagonal line are found on status 1 lands in relative proportion to their overall distribution. Species found above the line are represented “more than expected” on status 1 lands. Species found below the line are under-represented and may warrant further investigation. We will represent this comparison repeatedly by referring to the species “status coordinate” given in an “X/Y” format where X is the percent of the watershed occupied by the species, and Y is the percent of status 1 areas on which the species is found.

An examination of Figures 5-1 to 5-4 illustrates that most species are represented more than expected on status 1 lands. No amphibians or reptiles, and only 2 mammals, are represented less than expected on status 1 lands. Most birds are also represented more than expected.

In a more typical, less developed landscape, these results might suggest that the current status 1 lands provide most species with a reasonable level of protection from future development. However, we feel that another interpretation is more appropriate within such a heavily urbanized landscape. We believe that these results suggest that many species are present within the watershed only because of the refuge that parks provide, and that many species probably had larger distributions prior to urbanization. In support of this, many species found in greater proportion on status 1 lands require larger areas of

contiguous forest or areas buffered from development, and within the study area only parks provide this requirement. With the exception of status 1 lands, nearly all developable lands have been utilized for residential or industrial purposes.

These results emphasize the importance that parks may play in species conservation within the watershed. Most of the status 1 areas within the watershed are managed for recreation rather than biodiversity. The potential for increasing biodiversity protection within the watershed is therefore great.

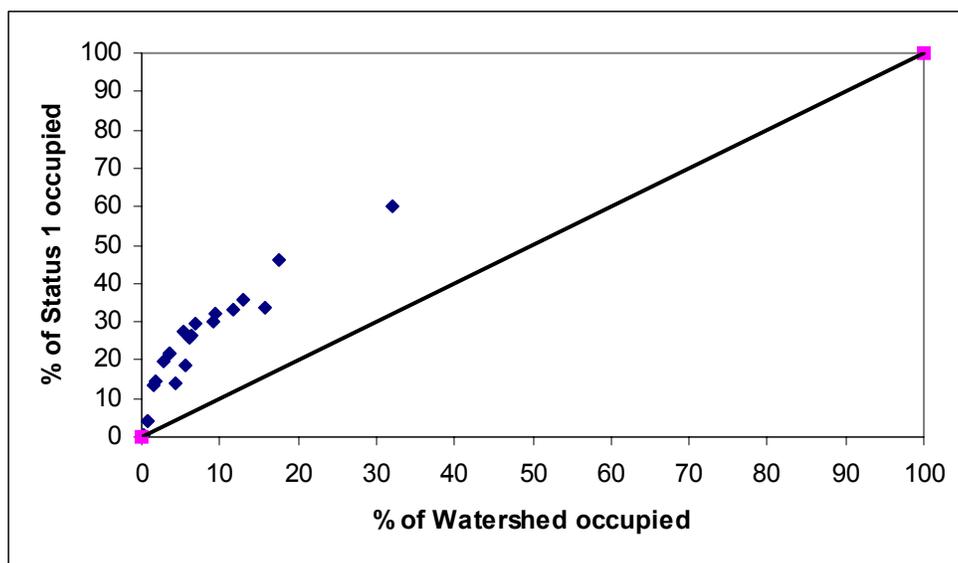


Figure 5-1. Distribution/protection status coordinates for amphibians.

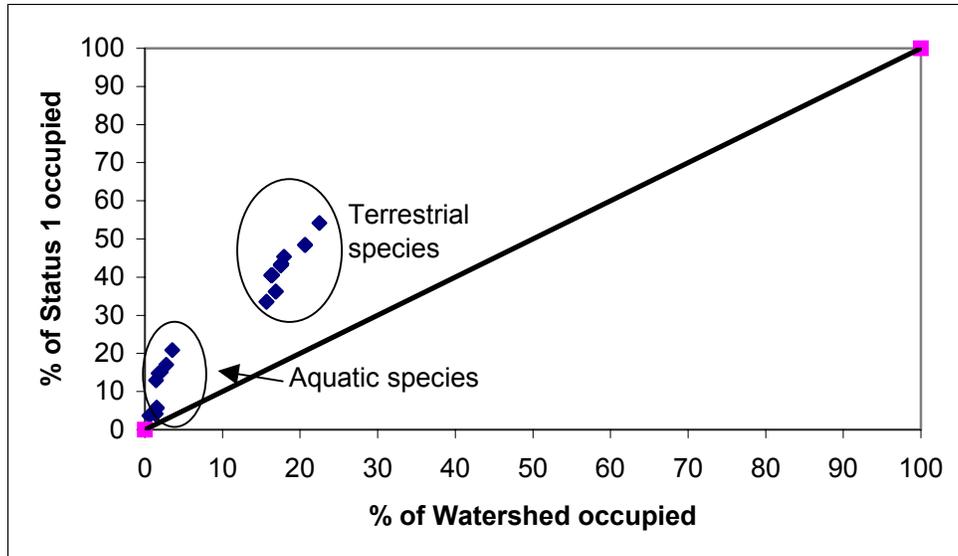


Figure 5-2. Distribution/protection status coordinates for reptiles.

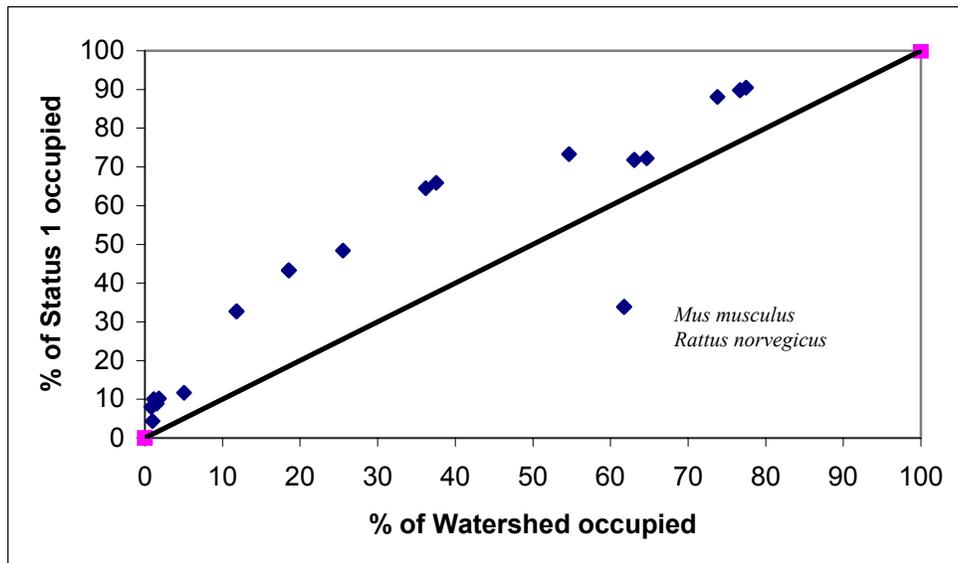


Figure 5-3. Distribution/protection status coordinates for mammals.

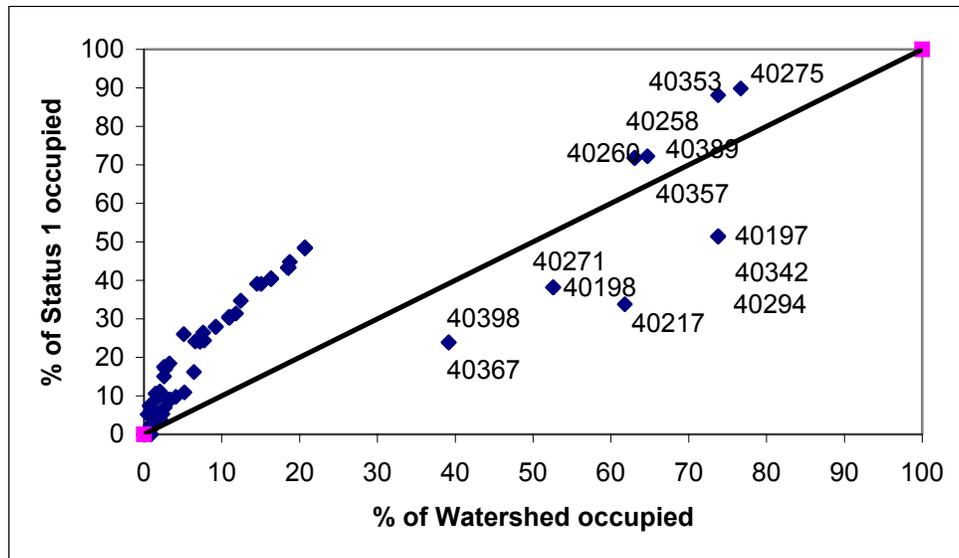


Figure 5-4. Distribution/protection status coordinates for birds (all groups combined). Numbers are species BOVA codes.

Limitations and Discussion

When applying the results of our analyses, it is critical that the following limitations are considered: 1) the limitations described for each of the component parts (land cover mapping, animal species mapping, stewardship mapping) of the analyses, 2) the spatial and thematic map accuracy of the components, and 3) the suitability of the results for the intended application.

Although individual species were modeled in this project, the compelling information appears within groups of species or taxa at the landscape level. Diversity measures treat each individual species equally, and some species models better represent actual distributions than others. Therefore, care should be taken in interpreting both individual species distributions and the community information that can be inferred from them. Landscape species diversity is likely to be more accurate than individual species distributions.

We also must stress that this project sought to map species distributions at the watershed-scale. Fine scale habitat characteristics, such as the presence of vernal breeding pools or suitable denning sites, will ultimately dictate whether or not a species occurs at any particular location. More study is needed on techniques to better identify these fine-scale habitat features on a landscape scale. It is also important to incorporate habitat structure, landscape pattern, and other abiotic factors (e.g., winter temperature, elevation) whenever possible.

6. CONCLUSIONS AND MANAGEMENT IMPLICATIONS

The Hunting Creek watershed is home to a large number of terrestrial vertebrates and a diverse array of habitats. This is true despite the fact the watershed is heavily urbanized.

In this study, we created predicted species distribution models for 228 species of birds, mammals, amphibians and reptiles, and used the Gap Analysis approach to assess species conservation status within the watershed. Because traditional gap stewardship properties, such as national forest, national parks, etc., do not exist within the watershed, we used county and city parks as a surrogate for important conservation lands (status 1). Although some of these properties may be of questionable conservation value, local agencies have control over their future use, and thus they provide some measure of conservation potential.

We found that most species are represented more than expected on status 1 lands, and many species are nearly restricted to these lands. These results suggest that many species are present within the watershed only because of the refuge that parks provide. This emphasizes the importance that parks may play in species conservation within the watershed.

To the best of our knowledge most of the status 1 areas within the watershed are managed for recreation rather than biodiversity. The potential for increasing biodiversity protection within the watershed is therefore great.

Many areas of future investigation have been identified through this effort. More research is needed in the areas of species/habitat relationships, especially within an urban landscape, and fine-scale habitat delineations. Furthermore, urban stewardship mapping protocols should be developed.

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APPENDICES

Appendix A. Sample species profile. This section provides an example of a species account report from the Virginia fish and Wildlife Information Service. These data were used to supply information on the distribution and habitats used for predictive species modeling.

030046 Snake, rainbow

Report compiled 10 July 2000

Taxonomy

Taxonomy for (030046) Snake, rainbow (*Farancia erytrogramma erytrogramma*)

| | |
|------------|--------------|
| Category | 03 Reptiles |
| Phylum | Chordata |
| SubPhylum | Vertebrata |
| Class | Reptilia |
| SubClass | |
| Order | Squamata |
| SubOrder | Serpentes |
| Family | Colubridae |
| SubFamily | |
| Genus | Farancia |
| SubGenus | |
| Species | erytrogramma |
| SubSpecies | erytrogramma |
| Authority | (Latreille) |

Taxonomy Comments

Other common names include mud snake, hoop snake, horn snake, red swamp snake, sand snake and sand hog *1006*, striped horn snake*10760*

The genus *Farancia* is New Latin and is a coined name. The specific and subspecific name *erytrogramma* is from the Greek *erythro* meaning "red" and *gramma* meaning "writing," apparently in reference to the distribution of red pigmentation around the black scales on the head and to the red stripes.*10760*

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Status

Status for (030046) Snake, rainbow (*Farancia erytrogramma erytrogramma*)

Status

223 Nongame-Protected
999 See Comments

Status Comments

This species appears secure in Va. despite the spotty occurrence of individual locality records. There is no information on loss of populations, but pollution of aquatic habitats is likely to have detrimental effects, especially if eels are affected. Protection of freshwater wetlands would increase the probability that this species will remain a part of our natural heritage for the long term.*10760*

Status References

Dept. Game and Inland Fisheries. 1990. 1990 Code of Virginia Section 29.1-100, Revised.
Nuisance species definition.: 1.

Life History

Life History for (030046) Snake, rainbow (*Farancia erythrogramma erythrogramma*)

Life History Comments

Physical description: This is a shiny iridescent snake with three red stripes on a bluish-black background. A broad reddish stripe bordered with black spots runs down the center of the belly and is flanked by yellow-orange coloration. The body is relatively stout and the head is barely distinct from the neck. The tail is short and ends in a spinelike tip. The juvenile is similar to the adult. The dorsal scales are smooth except above the anal region where they may be keeled. There are 19 scale rows and the anal plate is usually divided but is often single in Virginia. They are 8 inches or more at birth and they grow to between 36-44 inches with a maximum of 60 inches *1006*. In Virginia, maximum known SVL is 1518 mm (59.8 in.) and maximum total length is 1733 mm (68.2 in.).

Coloration and Pattern: iridescent with 3 red stripes on a black dorsum; middorsal stripe extends only to base of tail, whereas the lateral stripes on scale row 6 (counting from the ventrals on each side) extend onto dorsum of the tail; coloration below the 6th scale row is usually black; venter yellow with 2 primary rows of black spots - there may be a shorter, 3rd midventral row in some specimens; dorsum of head black to slate blue with some of the scales edged in red, forming an artistic pattern; throat, chin, infralabials, and supralabials yellow; each supralabial and some of the infralabials and chin shields have distinct black spots; yellow and red coloration fades to white in preservative. These are stout, cylindrical snakes with no difference in the width of the head and neck. The tail has a sharp spine.*10760*

Sexual dimorphism: Sexual dimorphism is exhibited in size, pattern, and scutellation. Adult females reach longer snout vent lengths (781-1518 mm, avg. = 1051.1+/-220.9, n=16) than males (722-730 mm, avg. = 726, n=2). Sexual dimorphism index is 1.45. However, tail length/total length ratio in males is higher (17.0-17.4%, avg. = 17.2, n=2) than in females (10.5-15.8%, avg. = 12.3+/-1.3%, n=16). Females have a higher number of ventrals (avg. = 170.8+/-2.3, 167-175, n=31) than males (159.2+/-1.5, 157-161, n=6). Counts of ventrals + subcaudals for males (204-210 avg. = 208.8+/-3.0, n=28). The midventral spots are usually more distinct in males than in females.*10760* Richmond reported that hatchlings from New Kent Co. were sexually dimorphic in number of ventrals (females 170-175, avg. = 172.0+/-1.2, n=39;; males 155-162, avg. = 159.3+/-1.5, n=46) and number of subcaudals (females 35-42, avg. = 37.6+/-1.3; males 44-49, avg. = 46.5+/-1.0) and ventrals + subcaudals (females 207-215, avg. = 209.7+/-1.6; males 202-210, avg. = 205.8+/-1.8). The midventral row of black spots is more pronounced in male hatchlings than females. However, these are statistical differences and cannot be used to assign gender to single individuals. *10760*

Juveniles: Juveniles are colored and patterned as adults. Hatchlings averaged 196.3+/-3.0 mm SVL (170-222, n=81), 231.3 +/-13.6 mm total length (197-270, n=81), and 5.9+/-1.1 g body mass (3.6-8.7, n=68).*10760*

Confusing Species: No other Virginia snake is as multicolored as *F. erytrogramma*. Mud snakes (*F. abacura*) have stout bodies and are shiny, but are uniformly black dorsally and red ventrally with some overlap on the sides. *10760*

Geographic Variation: There is no geographic variation in pattern, color, or scutellation in Va. *10760*

Reproduction: This species lays up to 52 eggs in an underground cavity in sandy soil, usually during July. The leathery white eggs are deposited from to 18 inches below the surface in exposed, dry, sandy fields. *1006* Females remain with their eggs in the nest, presumably to confer some protection against predation. *10760* The young hatch in the fall and overwinter on land, probably in a burrow near the nest, and move overland to an aquatic area in early spring. The males may reach sexual maturity by the end of their second or the beginning of their third year. The female probably reach maturity by the end of the third year, possibly the second *1006*.

Behavior: These snakes are both aquatic and burrowers. They are excellent swimmers but usually prowl along stream or swamp bottoms. At times they burrow into muck or mud. They have been found in dry sand at depths of up to 10 feet. The young have been found beneath boards logs and other debris. They may use their sharp tipped tail to probe. They have no definite period of hibernation since active specimens have been reported during every month. The main food of this species is eels. After catching an eel the snake usually climbs out of the water where the prey is swallowed head first. They may often rest with the tail dangling from its mouth *1006*.

Aquatic/terrestrial associations: This species is preyed on by aquatic turtles, raccoons, opossums, skunks, kingsnakes and hawks *1006*.

Nothing is known of the population ecology of this species anywhere in its range. Richmond plowed up 20 rainbow snakes in a 10 ac. field on one day in New Kent Co. Rainbow snakes will not bite, but will thrash about vigorously when picked up and attempt to scratch or poke the handler with the spine on the tail (it will not pierce the skin). These snakes appear to be oblivious to humans unless picked up. *10760*

Life History References

Linzey, D.W., M.J. Clifford. 1981. Snakes of Virginia. Univ. of Virginia Press, Charlottesville, VA.

County Distribution Map

Commonwealth of Virginia

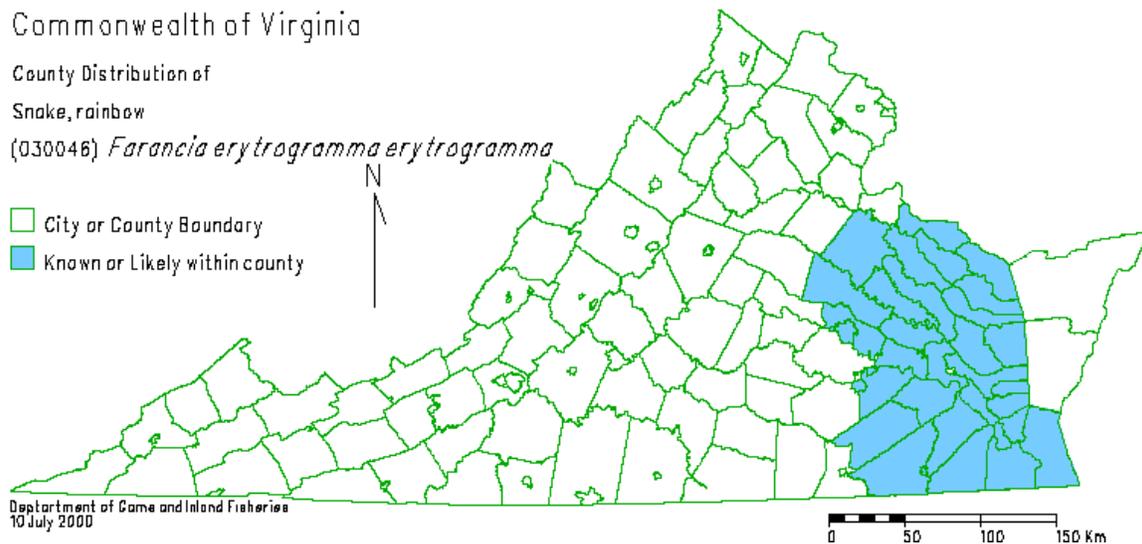
County Distribution of

Snake, rainbow

(030046) *Farancia erytrogramma erytrogramma*

□ City or County Boundary

■ Known or Likely within county



County Distribution

County Distribution for (030046) Snake, rainbow *Farancia erythrogramma erythrogramma*

| General Occurrence | City/County | References |
|--------------------|--------------------|------------|
| 1 Known | 033 Caroline | 11332 |
| 1 Known | 036 Charles City | 11332 |
| 1 Known | 095 James City | 11332 |
| 1 Known | 101 King William | 11332 |
| 1 Known | 127 New Kent | 4206 |
| 1 Known | 149 Prince George | 4206 |
| 1 Known | 175 Southampton | 4206 |
| 1 Known | 181 Surry | 11332 |
| 1 Known | 183 Sussex | 11332 |
| 1 Known | 620 Franklin | 4206 |
| 1 Known | 760 Richmond | 4206 |
| 1 Known | 810 Virginia Beach | 4206 |
| 2 Likely | 057 Essex | |
| 2 Likely | 073 Gloucester | |
| 2 Likely | 085 Hanover | |
| 2 Likely | 087 Henrico | |
| 2 Likely | 093 Isle of Wight | |
| 2 Likely | 097 King and Queen | |
| 2 Likely | 103 Lancaster | |
| 2 Likely | 115 Mathews | |
| 2 Likely | 119 Middlesex | |
| 2 Likely | 133 Northumberland | |
| 2 Likely | 149 Prince George | |
| 2 Likely | 159 Richmond | |
| 2 Likely | 193 Westmoreland | |
| 2 Likely | 199 York | |
| 2 Likely | 550 Chesapeake | |
| 2 Likely | 650 Hampton | |
| 2 Likely | 670 Hopewell | 4206 |
| 2 Likely | 700 Newport News | |
| 2 Likely | 710 Norfolk | |
| 2 Likely | 730 Petersburg | 4206 |
| 2 Likely | 735 Poquoson | |
| 2 Likely | 740 Portsmouth | |
| 2 Likely | 800 Suffolk | |

General Occurrence Comments

This species appears secure in Va. despite the spotty occurrence of individual locality records. There is no information on loss of populations, but pollution of aquatic habitats is likely to have detrimental effects, especially if eels are affected. Protection of freshwater wetlands would increase the probability that this species will remain a part of our natural heritage for the long term.*10760*

General Occurrence References

Mitchell, J., Pague, C. 1991. Amphibians and reptiles of Virginia -in prep.
 11332 Reay, Karen K., and Mitchell, Joseph C. 1999. Atlas of Amphibians and Reptiles in Virginia. (1). Virginia Department of Game and Inland Fisheries, Richmond, VA: 122.

| Resident Occurrence | City/County | References |
|---------------------|--------------|------------|
| 1 Known | 033 Caroline | 11332 |

| | | |
|---------|--------------------|-------|
| 1 Known | 036 Charles City | 11332 |
| 1 Known | 095 James City | 11332 |
| 1 Known | 101 King William | 11332 |
| 1 Known | 127 New Kent | 4206 |
| 1 Known | 149 Prince George | 4206 |
| 1 Known | 175 Southampton | 4206 |
| 1 Known | 181 Surry | |
| 1 Known | 183 Sussex | 11332 |
| 1 Known | 760 Richmond | 4206 |
| 1 Known | 810 Virginia Beach | 4206 |

Resident Occurrence Comments

Unvouchered Va. literature records are:

Chesterfield Co. - 4.8 km SW Chesterfield C.H.; Hanover Co. - Ellerson, Surry Co.
- Hog Island, Va. Beach City - Pungo.*10760*

Resident Occurrence References

4206 Mitchell, J., Pague, C. 1991. Amphibians and reptiles of Virginia -in prep.
11332 Reay, Karen K., and Mitchell, Joseph C. 1999. Atlas of Amphibians and Reptiles in Virginia. (1).
Virginia Department of Game and Inland Fisheries, Richmond, VA: 122.

Seasonal Occurrence - Not available

Seasonal Occurrence Comments

In Virginia, active specimens have been recorded in every month of the year. Museum records are about evenly spread over all months.*10760*

Seasonal Occurrence References

4206 Mitchell, J., Pague, C. 1991. Amphibians and reptiles of Virginia -in prep.
11332 Reay, Karen K., and Mitchell, Joseph C. 1999. Atlas of Amphibians and Reptiles in Virginia. (1).
Virginia Department of Game and Inland Fisheries, Richmond, VA: 122.

County Distribution for (030046) Snake, rainbow (*Farancia erythrogramma erythrogramma*)

Other Distribution for (030046) Snake, rainbow (*Farancia erythrogramma erythrogramma*)

USFWS Refuges

51510 Back Bay
51620 Presquile
51520 Mackay Island

USFWS Refuge References

4206 Mitchell, J., Pague, C. 1991. Amphibians and reptiles of Virginia -in prep.

NPS Park and Recreation Areas

367 Richmond National Battlefield Park

NPS Parks and Recreation Area References

4206 Mitchell, J., Pague, C. 1991. Amphibians and reptiles of Virginia -in prep.

USFS Ranger Districts - Not available

USFS Ranger District References - Not available

VDGIF Wildlife Management Areas

- 007 Chickahominy
- 008 Princess Anne
- 006 Kittewan

VDGIF Wildlife Management Area References

- 4206 Mitchell, J., Pague, C. 1991. Amphibians and reptiles of Virginia -in prep.

Administrative Units Comments - Not available

USGS Topographic Quadrangles

- 5009 Bon Air
- 5509 New Kent
- 5502 Franklin
- 5206 Prince George
- 6301 Knotts Island

USGS Topographic Quadrangle References

- 4206 Mitchell, J., Pague, C. 1991. Amphibians and reptiles of Virginia -in prep.

USGS Hydrologic Units

- 02080105 Mid Atlantic Region: Mattaponi River
- 02080203 Mid Atlantic Region: Middle James-Buffalo River
- 02080206 Mid Atlantic Region: Lower James River
- 03010201 South Atlantic-Gulf Region: Nottoway River
- 03010205 South Atlantic-Gulf Region: Albemarle River

USGS Hydrologic Unit References

- 10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Ecoregions

- 232012 Southeastern Mixed Forest: Flat Plains
- 232013 Southeastern Mixed Forest: Irregular Plains

Ecoregion References

- 10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Potential Natural Vegetation

- 065 Northern Cordgrass Prairie
- 101 Oak-Hickory-Pine Forest
- 103 Southern Floodplain Forest

Potential Natural Vegetation References

- 10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Physiographic Provinces

- 1 Coastal Plain

Physiographic Province References

- 10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Site Distribution Comments

Unvouchered Va. literature records are: Chesterfield Co. - 4.8 km SW Chesterfield C.H.; Hanover Co. - Ellerson, Surry Co.
- Hog Island, Va. Beach City - Pungo.*10760*

General Distribution Comments

Distribution: Coastal Plain of Va. The northern distributional limit of this species is in Charles Co., Maryland. This species is confined entirely to the N.A. Coastal Plain from Maryland south through peninsula Florida and eastern Louisiana.*10760*

County Abundance

County Abundance for (030046) Snake, rainbow *Farancia erythrogramma erythrogramma*

Relative Distribution Within County City/County - Not available

Distribution Within County Comments - Not available

Distribution Within County References - Not available

Relative Abundance within County City/County - Not available

Relative Abundance Within County Comments - Not available

Relative Abundance Within County References - Not available

Average Annual Population for Last 5 Years City/County - Not available

Average Annual Population for Last 5 Years Comments - Not available

Average Annual Population for Last 5 Years Referances - Not available

Average Annual Harvest for Last 5 Years City/County - Not available

Average Annual Harvest for Last 5 Years Comments - Not available

Average Annual Harvest for Last 5 Years References - Not available

Management Practices

Management Practices for (030046) Snake, rainbow *Farancia erythrogramma erythrogramma*

| | | | |
|---|------------|-----|--|
| B | Beneficial | 108 | Maintaining unique or special habitat features (wetlands, caves, etc.) |
| B | Beneficial | 118 | Developing/maintaining water holes, ponds, potholes, etc. |
| B | Beneficial | 130 | Maintaining dead/downed woody materials |
| B | Beneficial | 140 | Maintaining woodlots |
| B | Beneficial | 141 | Developing/maintaining green space (wildlife corridors) |
| B | Beneficial | 225 | Maintaining/protecting riparian habitats |
| B | Beneficial | 301 | Developing/maintaining brackish marsh |
| B | Beneficial | 303 | Developing/maintaining freshwater marsh |
| A | Adverse | 306 | Draining wetlands, marshes, ponds, lakes |
| B | Beneficial | 307 | Developing/maintaining/protecting wetlands |
| B | Beneficial | 417 | Controlling pollution (thermal, chemical, physical) |
| B | Beneficial | 506 | Reforestations |
| B | Beneficial | 999 | Other management practices (specified in comments) |

Beneficial Management References

10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Adverse Management References

10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Existing Management References - Not available

Management Comments

Rainbow snakes are generally considered highly aquatic, but Richmond found numerous adults and juveniles buried in sandy soil in floodplain farm fields in New Kent Co. they can also be found in freshwater creeks, ditches, and marshes and in brackish water marshes, rivers, and ditches. Adults and juveniles are terrestrial for unknown periods of time and have been found in pine woods, mixed hardwood and pine woods, and open fields. Juveniles have been found under all manner of surface objects. Rainbow snakes are active on the surface during rains. In Virginia, active specimens have been recorded in every month of the year. Museum records are about evenly spread over all months.*10760* This species appears secure in Va. despite the spotty occurrence of individual locality records. There is no information on loss of populations, but pollution of aquatic habitats is likely to have detrimental effects, especially if eels are affected. Protection of freshwater wetlands would increase the probability that this species will remain a part of our natural heritage for the long term.*10760* Nothing is known about the population ecology of this species anywhere in its range. Richmond plowed up to 20 rainbow snakes in a 10 acre field on one day in New Kent Co.*10760*

Food Habits

Food Habits for (030046) Snake, rainbow (*Farancia erytrogramma erytrogramma*)

Trophic Carnivore

Trophic References

Linzey, D.W., M.J. Clifford. 1981. Snakes of Virginia. Univ. of Virginia Press, Charlottesville, VA.

Food Utilized by Life Stage

| Life Stage | Food | Part | |
|-------------|---------------------|------|---------------|
| I Important | 7340 Anguilliformes | S | See Comments |
| G General | 7630 Caudata | X | Not Specified |
| G General | 7660 Salientia | X | Not Specified |

Food (General) Comments

The major food item for this species is eels. The young eat tadpoles and small frogs in addition to eels and salamanders *1006*. Richmond observed rainbow snakes eating eels in and out of water. Prey are eaten alive and usually swallowed headfirst. Enlarged posterior teeth occur on bones of the upper jaw in *F. erytrogramma*, presumably for holding on to slippery prey. Active foraging has been observed between 21-2300 hrs. *10760

Food (General) References

Linzey, D.W., M.J. Clifford. 1981. Snakes of Virginia. Univ. of Virginia Press, Charlottesville, VA.

10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Food (Important) References - Not available

Food (Adults) Comments

Adults consume mostly eels *1006*.

Food (Adult) References

Linzey, D.W., M.J. Clifford. 1981. Snakes of Virginia. Univ. of Virginia Press, Charlottesville, VA.

Food (Juvenile) Comments

The juveniles eat tadpoles and small frogs in addition to salamanders *1006*.

Food (Juvenile) References

Linzey, D.W., M.J. Clifford. 1981. Snakes of Virginia. Univ. of Virginia Press, Charlottesville, VA.

Food (Larval) Comments - Not available

Food (Larval) References - Not available

Habitat Associations

Habitat for (030046) Snake, rainbow (*Farancia erythrogramma erythrogramma*)

Habitat Terrestrial

Habitat References

Linzey, D.W., M.J. Clifford. 1981. Snakes of Virginia. Univ. of Virginia Press, Charlottesville, VA.

Forest Size Class - Not available

Forest Size References - Not available

SAF Type - Not available

SAF Type References - Not available

Land Use

- 20 Agricultural Land
- 21 Cropland and Pasture
- 50 Water
- 51 Streams and Canals
- 60 Wetland
- 61 Forested Wetland
- 62 Nonforested Wetland

Land Use References

10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

USFWS National Wetland Inventory

- R1 Riverine, tidal
- E2 Estuarine, intertidal
- R1 Riverine, tidal
- E2 Estuarine, intertidal

USFWS National Wetland Inventory References

10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Habitat Association

This species is found in swamps, marshes (fresh and brackish), or slow moving streams and adjacent sandy soils generally under 100 feet in elevation. The habitat includes suitable muck and sand for burrowing and eels for food *1006*. Rainbow snakes are generally considered highly aquatic, but Richmond found numerous adults and juveniles buried in sandy soil in floodplain farm fields in New Kent Co. they can also be found in freshwater creeks, ditches, and marshes and in brackish water marshes, rivers, and ditches. Adults and juveniles are terrestrial for unknown periods of time and have been found in pine woods, mixed hardwood and pine woods, and open fields. Juveniles have been found under all manner of surface objects. Rainbow snakes are active on the surface during rains. In Virginia, active specimens have been recorded in every month of the year. Museum records are about evenly spread over all months.*10760*

Animal or Plant Associations - Not available

Animal or Plant Association Comments - Not available

Animal or Plant Association References - Not available

USFWS Habitat Evaluation Procedures - Not available

USFWS Habitat Evaluation Procedure Comments - Not available

USFWS Habitat Evaluation Procedure References - Not available

Potential Natural Vegetation

065 Northern Cordgrass Prairie
101 Oak-Hickory-Pine Forest
103 Southern Floodplain Forest

Potential Natural Vegetation References

10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Environmental Association by Lifestage

Lifestage Environmental Associations for (030046) Snake, rainbow *Farancia erytrogramma erytrogramma*

| | | |
|---------|--------|---|
| General | 00320C | Soil Needs: Sand |
| General | 00360D | Soil Drainage: Imperfectly and poorly drained |
| General | 00650S | Coniferous Forest: Specified in Comments |
| General | 00660S | Hardwood Forest: Specified in Comments |

Environmental Associations Comments

They are found in brackish and freshwater marshes and swamps or in slow moving streams and the adjacent sandy soil *1006*. Rainbow snakes are generally considered highly aquatic, but Richmond found numerous adults and juveniles buried in sandy soil in floodplain farm fields in New Kent Co. They can also be found in freshwater creeks, ditches, and marshes and in brackish water marshes, rivers, and ditches. Adults and juveniles are terrestrial for unknown periods of time and have been found in pine woods, mixed hardwood and pine woods, and open fields. Juveniles have been found under all manner of surface objects. Rainbow snakes are active on the surface during rains. In Virginia, active specimens have been recorded in every month of the year. Museum records are about evenly spread over all months.*10760*

Environmental Associations References

Linzey, D.W., M.J. Clifford. 1981. Snakes of Virginia. Univ. of Virginia Press, Charlottesville, VA.

10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Environmental Associations (Limiting) References - Not available

Environmental Associations (Feeding Adults) Comments - Not available

Environmental Associations (Feeding Adults) References - Not available

Environmental Associations (Resting Adults) Comments - Not available

Environmental Associations (Resting Adults) References - Not available

Environmental Associations (Breeding Adults) Comments - Not available

Environmental Associations (Breeding Adults) References - Not available

Environmental Associations (Feeding Juvenile) Comments - Not available

Environmental Associations (Feeding Juvenile) References - Not available

Environmental Associations (Resting Juvenile) Comments - Not available

Environmental Associations (Resting Juvenile) References - Not available

Environmental Associations (Feeding Larvae) Comments - Not available

Environmental Associations (Feeding Larvae) References - Not available

Environmental Associations (Rest Larvae) Comments - Not available

Environmental Associations (Resting Larvae) References - Not available

Environmental Associations (Pupa) Comments - Not available

Environmental Associations (Pupa) References - Not available

Environmental Associations (Egg) Comments - Not available

Environmental Associations (Egg) References - Not available

References

References for (030046) Snake, rainbow (*Farancia erytrogramma erytrogramma*)

Collins, J.T., R. Conant, J.E. Huheey, J.L. Knight, E.M. Rundquist, H.M. Smith. 1982. Standard common and current scientific names for North American amphibians and reptiles. Herpetol. Circular No. 12. Society for the Study of Amphibians and Reptiles, Ohio Univ., Athens: 28.

Dept. Game and Inland Fisheries. 1990. 1990 Code of Virginia Section 29.1-100, Revised. Nuisance species definition.: 1.

Linzey, D.W., M.J. Clifford. 1981. Snakes of Virginia. Univ. of Virginia Press, Charlottesville, VA.

10760 Mitchell, J. C. 1994. The reptiles of Virginia. Smithsonian Institution Press, Washington, DC: 352.

Mitchell, J., Pague, C. 1991. Amphibians and reptiles of Virginia -in prep.
11332 Reay, Karen K., and Mitchell, Joseph C. 1999. Atlas of Amphibians and Reptiles in Virginia. (1).
Virginia Department of Game and Inland Fisheries, Richmond, VA: 122.

Report compiled 10 July 2000

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Appendix B. Species included in BOVA that were not modeled in this study. Reason not modeled: H = Very little or none of this habitat exists within the study area, M = Habitat that does exist could not be accurately modeled at the scale of the study, A = accidental.

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Group</u> | <u>Habitat</u> | <u>Reason</u> |
|------------|------------------------|-----------------------------------|----------------|---|---------------|
| 050124 | Mouse, prairie deer | <i>Peromyscus maniculatus</i> | Mammals | Open habitat such as pasture, meadows, and crop fields. | H/M |
| 050125 | Coyote | <i>Canis latrans</i> | Mammals | Brushy areas, forests, fields and meadows; prefer open land. | A |
| 020062 | Toad, Fowler's | <i>Bufo fowleri</i> | Amphibians | Sandy open areas, such as sand dunes and shorelines. | M |
| 030024 | Snake, eastern hognose | <i>Heterodon platirhinos</i> | Reptiles | Sandy open areas. | M |
| 040204 | Owl, barn | <i>Tyto alba</i> | Resident Birds | Open country, such as lightly-grazed pasture and hay fields. | H |
| 040224 | Woodpecker, red-headed | <i>Melanerpes erythrocephalus</i> | Resident Birds | Savannah-like grasslands with scattered trees. | H |
| 040254 | Raven, common | <i>Corvus corax</i> | Resident Birds | Mountainous areas and nests in areas of rock and remote cliffs. | H |
| 040293 | Shrike, loggerhead | <i>Lanius ludovicianus</i> | Resident Birds | Open grassland with an abundance of perching sites. | H |
| 040173 | Gull, laughing | <i>Larus atricilla</i> | Breeding Birds | Sandy islands, tufts of grass or reeds in saltwater marshes, beaches. | M |
| 040181 | Tern, common | <i>Sterna hirundo</i> | Breeding Birds | Relatively undisturbed sandy beaches. | H/M |
| 040186 | Tern, least | <i>Sterna antillarum</i> | Breeding Birds | Relatively undisturbed, broad, flat open sand beaches. | H/M |
| 040216 | Nighthawk, common | <i>Chordeiles minor</i> | Breeding Birds | Plowed fields, gravel beaches, barren areas with rocky soil. | H/M |
| 040328 | Warbler, prairie | <i>Dendroica discolor</i> | Breeding Birds | Pine scrub, abandoned fields with scattered saplings. | M |
| 040337 | Chat, yellow-breasted | <i>Icteria virens</i> | Breeding Birds | Brushy pastures, thickets or briar patches, usually near water. | M |
| 040347 | Oriole, orchard | <i>Icterus spurius</i> | Breeding Birds | Orchards, woodland margins, open woodlands. | H |
| 040361 | Bunting, indigo | <i>Passerina cyanea</i> | Breeding Birds | Edges of woods, old burns, open brushy fields, roadside thickets. | M |
| 040371 | Goldfinch, American | <i>Carduelis tristis</i> | Breeding Birds | Open weedy fields, farms, forest edges, open swamps. | M |
| 040378 | Sparrow, grasshopper | <i>Ammodramus savannarum</i> | Breeding Birds | Hayfields, weedy fallow fields, prairies. | H |
| 040391 | Sparrow, field | <i>Spizella pusilla</i> | Breeding Birds | Old fields with scattered woody vegetation, abandoned hayfields. | H/M |

Appendix C. List of species and the operations used to model habitat. Descriptions of variables are presented in Table 3-2.

Amphibians

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Operation</u> |
|------------|---------------------------------|----------------------------------|--|
| 20004 | Bullfrog | <i>Rana catesbeiana</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20006 | Treefrog, Cope's gray | <i>Hyla chrysoscelis</i> | (ProxH2O AND ForSize) OR WetAreas NOT Industry |
| 20007 | Treefrog, gray | <i>Hyla versicolor</i> | (ProxH2O AND ForSize) OR WetAreas NOT Industry |
| 20008 | Frog, northern green | <i>Rana clamitans</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20009 | Treefrog, green | <i>Hyla cinerea</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20012 | Frog, eastern cricket | <i>Acris crepitans</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20013 | Frog, pickerel | <i>Rana palustris</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20016 | Frog, southern leopard | <i>Rana sphenoccephala</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20018 | Frog, southeastern chorus | <i>Pseudacris feriarum</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20019 | Frog, wood | <i>Rana sylvatica</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20029 | Salamander, four-toed | <i>Hemidactylum scutatum</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20035 | Salamander, marbled | <i>Ambystoma opacum</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20038 | Salamander, northern dusky | <i>Desmognathus fuscus</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20043 | Salamander, northern red-backed | <i>Plethodon cinereus</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20049 | Salamander, spotted | <i>Ambystoma maculatum</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20051 | Salamander, three-lined | <i>Eurycea guttolineata</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20053 | Salamander, northern two-lined | <i>Eurycea bislineata</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20059 | Toad, American | <i>Bufo americanus</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20065 | Newt, red-spotted | <i>Notophthalmus viridescens</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20069 | Salamander, eastern mud | <i>Pseudotriton montanus</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20070 | Salamander, northern red | <i>Pseudotriton ruber</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20071 | Peeper, northern spring | <i>Pseudacris crucifer</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 20080 | Salamander, white-spotted slimy | <i>Plethodon cylindraceus</i> | ForSize NOT WetAreas NOT Industry |

Reptiles

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Operation</u> |
|-------------------|--------------------------------|----------------------------------|---|
| 30002 | Lizard, northern fence | <i>Sceloporus undulatus</i> | ((ForSize or ForEdge) Not WetAreas) NOT Industry |
| 30004 | Skink, five-lined | <i>Eumeces fasciatus</i> | AdjH2O AND ForSize NOT Industry |
| 30005 | Skink, southeastern five-lined | <i>Eumeces inexpectatus</i> | (ForSize OR ForEdge) NOT Industry |
| 30006 | Skink, broadhead | <i>Eumeces laticeps</i> | ForSize NOT WetAreas NOT Industry |
| 30007 | Skink, little brown | <i>Scincella lateralis</i> | ForSize NOT Industry |
| 30016 | Copperhead, northern | <i>Agkistrodon contortrix</i> | (WetAreas OR ForSize OR ForEdge) NOT Industry |
| 30018 | Racer, northern black | <i>Coluber constrictor</i> | ((ForSize or ForEdge) Not WetAreas) NOT Industry |
| 30019 | Snake, eastern worm | <i>Carphophis amoenus</i> | ForSize NOT Industry |
| 30020 | Snake, northern ringneck | <i>Diadophis punctatus</i> | ForSize NOT Industry |
| 30022 | Snake, corn | <i>Elaphe guttata</i> | (ForSize OR ForEdge) NOT Industry |
| 30023 | Snake, black rat | <i>Elaphe obsoleta</i> | (ForSize or ForEdge) NOT Industry |
| 30026 | Kingsnake, eastern | <i>Lampropeltis getula</i> | ((AdjH2O AND LC_Code) OR ForSize OR ForEdge) NOT Industry |
| 30027 | Kingsnake, mole | <i>Lampropeltis calligaster</i> | (ForSize NOT WetAreas) NOT Industry |
| 30029 | Snake, eastern milk | <i>Lampropeltis triangulum</i> | ForSize NOT Industry |
| 30033 | Snake, queen | <i>Regina septemvittata</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30034 | Snake, northern water | <i>Nerodia sipedon</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30038 | Snake, rough green | <i>Opheodrys aestivus</i> | ForMaj NOT Industry |
| 30041 | Snake, northern brown | <i>Storeria dekayi</i> | ForMaj NOT Industry |
| 30042 | Snake, northern red-bellied | <i>Storeria occipitomaculata</i> | ((AdjH2O AND LC_Code) OR ForSize) NOT Industry |
| 30044 | Snake, eastern garter | <i>Thamnophis sirtalis</i> | ((AdjH2O AND LC_Code) OR ForMaj OR ForEdge) NOT Industry |
| 30045 | Snake, eastern ribbon | <i>Thamnophis sauritus</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30049 | Earthsnake, eastern smooth | <i>Virginia valeriae</i> | ForSize OR ForEdge NOT Industry |
| 30050 | Turtle, eastern snapping | <i>Chelydra serpentina</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30051 | Turtle, eastern mud | <i>Kinosternon subrubrum</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30052 | Turtle, eastern musk | <i>Sternotherus odoratus</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30057 | Cooter, northern red-bellied | <i>Pseudemys rubriventris</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30058 | Slider, yellowbellied | <i>Trachemys scripta</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30060 | Turtle, eastern painted | <i>Chrysemys picta</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30062 | Turtle, wood | <i>Clemmys insculpta</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30063 | Turtle, spotted | <i>Clemmys guttata</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 30068 | Turtle, eastern box | <i>Terrapene carolina</i> | ForSize NOT Industry |
| 30077 | Slider, red-eared | <i>Trachemys scripta</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |

Mammals

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Operation</u> |
|------------|--------------------------------|--|---|
| 50001 | Opossum, Virginia | <i>Didelphis virginiana virginiana</i> | LC_Code |
| 50007 | Shrew, southeastern | <i>Sorex longirostris longirostris</i> | LC_Code |
| 50013 | Shrew, Kirtland's short-tailed | <i>Blarina brevicauda kirtlandi</i> | WetAreas NOT Industry |
| 50017 | Mole, eastern | <i>Scalopus aquaticus aquaticus</i> | LC_Code NOT Industry |
| 50019 | Mole, star-nosed | <i>Condylura cristata cristata</i> | WetAreas NOT Industry |
| 50028 | Bat, big brown | <i>Eptesicus fuscus fuscus</i> | LC_Code OR WetAreas |
| 50029 | Bat, eastern red | <i>Lasiurus borealis borealis</i> | LC_Code |
| 50038 | Raccoon | <i>Procyon lotor lotor</i> | LC_Code |
| 50042 | Mink, common | <i>Mustela vison mink</i> | WetAreas NOT Industry |
| 50047 | Skunk, striped | <i>Mephitis mephitis nigra</i> | LC_Code |
| 50049 | Fox, red | <i>Vulpes vulpes fulva</i> | ForSize OR OpenSize |
| 50050 | Fox, eastern gray | <i>Urocyon cinereoargenteus c.</i> | ForSize OR OpenSize |
| 50054 | Woodchuck | <i>Marmota monax monax</i> | OpenSize |
| 50055 | Chipmunk, Fisher's eastern | <i>Tamias striatus fisheri</i> | LC_Code NOT Industry |
| 50058 | Squirrel, northern gray | <i>Sciurus carolinensis pennsylvanicus</i> | LC_Code NOT Industry |
| 50065 | Squirrel, southern flying | <i>Glaucomys volans volans</i> | ForSize NOT Industry |
| 50069 | Beaver | <i>Castor canadensis</i> | WetAreas NOT Industry |
| 50073 | Mouse, northern white-footed | <i>Peromyscus leucopus noveboracensis</i> | ForSize NOT Industry |
| 50082 | Vole, meadow | <i>Microtus pennsylvanicus p.</i> | WetAreas NOT Industry |
| 50092 | Muskrat, common | <i>Ondatra zibethicus zibethicus</i> | WetAreas NOT Industry |
| 50095 | Rat, Norway | <i>Rattus norvegicus norvegicus</i> | LC_Code |
| 50098 | Mouse, house | <i>Mus musculus musculus</i> | LC_Code |
| 50099 | Mouse, meadow jumping | <i>Zapus hudsonius americanus</i> | (AdjH2O AND LC_Code) NOT Industry |
| 50103 | Cottontail, eastern | <i>Sylvilagus floridanus mallurus</i> | LC_Code NOT Industry |
| 50108 | Deer, white-tailed | <i>Odocoileus virginianus</i> | ((ForBuff AND LC_Code) OR ForSize) NOT Industry |

Breeding Birds

| <u>Num</u> | <u>Name</u> | <u>Scientific Name</u> | <u>Operation</u> |
|------------|--------------------------------|-----------------------------------|---|
| 40028 | Heron, green | <i>Butorides virescens</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40032 | Egret, great | <i>Ardea alba</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40036 | Night-heron, yellow-crowned | <i>Nyctanassa violacea</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40037 | Bittern, least | <i>Ixobrychus exilis</i> | WetAreas NOT Industry |
| 40038 | Bittern, American | <i>Botaurus lentiginosus</i> | WetAreas NOT Industry |
| 40095 | Osprey | <i>Pandion haliaetus</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40112 | Moorhen, common | <i>Gallinula chloropus</i> | WetAreas NOT Industry |
| 40134 | Sandpiper, spotted | <i>Actitis macularia</i> | WetAreas NOT Industry |
| 40202 | Cuckoo, yellow-billed | <i>Coccyzus americanus</i> | ForSize NOT Industry |
| 40214 | Chuck-will's-widow | <i>Caprimulgus carolinensis</i> | ForSize NOT Industry |
| 40215 | Whip-poor-will | <i>Caprimulgus vociferus</i> | ForSize NOT Industry |
| 40217 | Swift, chimney | <i>Chaetura pelagica</i> | LC_Code |
| 40218 | Hummingbird, ruby-throated | <i>Archilochus colubris</i> | ForSize NOT Industry |
| 40229 | Kingbird, eastern | <i>Tyrannus tyrannus</i> | OpenSize NOT Industry |
| 40234 | Flycatcher, great crested | <i>Myiarchus crinitus</i> | (WetAreas OR ForSize) NOT Industry |
| 40239 | Flycatcher, Acadian | <i>Empidonax virescens</i> | ForSize NOT Industry |
| 40240 | Flycatcher, willow | <i>Empidonax traillii</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40243 | Pewee, eastern wood | <i>Contopus virens</i> | ForSize NOT Industry |
| 40246 | Swallow, tree | <i>Tachycineta bicolor</i> | (ProxH2O AND OpenSize) OR WetAreas NOT Industry |
| 40248 | Swallow, northern rough-winged | <i>Stelgidopteryx serripennis</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40249 | Swallow, barn | <i>Hirundo rustica</i> | WetAreas OR OpenSize NOT Industry |
| 40251 | Martin, purple | <i>Progne subis</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40272 | Catbird, gray | <i>Dumetella carolinensis</i> | ForMaj NOT Industry |
| 40277 | Thrush, wood | <i>Hylocichla mustelina</i> | ForSize NOT Industry |
| 40281 | Veery | <i>Catharus fuscescens</i> | ForSize NOT Industry |
| 40284 | Gnatcatcher, blue-gray | <i>Poliophtila caerulea</i> | WetAreas NOT Industry |
| 40295 | Vireo, white-eyed | <i>Vireo griseus</i> | WetAreas NOT Industry |
| 40297 | Vireo, yellow-throated | <i>Vireo flavifrons</i> | AdjH2O AND LC_Code AND ForSize NOT Industry |
| 40299 | Vireo, red-eyed | <i>Vireo olivaceus</i> | ForSize NOT Industry |
| 40301 | Vireo, warbling | <i>Vireo gilvus</i> | AdjH2O AND ForSize NOT Industry |
| 40302 | Warbler, black-and-white | <i>Mniotilta varia</i> | WetAreas NOT Industry |
| 40303 | Warbler, prothonotary | <i>Protonotaria citrea</i> | WetAreas NOT Industry |
| 40305 | Warbler, worm-eating | <i>Helmitheros vermivorus</i> | WetAreas NOT Industry |

| <u>Num</u> | <u>Name</u> | <u>Scientific Name</u> | <u>Operation</u> |
|------------|--------------------------|-----------------------------|---------------------------------|
| 40312 | Parula, northern | <i>Parula americana</i> | WetAreas NOT Industry |
| 40313 | Warbler, yellow | <i>Dendroica petechia</i> | AdjH2O AND LC_Code NOT Industry |
| 40320 | Warbler, cerulean | <i>Dendroica cerulea</i> | WetAreas NOT Industry |
| 40322 | Warbler, yellow-throated | <i>Dendroica dominica</i> | WetAreas NOT Industry |
| 40326 | Warbler, pine | <i>Dendroica pinus</i> | ForSize NOT Industry |
| 40330 | Ovenbird | <i>Seiurus aurocapillus</i> | ForSize NOT Industry |
| 40332 | Waterthrush, Louisiana | <i>Seiurus motacilla</i> | AdjH2O AND ForSize NOT Industry |
| 40333 | Warbler, Kentucky | <i>Oporornis formosus</i> | WetAreas NOT Industry |
| 40336 | Yellowthroat, common | <i>Geothlypis trichas</i> | WetAreas NOT Industry |
| 40338 | Warbler, hooded | <i>Wilsonia citrina</i> | ForSize NOT Industry |
| 40341 | Redstart, American | <i>Setophaga ruticilla</i> | WetAreas NOT Industry |
| 40348 | Oriole, Baltimore | <i>Icterus galbula</i> | ForMaj NOT Industry |
| 40355 | Tanager, scarlet | <i>Piranga olivacea</i> | ForSize NOT Industry |
| 40360 | Grosbeak, blue | <i>Guiraca caerulea</i> | OpenSize NOT Industry |
| 40389 | Sparrow, chipping | <i>Spizella passerina</i> | LC_Code NOT Industry |

Resident Birds

| <u>Num</u> | <u>Name</u> | <u>Scientific Name</u> | <u>Operation</u> |
|------------|----------------------------|---------------------------------|---|
| 40027 | Heron, great blue | <i>Ardea herodias</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40035 | Night-heron, black-crowned | <i>Nycticorax nycticorax</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40045 | Goose, Canada | <i>Branta canadensis</i> | (ProxH2O AND OpenSize) OR WetAreas NOT Industry |
| 40051 | Mallard | <i>Anas platyrhynchos</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40052 | Duck, American black | <i>Anas rubripes</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40057 | Teal, blue-winged | <i>Anas discors</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40061 | Duck, wood | <i>Aix sponsa</i> | (ProxH2O AND ForSize) OR WetAreas NOT Industry |
| 40077 | Merganser, hooded | <i>Lophodytes cucullatus</i> | (ProxH2O AND ForSize) OR WetAreas NOT Industry |
| 40080 | Vulture, turkey | <i>Cathartes aura</i> | ForSize NOT Industry |
| 40081 | Vulture, black | <i>Coragyps atratus</i> | ForSize NOT Industry |
| 40085 | Hawk, sharp-shinned | <i>Accipiter striatus</i> | ForSize NOT Industry |
| 40087 | Hawk, red-tailed | <i>Buteo jamaicensis</i> | ForSize NOT Industry |
| 40088 | Hawk, red-shouldered | <i>Buteo lineatus</i> | WetAreas NOT Industry |
| 40093 | Eagle, bald | <i>Haliaeetus leucocephalus</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40098 | Kestrel, American | <i>Falco sparverius</i> | OpenSize NOT Industry |
| 40100 | Bobwhite, northern | <i>Colinus virginianus</i> | ForSize NOT Industry |
| 40102 | Turkey, wild | <i>Meleagris gallopavo</i> | ForSize NOT Industry |
| 40105 | Rail, king | <i>Rallus elegans</i> | WetAreas NOT Industry |
| 40107 | Rail, Virginia | <i>Rallus limicola</i> | WetAreas NOT Industry |
| 40113 | Coot, American | <i>Fulica americana</i> | WetAreas |
| 40119 | Killdeer | <i>Charadrius vociferus</i> | WetAreas OR OpenSize NOT Industry |
| 40140 | Woodcock, American | <i>Scolopax minor</i> | ForSize NOT Industry |
| 40173 | Gull, laughing | <i>Larus atricilla</i> | WetAreas |
| 40197 | Dove, rock | <i>Columba livia</i> | LC_Code |
| 40198 | Dove, mourning | <i>Zenaidura macroura</i> | LC_Code NOT ForMaj NOT Industry |
| 40205 | Screech-owl, eastern | <i>Otus asio</i> | ForSize NOT Industry |
| 40206 | Owl, great horned | <i>Bubo virginianus</i> | ForSize NOT Industry |
| 40209 | Owl, barred | <i>Strix varia</i> | ForSize NOT Industry |
| 40220 | Kingfisher, belted | <i>Ceryle alcyon</i> | (ProxH2O AND LC_Code) OR WetAreas NOT Industry |
| 40221 | Flicker, northern | <i>Colaptes auratus</i> | ForSize NOT Industry |
| 40222 | Woodpecker, pileated | <i>Dryocopus pileatus</i> | ForSize NOT Industry |
| 40223 | Woodpecker, red-bellied | <i>Melanerpes carolinus</i> | ForSize NOT Industry |
| 40226 | Woodpecker, hairy | <i>Picoides villosus</i> | ForSize NOT Industry |

| <u>Num</u> | <u>Name</u> | <u>Scientific Name</u> | <u>Operation</u> |
|------------|--------------------------|---------------------------------|---------------------------------|
| 40227 | Woodpecker, downy | <i>Picoides pubescens</i> | ForMaj NOT Industry |
| 40236 | Phoebe, eastern | <i>Sayornis phoebe</i> | OpenSize NOT Industry |
| 40252 | Jay, blue | <i>Cyanocitta cristata</i> | ForMaj NOT Industry |
| 40255 | Crow, American | <i>Corvus brachyrhynchos</i> | ForSize |
| 40256 | Crow, fish | <i>Corvus ossifragus</i> | (AdjH2O AND ForSize) |
| 40258 | Chickadee, Carolina | <i>Poecile carolinensis</i> | LC_Code NOT Industry |
| 40260 | Titmouse, tufted | <i>Baeolophus bicolor</i> | LC_Code NOT Industry |
| 40261 | Nuthatch, white-breasted | <i>Sitta carolinensis</i> | ForSize NOT Industry |
| 40265 | Wren, house | <i>Troglodytes aedon</i> | ForMaj NOT Industry |
| 40268 | Wren, Carolina | <i>Thryothorus ludovicianus</i> | ForMaj NOT Industry |
| 40269 | Wren, marsh | <i>Cistothorus palustris</i> | WetAreas NOT Industry |
| 40271 | Mockingbird, northern | <i>Mimus polyglottos</i> | LC_Code NOT ForMaj NOT Industry |
| 40273 | Thrasher, brown | <i>Toxostoma rufum</i> | ForMaj NOT Industry |
| 40275 | Robin, American | <i>Turdus migratorius</i> | LC_Code NOT Industry |
| 40282 | Bluebird, eastern | <i>Sialia sialis</i> | OpenSize NOT Industry |
| 40290 | Waxwing, cedar | <i>Bombycilla cedrorum</i> | ForMaj NOT Industry |
| 40294 | Starling, European | <i>Sturnus vulgaris</i> | LC_Code |
| 40342 | Sparrow, house | <i>Passer domesticus</i> | LC_Code |
| 40344 | Meadowlark, eastern | <i>Sturnella magna</i> | OpenSize NOT Industry |
| 40346 | Blackbird, red-winged | <i>Agelaius phoeniceus</i> | WetAreas NOT Industry |
| 40352 | Grackle, common | <i>Quiscalus quiscula</i> | ForSize |
| 40353 | Cowbird, brown-headed | <i>Molothrus ater</i> | LC_Code |
| 40357 | Cardinal, northern | <i>Cardinalis cardinalis</i> | LC_Code |
| 40367 | Finch, house | <i>Carpodacus mexicanus</i> | LC_Code |
| 40375 | Towhee, eastern | <i>Pipilo erythrophthalmus</i> | ForMaj NOT Industry |
| 40397 | Sparrow, swamp | <i>Melospiza georgiana</i> | WetAreas NOT Industry |
| 40398 | Sparrow, song | <i>Melospiza melodia</i> | LC_Code |

Wintering Birds

| <u>Num</u> | <u>Name</u> | <u>Scientific Name</u> | <u>Operation</u> |
|------------|---------------------------|--------------------------------|---------------------------------|
| 40141 | Snipe, common | <i>Gallinago gallinago</i> | WetAreas NOT Industry |
| 40165 | Gull, great black-backed | <i>Larus marinus</i> | WetAreas |
| 40166 | Gull, lesser black-backed | <i>Larus fuscus</i> | WetAreas |
| 40167 | Gull, herring | <i>Larus argentatus</i> | WetAreas |
| 40170 | Gull, ring-billed | <i>Larus delawarensis</i> | WetAreas |
| 40175 | Gull, Bonaparte's | <i>Larus philadelphia</i> | WetAreas |
| 40213 | Owl, northern saw-whet | <i>Aegolius acadicus</i> | ForSize NOT Industry |
| 40225 | Sapsucker, yellow-bellied | <i>Sphyrapicus varius</i> | ForSize NOT Industry |
| 40262 | Nuthatch, red-breasted | <i>Sitta canadensis</i> | ForSize NOT Industry |
| 40264 | Creeper, brown | <i>Certhia americana</i> | ForSize NOT Industry |
| 40266 | Wren, winter | <i>Troglodytes troglodytes</i> | ForSize NOT Industry |
| 40278 | Thrush, hermit | <i>Catharus guttatus</i> | ForSize NOT Industry |
| 40285 | Kinglet, golden-crowned | <i>Regulus satrapa</i> | ForSize NOT Industry |
| 40286 | Kinglet, ruby-crowned | <i>Regulus calendula</i> | ForSize NOT Industry |
| 40287 | Pipit, American | <i>Anthus rubescens</i> | OpenSize NOT Industry |
| 40317 | Warbler, yellow-rumped | <i>Dendroica coronata</i> | ForMaj AND LC_Code NOT Industry |

Waterfowl

| <u>Num</u> | <u>Name</u> | <u>Scientific Name</u> | <u>Operation</u> |
|-------------------|---------------------------|--------------------------------|-------------------------|
| 40001 | Loon, common | <i>Gavia immer</i> | WetAreas NOT Industry |
| 40008 | Grebe, pied-billed | <i>Podilymbus podiceps</i> | WetAreas NOT Industry |
| 40024 | Cormorant, double-crested | <i>Phalacrocorax auritus</i> | WetAreas NOT Industry |
| 40044 | Swan, tundra | <i>Cygnus columbianus</i> | WetAreas NOT Industry |
| 40049 | Goose, lesser snow | <i>Chen caerulescens</i> | WetAreas NOT Industry |
| 40053 | Gadwall | <i>Anas strepera</i> | WetAreas NOT Industry |
| 40054 | Pintail, northern | <i>Anas acuta</i> | WetAreas NOT Industry |
| 40056 | Teal, green-winged | <i>Anas crecca</i> | WetAreas NOT Industry |
| 40059 | Wigeon, American | <i>Anas americana</i> | WetAreas NOT Industry |
| 40060 | Shoveler, northern | <i>Anas clypeata</i> | WetAreas NOT Industry |
| 40062 | Redhead | <i>Aythya americana</i> | WetAreas NOT Industry |
| 40063 | Duck, ring-necked | <i>Aythya collaris</i> | WetAreas NOT Industry |
| 40064 | Canvasback | <i>Aythya valisineria</i> | WetAreas NOT Industry |
| 40065 | Scaup, greater | <i>Aythya marila</i> | WetAreas NOT Industry |
| 40066 | Scaup, lesser | <i>Aythya affinis</i> | WetAreas NOT Industry |
| 40067 | Goldeneye, common | <i>Bucephala clangula</i> | WetAreas NOT Industry |
| 40068 | Bufflehead | <i>Bucephala albeola</i> | WetAreas NOT Industry |
| 40069 | Oldsquaw | <i>Clangula hyemalis</i> | WetAreas NOT Industry |
| 40073 | Scoter, white-winged | <i>Melanitta fusca</i> | WetAreas NOT Industry |
| 40074 | Scoter, surf | <i>Melanitta perspicillata</i> | WetAreas NOT Industry |
| 40075 | Scoter, black | <i>Melanitta nigra</i> | WetAreas NOT Industry |
| 40076 | Duck, ruddy | <i>Oxyura jamaicensis</i> | WetAreas NOT Industry |
| 40078 | Merganser, common | <i>Mergus merganser</i> | WetAreas NOT Industry |
| 40079 | Merganser, red-breasted | <i>Mergus serrator</i> | WetAreas NOT Industry |

Appendix D. Parameters for species models, not including land cover or wetland type. No data indicates that variable was not used to create model. Operations to create species models are presented in Appendix C. Parameters for suitable land cover are presented in Appendix E. Parameters for suitable wetlands are presented in Appendix F.

Amphibians

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>ForSize</u> <u>(cells)</u> | <u>OpenSize</u> <u>(cells)</u> | <u>ForBuff</u> (m) | <u>WetSize</u> <u>(m²)</u> | <u>ProxH2O</u> <u>(m)</u> | <u>AdjH2O</u> (m) |
|------------|---------------------------------|----------------------------------|----------------------------------|-----------------------------------|--------------------|--|------------------------------|-------------------|
| 20004 | Bullfrog | <i>Rana catesbeiana</i> | | | | 2500 | 100 | |
| 20006 | Treefrog, Cope's gray | <i>Hyla chrysoscelis</i> | 11 | | | | 500 | |
| 20007 | Treefrog, gray | <i>Hyla versicolor</i> | 11 | | | | 500 | |
| 20008 | Frog, northern green | <i>Rana clamitans</i> | | | | | 100 | |
| 20009 | Treefrog, green | <i>Hyla cinerea</i> | | | | | 500 | |
| 20012 | Frog, eastern cricket | <i>Acris crepitans</i> | | | | | 100 | |
| 20013 | Frog, pickerel | <i>Rana palustris</i> | | | | | 500 | |
| 20016 | Frog, southern leopard | <i>Rana sphenocephala</i> | | | | | 500 | |
| 20018 | Frog, southeastern chorus | <i>Pseudacris feriarum</i> | | | | | 100 | |
| 20019 | Frog, wood | <i>Rana sylvatica</i> | | | | | 500 | |
| 20029 | Salamander, four-toed | <i>Hemidactylium scutatum</i> | | | | | 250 | |
| 20035 | Salamander, marbled | <i>Ambystoma opacum</i> | | | | | 250 | |
| 20038 | Salamander, northern dusky | <i>Desmognathus fuscus</i> | | | | | 100 | |
| 20043 | Salamander, northern red-backed | <i>Plethodon cinereus</i> | | | | | 250 | |
| 20049 | Salamander, spotted | <i>Ambystoma maculatum</i> | | | | | 250 | |
| 20051 | Salamander, three-lined | <i>Eurycea guttolineata</i> | | | | | 100 | |
| 20053 | Salamander, northern two-lined | <i>Eurycea bislineata</i> | | | | | 25 | |
| 20059 | Toad, American | <i>Bufo americanus</i> | | | | | 500 | |
| 20065 | Newt, red-spotted | <i>Notophthalmus viridescens</i> | | | | | 100 | |
| 20069 | Salamander, eastern mud | <i>Pseudotriton montanus</i> | | | | | 25 | |
| 20070 | Salamander, northern red | <i>Pseudotriton ruber</i> | | | | | 100 | |
| 20071 | Peeper, northern spring | <i>Pseudacris crucifer</i> | | | | | 100 | |
| 20080 | Salamander, white-spotted slimy | <i>Plethodon cylindraceus</i> | 22 | | | | | |

Reptiles

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>ForSize</u> <u>(cells)</u> | <u>OpenSize</u> <u>(cells)</u> | <u>ForBuff (m)</u> | <u>WetSize</u> <u>(m²)</u> | <u>ProxH2O</u> <u>(m)</u> | <u>AdjH2O (m)</u> |
|------------|--------------------------------|----------------------------------|----------------------------------|-----------------------------------|--------------------|--|------------------------------|-------------------|
| 30002 | Lizard, northern fence | <i>Sceloporus undulatus</i> | 22 | | | | | |
| 30004 | Skink, five-lined | <i>Eumeces fasciatus</i> | 22 | | | | 200 | |
| 30005 | Skink, southeastern five-lined | <i>Eumeces inexpectatus</i> | 22 | | | | | |
| 30006 | Skink, broadhead | <i>Eumeces laticeps</i> | 22 | | | | | |
| 30007 | Skink, little brown | <i>Scincella lateralis</i> | 22 | | | | | |
| 30016 | Copperhead, northern | <i>Agkistrodon contortrix</i> | 22 | | | | | |
| 30018 | Racer, northern black | <i>Coluber constrictor</i> | 22 | | | | | |
| 30019 | Snake, eastern worm | <i>Carphophis amoenus</i> | 22 | | | | | |
| 30020 | Snake, northern ringneck | <i>Diadophis punctatus</i> | 22 | | | | | |
| 30022 | Snake, corn | <i>Elaphe guttata</i> | 22 | | | | | |
| 30023 | Snake, black rat | <i>Elaphe obsoleta</i> | 22 | | | | | |
| 30026 | Kingsnake, eastern | <i>Lampropeltis getula</i> | 22 | | | | 25 | |
| 30027 | Kingsnake, mole | <i>Lampropeltis calligaster</i> | 22 | | | | | |
| 30029 | Snake, eastern milk | <i>Lampropeltis triangulum</i> | 22 | | | | | |
| 30033 | Snake, queen | <i>Regina septemvittata</i> | | | | 25 | | |
| 30034 | Snake, northern water | <i>Nerodia sipedon</i> | | | | 25 | | |
| 30038 | Snake, rough green | <i>Opheodrys aestivus</i> | | | | | | |
| 30041 | Snake, northern brown | <i>Storeria dekayi</i> | | | | | | |
| 30042 | Snake, northern red-bellied | <i>Storeria occipitomaculata</i> | 22 | | | | 25 | |
| 30044 | Snake, eastern garter | <i>Thamnophis sirtalis</i> | | | | | 25 | |
| 30045 | Snake, eastern ribbon | <i>Thamnophis sauritus</i> | | | | 25 | | |
| 30049 | Earthsnake, eastern smooth | <i>Virginia valeriae</i> | 22 | | | | | |
| 30050 | Turtle, eastern snapping | <i>Chelydra serpentina</i> | | | | 25 | | |
| 30051 | Turtle, eastern mud | <i>Kinosternon subrubrum</i> | | | | 25 | | |
| 30052 | Turtle, eastern musk | <i>Sternotherus odoratus</i> | | | | 25 | | |
| 30057 | Cooter, northern red-bellied | <i>Pseudemys rubriventris</i> | | | | 25 | | |

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>ForSize</u> <u>(cells)</u> | <u>OpenSize</u> <u>(cells)</u> | <u>ForBuff (m)</u> | <u>WetSize</u> <u>(m²)</u> | <u>ProxH2O</u> <u>(m)</u> | <u>AdjH2O (m)</u> |
|------------|-------------------------|---------------------------|----------------------------------|-----------------------------------|--------------------|--|------------------------------|-------------------|
| 30058 | Slider, yellowbellied | <i>Trachemys scripta</i> | | | | 25 | | |
| 30060 | Turtle, eastern painted | <i>Chrysemys picta</i> | | | | 25 | | |
| 30062 | Turtle, wood | <i>Clemmys insculpta</i> | | | | 25 | | |
| 30063 | Turtle, spotted | <i>Clemmys guttata</i> | | | | 25 | | |
| 30068 | Turtle, eastern box | <i>Terrapene carolina</i> | 22 | | | | | |
| 30077 | Slider, red-eared | <i>Trachemys scripta</i> | | | | 25 | | |

Mammals

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>ForSize</u> <u>(cells)</u> | <u>OpenSize</u> <u>(cells)</u> | <u>ForBuff</u> (m) | <u>WetSize</u> <u>(m²)</u> | <u>ProxH2O</u> <u>(m)</u> | <u>AdjH2O</u> (m) |
|------------|--------------------------------|--|----------------------------------|-----------------------------------|--------------------|--|------------------------------|-------------------|
| 50001 | Opossum, Virginia | <i>Didelphis virginiana virginiana</i> | | | | | | |
| 50007 | Shrew, southeastern | <i>Sorex longirostris longirostris</i> | | | | | | |
| 50013 | Shrew, Kirtland's short-tailed | <i>Blarina brevicauda kirtlandi</i> | | | | | | |
| 50017 | Mole, eastern | <i>Scalopus aquaticus aquaticus</i> | | | | | | |
| 50019 | Mole, star-nosed | <i>Condylura cristata cristata</i> | | | | | | |
| 50028 | Bat, big brown | <i>Eptesicus fuscus fuscus</i> | | | | | | |
| 50029 | Bat, eastern red | <i>Lasiurus borealis borealis</i> | | | | | | |
| 50038 | Raccoon | <i>Procyon lotor lotor</i> | | | | | | |
| 50042 | Mink, common | <i>Mustela vison mink</i> | | | | | | |
| 50047 | Skunk, striped | <i>Mephitis mephitis nigra</i> | | | | | | |
| 50049 | Fox, red | <i>Vulpes vulpes fulva</i> | 111 | 111 | | | | |
| 50050 | Fox, eastern gray | <i>Urocyon cinereoargenteus cinereoargenteus</i> | 111 | 111 | | | | |
| 50054 | Woodchuck | <i>Marmota monax monax</i> | | 11 | | | | |
| 50055 | Chipmunk, Fisher's eastern | <i>Tamias striatus fisheri</i> | | | | | | |
| 50058 | Squirrel, northern gray | <i>Sciurus carolinensis pennsylvanicus</i> | | | | | | |
| 50065 | Squirrel, southern flying | <i>Glaucomys volans volans</i> | 11 | | | | | |
| 50069 | Beaver | <i>Castor canadensis</i> | | | | 10000 | | |
| 50073 | Mouse, northern white-footed | <i>Peromyscus leucopus noveboracensis</i> | 11 | | | | | |
| 50082 | Vole, meadow | <i>Microtus pennsylvanicus pennsylvanicus</i> | | | | | | |
| 50092 | Muskrat, common | <i>Ondatra zibethicus zibethicus</i> | | | | | | |
| 50095 | Rat, Norway | <i>Rattus norvegicus norvegicus</i> | | | | | | |
| 50098 | Mouse, house | <i>Mus musculus musculus</i> | | | | | | |
| 50099 | Mouse, meadow jumping | <i>Zapus hudsonius americanus</i> | | | | | | 100 |
| 50103 | Cottontail, eastern | <i>Sylvilagus floridanus mallurus</i> | | | | | | |
| 50108 | Deer, white-tailed | <i>Odocoileus virginianus</i> | 111 | | 500 | | | |

Breeding Birds

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>ForSize</u> <u>(cells)</u> | <u>OpenSize</u> <u>(cells)</u> | <u>ForBuff (m)</u> | <u>WetSize</u> <u>(m²)</u> | <u>ProxH2O</u> <u>(m)</u> | <u>AdjH2O (m)</u> |
|------------|--------------------------------|-----------------------------------|----------------------------------|-----------------------------------|--------------------|--|------------------------------|-------------------|
| 40028 | Heron, green | <i>Butorides virescens</i> | | | | 10000 | 25 | |
| 40032 | Egret, great | <i>Ardea alba</i> | | | | | 25 | |
| 40036 | Night-heron, yellow-crowned | <i>Nyctanassa violacea</i> | | | | 10000 | 25 | |
| 40037 | Bittern, least | <i>Ixobrychus exilis</i> | | | | 10000 | | |
| 40038 | Bittern, American | <i>Botaurus lentiginosus</i> | | | | 10000 | | |
| 40095 | Osprey | <i>Pandion haliaetus</i> | | | | 10000 | 100 | |
| 40112 | Moorhen, common | <i>Gallinula chloropus</i> | | | | 10000 | | |
| 40134 | Sandpiper, spotted | <i>Actitis macularia</i> | | | | 10000 | | |
| 40202 | Cuckoo, yellow-billed | <i>Coccyzus americanus</i> | 111 | | | | | |
| 40214 | Chuck-will's-widow | <i>Caprimulgus carolinensis</i> | 111 | | | | | |
| 40215 | Whip-poor-will | <i>Caprimulgus vociferus</i> | 111 | | | | | |
| 40217 | Swift, chimney | <i>Chaetura pelagica</i> | | | | | | |
| 40218 | Hummingbird, ruby-throated | <i>Archilochus colubris</i> | 111 | | | | | |
| 40229 | Kingbird, eastern | <i>Tyrannus tyrannus</i> | | 22 | | | | |
| 40234 | Flycatcher, great crested | <i>Myiarchus crinitus</i> | 11 | | | | | |
| 40239 | Flycatcher, Acadian | <i>Empidonax virescens</i> | 411 | | | | | |
| 40240 | Flycatcher, willow | <i>Empidonax traillii</i> | | | | | 100 | |
| 40243 | Pewee, eastern wood | <i>Contopus virens</i> | 11 | | | | | |
| 40246 | Swallow, tree | <i>Tachycineta bicolor</i> | | 22 | | | 200 | |
| 40248 | Swallow, northern rough-winged | <i>Stelgidopteryx serripennis</i> | | | | | 100 | |
| 40249 | Swallow, barn | <i>Hirundo rustica</i> | | 22 | | | | |
| 40251 | Martin, purple | <i>Progne subis</i> | | | | | 200 | |
| 40272 | Catbird, gray | <i>Dumetella carolinensis</i> | | | | | | |
| 40277 | Thrush, wood | <i>Hylocichla mustelina</i> | 33 | | | | | |
| 40281 | Veery | <i>Catharus fuscescens</i> | 556 | | | | | |
| 40284 | Gnatcatcher, blue-gray | <i>Polioptila caerulea</i> | | | | 370000 | | |
| 40295 | Vireo, white-eyed | <i>Vireo griseus</i> | | | | 10000 | | |
| 40297 | Vireo, yellow-throated | <i>Vireo flavifrons</i> | 111 | | | | | 100 |
| 40299 | Vireo, red-eyed | <i>Vireo olivaceus</i> | 78 | | | | | |
| 40301 | Vireo, warbling | <i>Vireo gilvus</i> | 2 | | | | | 100 |
| 40302 | Warbler, black-and-white | <i>Mniotilta varia</i> | | | | 100000 | | |
| 40303 | Warbler, prothonotary | <i>Protonotaria citrea</i> | | | | 100000 | | |

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>ForSize</u> <u>(cells)</u> | <u>OpenSize</u> <u>(cells)</u> | <u>ForBuff (m)</u> | <u>WetSize</u> <u>(m²)</u> | <u>ProxH2O</u> <u>(m)</u> | <u>AdjH2O (m)</u> |
|------------|--------------------------|-------------------------------|----------------------------------|-----------------------------------|--------------------|--|------------------------------|-------------------|
| 40305 | Warbler, worm-eating | <i>Helmitheros vermivorus</i> | | | | 100000 | | |
| 40312 | Parula, northern | <i>Parula americana</i> | | | | 100000 | | |
| 40313 | Warbler, yellow | <i>Dendroica petechia</i> | | | | | | 200 |
| 40320 | Warbler, cerulean | <i>Dendroica cerulea</i> | | | | 100000 | | |
| 40322 | Warbler, yellow-throated | <i>Dendroica dominica</i> | | | | 10000 | | |
| 40326 | Warbler, pine | <i>Dendroica pinus</i> | 111 | | | | | |
| 40330 | Ovenbird | <i>Seiurus aurocapillus</i> | 167 | | | | | |
| 40332 | Waterthrush, Louisiana | <i>Seiurus motacilla</i> | 1111 | | | | | 200 |
| 40333 | Warbler, Kentucky | <i>Oporornis formosus</i> | | | | 450000 | | |
| 40336 | Yellowthroat, common | <i>Geothlypis trichas</i> | | | | | | |
| 40338 | Warbler, hooded | <i>Wilsonia citrina</i> | 111 | | | | | |
| 40341 | Redstart, American | <i>Setophaga ruticilla</i> | | | | 100000 | | |
| 40348 | Oriole, Baltimore | <i>Icterus galbula</i> | | | | | | |
| 40355 | Tanager, scarlet | <i>Piranga olivacea</i> | 333 | | | | | |
| 40360 | Grosbeak, blue | <i>Guiraca caerulea</i> | | 22 | | | | |
| 40389 | Sparrow, chipping | <i>Spizella passerina</i> | | | | | | |

Resident Birds

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>ForSize</u> <u>(cells)</u> | <u>OpenSize</u> <u>(cells)</u> | <u>ForBuff</u> (m) | <u>WetSize</u> <u>(m²)</u> | <u>ProxH2O</u> <u>(m)</u> | <u>AdjH2O</u> (m) |
|------------|----------------------------|---------------------------------|----------------------------------|-----------------------------------|--------------------|--|------------------------------|-------------------|
| 40027 | Heron, great blue | <i>Ardea herodias</i> | | | | | 25 | |
| 40035 | Night-heron, black-crowned | <i>Nycticorax nycticorax</i> | | | | 10000 | 25 | |
| 40045 | Goose, Canada | <i>Branta canadensis</i> | | 4 | | 5000 | 500 | |
| 40051 | Mallard | <i>Anas platyrhynchos</i> | | | | | 25 | |
| 40052 | Duck, American black | <i>Anas rubripes</i> | | | | 10000 | 25 | |
| 40057 | Teal, blue-winged | <i>Anas discors</i> | | | | 10000 | 25 | |
| 40061 | Duck, wood | <i>Aix sponsa</i> | 111 | | | 10000 | 1000 | |
| 40077 | Merganser, hooded | <i>Lophodytes cucullatus</i> | 111 | | | 10000 | 500 | |
| 40080 | Vulture, turkey | <i>Cathartes aura</i> | 22 | | | | | |
| 40081 | Vulture, black | <i>Coragyps atratus</i> | 22 | | | | | |
| 40085 | Hawk, sharp-shinned | <i>Accipiter striatus</i> | 111 | | | | | |
| 40087 | Hawk, red-tailed | <i>Buteo jamaicensis</i> | 22 | | | | | |
| 40088 | Hawk, red-shouldered | <i>Buteo lineatus</i> | | | | 1000000 | | |
| 40093 | Eagle, bald | <i>Haliaeetus leucocephalus</i> | | | | 300000 | 100 | |
| 40098 | Kestrel, American | <i>Falco sparverius</i> | | 22 | | | | |
| 40100 | Bobwhite, northern | <i>Colinus virginianus</i> | 111 | | | | | |
| 40102 | Turkey, wild | <i>Meleagris gallopavo</i> | 111 | | | | | |
| 40105 | Rail, king | <i>Rallus elegans</i> | | | | 10000 | | |
| 40107 | Rail, Virginia | <i>Rallus limicola</i> | | | | 10000 | | |
| 40113 | Coot, American | <i>Fulica americana</i> | | | | | | |
| 40119 | Killdeer | <i>Charadrius vociferus</i> | | 22 | | | | |
| 40140 | Woodcock, American | <i>Scolopax minor</i> | 111 | | | | | |
| 40197 | Dove, rock | <i>Larus atricilla</i> | | | | | | |
| 40198 | Dove, mourning | <i>Columba livia</i> | | | | | | |
| 40204 | Owl, barn | <i>Zenaidura macroura</i> | | | | | | |
| 40205 | Screech-owl, eastern | <i>Otus asio</i> | 111 | | | | | |
| 40206 | Owl, great horned | <i>Bubo virginianus</i> | 11 | | | | | |
| 40209 | Owl, barred | <i>Strix varia</i> | 11 | | | | | |
| 40220 | Kingfisher, belted | <i>Ceryle alcyon</i> | | | | | 100 | |
| 40221 | Flicker, northern | <i>Colaptes auratus</i> | 111 | | | | | |
| 40222 | Woodpecker, pileated | <i>Dryocopus pileatus</i> | 1111 | | | | | |
| 40223 | Woodpecker, red-bellied | <i>Melanerpes carolinus</i> | 11 | | | | | |

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>ForSize</u> <u>(cells)</u> | <u>OpenSize</u> <u>(cells)</u> | <u>ForBuff</u> (m) | <u>WetSize</u> <u>(m²)</u> | <u>ProxH2O</u> <u>(m)</u> | <u>AdjH2O</u> (m) |
|------------|--------------------------|---------------------------------|----------------------------------|-----------------------------------|--------------------|--|------------------------------|-------------------|
| 40226 | Woodpecker, hairy | <i>Picoides villosus</i> | 200 | | | | | |
| 40227 | Woodpecker, downy | <i>Picoides pubescens</i> | | | | | | |
| 40236 | Phoebe, eastern | <i>Sayornis phoebe</i> | | 22 | | | | |
| 40252 | Jay, blue | <i>Cyanocitta cristata</i> | | | | | | |
| 40255 | Crow, American | <i>Corvus brachyrhynchos</i> | 22 | | | | | |
| 40256 | Crow, fish | <i>Corvus ossifragus</i> | 11 | | | | | 500 |
| 40258 | Chickadee, Carolina | <i>Poecile carolinensis</i> | | | | | | |
| 40260 | Titmouse, tufted | <i>Baeolophus bicolor</i> | | | | | | |
| 40261 | Nuthatch, white-breasted | <i>Sitta carolinensis</i> | 89 | | | | | |
| 40265 | Wren, house | <i>Troglodytes aedon</i> | | | | | | |
| 40268 | Wren, Carolina | <i>Thryothorus ludovicianus</i> | | | | | | |
| 40269 | Wren, marsh | <i>Cistothorus palustris</i> | | | | | | |
| 40271 | Mockingbird, northern | <i>Mimus polyglottos</i> | | | | | | |
| 40273 | Thrasher, brown | <i>Toxostoma rufum</i> | | | | | | |
| 40275 | Robin, American | <i>Turdus migratorius</i> | | | | | | |
| 40282 | Bluebird, eastern | <i>Sialia sialis</i> | | 22 | | | | |
| 40290 | Waxwing, cedar | <i>Bombycilla cedrorum</i> | | | | | | |
| 40294 | Starling, European | <i>Sturnus vulgaris</i> | | | | | | |
| 40342 | Sparrow, house | <i>Passer domesticus</i> | | | | | | |
| 40344 | Meadowlark, eastern | <i>Sturnella magna</i> | | 22 | | | | |
| 40346 | Blackbird, red-winged | <i>Agelaius phoeniceus</i> | | | | | | 200 |
| 40352 | Grackle, common | <i>Quiscalus quiscula</i> | 11 | | | | | |
| 40353 | Cowbird, brown-headed | <i>Molothrus ater</i> | | | | | | |
| 40357 | Cardinal, northern | <i>Cardinalis cardinalis</i> | | | | | | |
| 40367 | Finch, house | <i>Carpodacus mexicanus</i> | | | | | | |
| 40375 | Towhee, eastern | <i>Pipilo erythrophthalmus</i> | | | | | | |
| 40397 | Sparrow, swamp | <i>Melospiza georgiana</i> | | | | | | |
| 40398 | Sparrow, song | <i>Melospiza melodia</i> | | | | | | |

Wintering Birds

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>ForSize</u> <u>(cells)</u> | <u>OpenSize</u> <u>(cells)</u> | <u>ForBuff</u> (m) | <u>WetSize</u> <u>(m²)</u> | <u>ProxH2O</u> <u>(m)</u> | <u>AdjH2O</u> (m) |
|------------|---------------------------|--------------------------------|----------------------------------|-----------------------------------|--------------------|--|------------------------------|-------------------|
| 40141 | Snipe, common | <i>Gallinago gallinago</i> | | | | 30000 | | |
| 40165 | Gull, great black-backed | <i>Larus marinus</i> | | | | | | |
| 40166 | Gull, lesser black-backed | <i>Larus fuscus</i> | | | | | | |
| 40167 | Gull, herring | <i>Larus argentatus</i> | | | | | | |
| 40170 | Gull, ring-billed | <i>Larus delawarensis</i> | | | | | | |
| 40175 | Gull, Bonaparte's | <i>Larus philadelphia</i> | | | | | | |
| 40213 | Owl, northern saw-whet | <i>Aegolius acadicus</i> | 111 | | | | | |
| 40225 | Sapsucker, yellow-bellied | <i>Sphyrapicus varius</i> | 11 | | | | | |
| 40262 | Nuthatch, red-breasted | <i>Sitta canadensis</i> | 11 | | | | | |
| 40264 | Creeper, brown | <i>Certhia americana</i> | 111 | | | | | |
| 40266 | Wren, winter | <i>Troglodytes troglodytes</i> | 111 | | | | | |
| 40278 | Thrush, hermit | <i>Catharus guttatus</i> | 111 | | | | | |
| 40285 | Kinglet, golden-crowned | <i>Regulus satrapa</i> | 111 | | | | | |
| 40286 | Kinglet, ruby-crowned | <i>Regulus calendula</i> | 22 | | | | | |
| 40287 | Pipit, American | <i>Anthus rubescens</i> | | 55 | | | | |
| 40317 | Warbler, yellow-rumped | <i>Dendroica coronata</i> | | | | | | |

Waterfowl

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>ForSize</u> <u>(cells)</u> | <u>OpenSize</u> <u>(cells)</u> | <u>ForBuff</u> (m) | <u>WetSize</u> <u>(m²)</u> | <u>ProxH2O</u> <u>(m)</u> | <u>AdjH2O</u> (m) |
|------------|---------------------------|--------------------------------|----------------------------------|-----------------------------------|--------------------|--|------------------------------|-------------------|
| 40001 | Loon, common | <i>Gavia immer</i> | | | | 10000 | | |
| 40008 | Grebe, pied-billed | <i>Podilymbus podiceps</i> | | | | 5000 | | |
| 40024 | Cormorant, double-crested | <i>Phalacrocorax auritus</i> | | | | 5000 | | |
| 40044 | Swan, tundra | <i>Cygnus columbianus</i> | | | | 5000 | | |
| 40049 | Goose, lesser snow | <i>Chen caerulescens</i> | | | | 5000 | | |
| 40053 | Gadwall | <i>Anas strepera</i> | | | | 5000 | | |
| 40054 | Pintail, northern | <i>Anas acuta</i> | | | | 5000 | | |
| 40056 | Teal, green-winged | <i>Anas crecca</i> | | | | 5000 | | |
| 40059 | Wigeon, American | <i>Anas americana</i> | | | | 5000 | | |
| 40060 | Shoveler, northern | <i>Anas clypeata</i> | | | | 5000 | | |
| 40062 | Redhead | <i>Aythya americana</i> | | | | 5000 | | |
| 40063 | Duck, ring-necked | <i>Aythya collaris</i> | | | | 5000 | | |
| 40064 | Canvasback | <i>Aythya valisineria</i> | | | | 10000 | | |
| 40065 | Scaup, greater | <i>Aythya marila</i> | | | | 10000 | | |
| 40066 | Scaup, lesser | <i>Aythya affinis</i> | | | | 5000 | | |
| 40067 | Goldeneye, common | <i>Bucephala clangula</i> | | | | 10000 | | |
| 40068 | Bufflehead | <i>Bucephala albeola</i> | | | | 5000 | | |
| 40069 | Oldsquaw | <i>Clangula hyemalis</i> | | | | 10000 | | |
| 40073 | Scoter, white-winged | <i>Melanitta fusca</i> | | | | 10000 | | |
| 40074 | Scoter, surf | <i>Melanitta perspicillata</i> | | | | 5000 | | |
| 40075 | Scoter, black | <i>Melanitta nigra</i> | | | | 10000 | | |
| 40076 | Duck, ruddy | <i>Oxyura jamaicensis</i> | | | | 5000 | | |
| 40078 | Merganser, common | <i>Mergus merganser</i> | | | | 5000 | | |
| 40079 | Merganser, red-breasted | <i>Mergus serrator</i> | | | | 5000 | | |

Appendix E. Suitable land cover codes for species models. 1 = suitable; 0 = not suitable. No data indicates that land cover was not a variable used to create species model. Operations to create species models are presented in Appendix C.

Amphibians

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>LC1</u> | <u>LC3</u> | <u>LC4</u> | <u>LC5</u> |
|------------|---------------------------------|----------------------------------|------------|------------|------------|------------|
| 20004 | Bullfrog | <i>Rana catesbeiana</i> | 1 | 1 | 0 | 1 |
| 20006 | Treefrog, Cope's gray | <i>Hyla chrysoscelis</i> | | | | |
| 20007 | Treefrog, gray | <i>Hyla versicolor</i> | | | | |
| 20008 | Frog, northern green | <i>Rana clamitans</i> | 0 | 0 | 0 | 1 |
| 20009 | Treefrog, green | <i>Hyla cinerea</i> | 1 | 0 | 0 | 0 |
| 20012 | Frog, eastern cricket | <i>Acris crepitans</i> | 0 | 0 | 0 | 1 |
| 20013 | Frog, pickerel | <i>Rana palustris</i> | 0 | 0 | 0 | 1 |
| 20016 | Frog, southern leopard | <i>Rana sphenocephala</i> | 1 | 0 | 0 | 1 |
| 20018 | Frog, southeastern chorus | <i>Pseudacris feriarum</i> | 0 | 0 | 0 | 1 |
| 20019 | Frog, wood | <i>Rana sylvatica</i> | 1 | 0 | 0 | 0 |
| 20029 | Salamander, four-toed | <i>Hemidactylium scutatum</i> | 1 | 0 | 0 | 0 |
| 20035 | Salamander, marbled | <i>Ambystoma opacum</i> | 1 | 0 | 0 | 0 |
| 20038 | Salamander, northern dusky | <i>Desmognathus fuscus</i> | 1 | 0 | 0 | 0 |
| 20043 | Salamander, northern red-backed | <i>Plethodon cinereus</i> | 1 | 0 | 0 | 0 |
| 20049 | Salamander, spotted | <i>Ambystoma maculatum</i> | 1 | 0 | 0 | 0 |
| 20051 | Salamander, three-lined | <i>Eurycea guttolineata</i> | 1 | 0 | 0 | 0 |
| 20053 | Salamander, northern two-lined | <i>Eurycea bislineata</i> | 1 | 0 | 0 | 0 |
| 20059 | Toad, American | <i>Bufo americanus</i> | 1 | 1 | 0 | 1 |
| 20065 | Newt, red-spotted | <i>Notophthalmus viridescens</i> | 1 | 1 | 0 | 0 |
| 20069 | Salamander, eastern mud | <i>Pseudotriton montanus</i> | 1 | 0 | 0 | 0 |
| 20070 | Salamander, northern red | <i>Pseudotriton ruber</i> | 1 | 0 | 0 | 0 |
| 20071 | Peeper, northern spring | <i>Pseudacris crucifer</i> | 1 | 1 | 0 | 1 |
| 20080 | Salamander, white-spotted slimy | <i>Plethodon cylindraceus</i> | | | | |

Reptiles

| Num | Common Name | Scientific Name | LC1 | LC3 | LC4 | LC5 |
|------------|--------------------------------|----------------------------------|------------|------------|------------|------------|
| 30002 | Lizard, northern fence | <i>Sceloporus undulatus</i> | | | | |
| 30004 | Skink, five-lined | <i>Eumeces fasciatus</i> | | | | |
| 30005 | Skink, southeastern five-lined | <i>Eumeces inexpectatus</i> | | | | |
| 30006 | Skink, broadhead | <i>Eumeces laticeps</i> | | | | |
| 30007 | Skink, little brown | <i>Scincella lateralis</i> | | | | |
| 30016 | Copperhead, northern | <i>Agkistrodon contortrix</i> | | | | |
| 30018 | Racer, northern black | <i>Coluber constrictor</i> | | | | |
| 30019 | Snake, eastern worm | <i>Carphophis amoenus</i> | | | | |
| 30020 | Snake, northern ringneck | <i>Diadophis punctatus</i> | | | | |
| 30022 | Snake, corn | <i>Elaphe guttata</i> | | | | |
| 30023 | Snake, black rat | <i>Elaphe obsoleta</i> | | | | |
| 30026 | Kingsnake, eastern | <i>Lampropeltis getula</i> | 1 | 0 | 0 | 1 |
| 30027 | Kingsnake, mole | <i>Lampropeltis calligaster</i> | | | | |
| 30029 | Snake, eastern milk | <i>Lampropeltis triangulum</i> | | | | |
| 30033 | Snake, queen | <i>Regina septemvittata</i> | 1 | 0 | 0 | 1 |
| 30034 | Snake, northern water | <i>Nerodia sipedon</i> | 1 | 0 | 0 | 1 |
| 30038 | Snake, rough green | <i>Opheodrys aestivus</i> | 1 | 1 | 0 | 0 |
| 30041 | Snake, northern brown | <i>Storeria dekayi</i> | 1 | 1 | 0 | 0 |
| 30042 | Snake, northern red-bellied | <i>Storeria occipitomaculata</i> | 1 | 0 | 0 | 1 |
| 30044 | Snake, eastern garter | <i>Thamnophis sirtalis</i> | 1 | 1 | 0 | 1 |
| 30045 | Snake, eastern ribbon | <i>Thamnophis sauritus</i> | 1 | 0 | 0 | 1 |
| 30049 | Earthsnake, eastern smooth | <i>Virginia valeriae</i> | | | | |
| 30050 | Turtle, eastern snapping | <i>Chelydra serpentina</i> | 1 | 0 | 0 | 1 |
| 30051 | Turtle, eastern mud | <i>Kinosternon subrubrum</i> | 1 | 0 | 0 | 1 |
| 30052 | Turtle, eastern musk | <i>Sternotherus odoratus</i> | 1 | 0 | 0 | 1 |
| 30057 | Cooter, northern red-bellied | <i>Pseudemys rubriventris</i> | 1 | 0 | 0 | 1 |
| 30058 | Slider, yellowbellied | <i>Trachemys scripta</i> | 1 | 0 | 0 | 1 |
| 30060 | Turtle, eastern painted | <i>Chrysemys picta</i> | 1 | 0 | 0 | 1 |
| 30062 | Turtle, wood | <i>Clemmys insculpta</i> | 1 | 0 | 0 | 0 |
| 30063 | Turtle, spotted | <i>Clemmys guttata</i> | 1 | 0 | 0 | 1 |
| 30068 | Turtle, eastern box | <i>Terrapene carolina</i> | | | | |
| 30077 | Slider, red-eared | <i>Trachemys scripta</i> | 1 | 0 | 0 | 1 |

Mammals

| Num | Common Name | Scientific Name | LC1 | LC3 | LC4 | LC5 |
|------------|--------------------------------|--|------------|------------|------------|------------|
| 50001 | Opossum, Virginia | <i>Didelphis virginiana virginiana</i> | 1 | 1 | 0 | 1 |
| 50007 | Shrew, southeastern | <i>Sorex longirostris longirostris</i> | 1 | 0 | 0 | 1 |
| 50013 | Shrew, Kirtland's short-tailed | <i>Blarina brevicauda kirtlandi</i> | | | | |
| 50017 | Mole, eastern | <i>Scalopus aquaticus aquaticus</i> | 1 | 0 | 0 | 1 |
| 50019 | Mole, star-nosed | <i>Condylura cristata cristata</i> | | | | |
| 50028 | Bat, big brown | <i>Eptesicus fuscus fuscus</i> | 1 | 1 | 0 | 1 |
| 50029 | Bat, eastern red | <i>Lasiurus borealis borealis</i> | 1 | 0 | 0 | 0 |
| 50038 | Raccoon | <i>Procyon lotor lotor</i> | 1 | 1 | 0 | 0 |
| 50042 | Mink, common | <i>Mustela vison mink</i> | | | | |
| 50047 | Skunk, striped | <i>Mephitis mephitis nigra</i> | 1 | 1 | 0 | 1 |
| 50049 | Fox, red | <i>Vulpes vulpes fulva</i> | | | | |
| 50050 | Fox, eastern gray | <i>Urocyon cinereoargenteus cinereoargenteus</i> | | | | |
| 50054 | Woodchuck | <i>Marmota monax monax</i> | | | | |
| 50055 | Chipmunk, Fisher's eastern | <i>Tamias striatus fisheri</i> | 1 | 1 | 0 | 0 |
| 50058 | Squirrel, northern gray | <i>Sciurus carolinensis pennsylvanicus</i> | 1 | 1 | 0 | 0 |
| 50065 | Squirrel, southern flying | <i>Glaucomys volans volans</i> | | | | |
| 50069 | Beaver | <i>Castor canadensis</i> | | | | |
| 50073 | Mouse, northern white-footed | <i>Peromyscus leucopus noveboracensis</i> | | | | |
| 50082 | Vole, meadow | <i>Microtus pennsylvanicus pennsylvanicus</i> | | | | |
| 50092 | Muskrat, common | <i>Ondatra zibethicus zibethicus</i> | | | | |
| 50095 | Rat, Norway | <i>Rattus norvegicus norvegicus</i> | 0 | 1 | 1 | 0 |
| 50098 | Mouse, house | <i>Mus musculus musculus</i> | 0 | 1 | 1 | 0 |
| 50099 | Mouse, meadow jumping | <i>Zapus hudsonius americanus</i> | 1 | 0 | 0 | 1 |
| 50103 | Cottontail, eastern | <i>Sylvilagus floridanus mallurus</i> | 1 | 1 | 0 | 1 |
| 50108 | Deer, white-tailed | <i>Odocoileus virginianus</i> | 1 | 1 | 0 | 1 |

Breeding Birds

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>LC1</u> | <u>LC3</u> | <u>LC4</u> | <u>LC5</u> |
|-------------------|--------------------------------|-----------------------------------|-------------------|-------------------|-------------------|-------------------|
| 40028 | Heron, green | <i>Butorides virescens</i> | 1 | 0 | 0 | 1 |
| 40032 | Egret, great | <i>Ardea alba</i> | 1 | 0 | 0 | 1 |
| 40036 | Night-heron, yellow-crowned | <i>Nyctanassa violacea</i> | 1 | 0 | 0 | 1 |
| 40037 | Bittern, least | <i>Ixobrychus exilis</i> | | | | |
| 40038 | Bittern, American | <i>Botaurus lentiginosus</i> | | | | |
| 40095 | Osprey | <i>Pandion haliaetus</i> | 1 | 0 | 0 | 0 |
| 40112 | Moorhen, common | <i>Gallinula chloropus</i> | | | | |
| 40134 | Sandpiper, spotted | <i>Actitis macularia</i> | | | | |
| 40202 | Cuckoo, yellow-billed | <i>Coccyzus americanus</i> | | | | |
| 40214 | Chuck-will's-widow | <i>Caprimulgus carolinensis</i> | | | | |
| 40215 | Whip-poor-will | <i>Caprimulgus vociferus</i> | | | | |
| 40217 | Swift, chimney | <i>Chaetura pelagica</i> | 0 | 1 | 1 | 0 |
| 40218 | Hummingbird, ruby-throated | <i>Archilochus colubris</i> | | | | |
| 40229 | Kingbird, eastern | <i>Tyrannus tyrannus</i> | | | | |
| 40234 | Flycatcher, great crested | <i>Myiarchus crinitus</i> | | | | |
| 40239 | Flycatcher, Acadian | <i>Empidonax virescens</i> | | | | |
| 40240 | Flycatcher, willow | <i>Empidonax traillii</i> | 1 | 0 | 0 | 1 |
| 40243 | Pewee, eastern wood | <i>Contopus virens</i> | | | | |
| 40246 | Swallow, tree | <i>Tachycineta bicolor</i> | | | | |
| 40248 | Swallow, northern rough-winged | <i>Stelgidopteryx serripennis</i> | 0 | 0 | 0 | 1 |
| 40249 | Swallow, barn | <i>Hirundo rustica</i> | | | | |
| 40251 | Martin, purple | <i>Progne subis</i> | 0 | 1 | 0 | 1 |
| 40272 | Catbird, gray | <i>Dumetella carolinensis</i> | 1 | 1 | 0 | 0 |
| 40277 | Thrush, wood | <i>Hylocichla mustelina</i> | | | | |
| 40281 | Veery | <i>Catharus fuscescens</i> | | | | |
| 40284 | Gnatcatcher, blue-gray | <i>Polioptila caerulea</i> | | | | |
| 40295 | Vireo, white-eyed | <i>Vireo griseus</i> | | | | |
| 40297 | Vireo, yellow-throated | <i>Vireo flavifrons</i> | 1 | 0 | 0 | 0 |
| 40299 | Vireo, red-eyed | <i>Vireo olivaceus</i> | | | | |
| 40301 | Vireo, warbling | <i>Vireo gilvus</i> | | | | |
| 40302 | Warbler, black-and-white | <i>Mniotilta varia</i> | | | | |
| 40303 | Warbler, prothonotary | <i>Protonotaria citrea</i> | | | | |
| 40305 | Warbler, worm-eating | <i>Helmitheros vermivorus</i> | | | | |

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>LC1</u> | <u>LC3</u> | <u>LC4</u> | <u>LC5</u> |
|------------|--------------------------|-----------------------------|------------|------------|------------|------------|
| 40312 | Parula, northern | <i>Parula americana</i> | | | | |
| 40313 | Warbler, yellow | <i>Dendroica petechia</i> | 1 | 0 | 0 | 0 |
| 40320 | Warbler, cerulean | <i>Dendroica cerulea</i> | | | | |
| 40322 | Warbler, yellow-throated | <i>Dendroica dominica</i> | | | | |
| 40326 | Warbler, pine | <i>Dendroica pinus</i> | | | | |
| 40330 | Ovenbird | <i>Seiurus aurocapillus</i> | | | | |
| 40332 | Waterthrush, Louisiana | <i>Seiurus motacilla</i> | | | | |
| 40333 | Warbler, Kentucky | <i>Oporornis formosus</i> | | | | |
| 40336 | Yellowthroat, common | <i>Geothlypis trichas</i> | | | | |
| 40338 | Warbler, hooded | <i>Wilsonia citrina</i> | | | | |
| 40341 | Redstart, American | <i>Setophaga ruticilla</i> | | | | |
| 40348 | Oriole, Baltimore | <i>Icterus galbula</i> | 1 | 0 | 0 | 0 |
| 40355 | Tanager, scarlet | <i>Piranga olivacea</i> | | | | |
| 40360 | Grosbeak, blue | <i>Guiraca caerulea</i> | | | | |
| 40389 | Sparrow, chipping | <i>Spizella passerina</i> | 1 | 1 | 0 | 0 |

Resident Birds

| Num | Common Name | Scientific Name | LC1 | LC3 | LC4 | LC5 |
|------------|----------------------------|---------------------------------|------------|------------|------------|------------|
| 40027 | Heron, great blue | <i>Ardea herodias</i> | 1 | 0 | 0 | 1 |
| 40035 | Night-heron, black-crowned | <i>Nycticorax nycticorax</i> | 1 | 0 | 0 | 1 |
| 40045 | Goose, Canada | <i>Branta canadensis</i> | | | | |
| 40051 | Mallard | <i>Anas platyrhynchos</i> | 0 | 0 | 0 | 1 |
| 40052 | Duck, American black | <i>Anas rubripes</i> | 0 | 0 | 0 | 1 |
| 40057 | Teal, blue-winged | <i>Anas discors</i> | 0 | 0 | 0 | 1 |
| 40061 | Duck, wood | <i>Aix sponsa</i> | | | | |
| 40077 | Merganser, hooded | <i>Lophodytes cucullatus</i> | | | | |
| 40080 | Vulture, turkey | <i>Cathartes aura</i> | | | | |
| 40081 | Vulture, black | <i>Coragyps atratus</i> | | | | |
| 40085 | Hawk, sharp-shinned | <i>Accipiter striatus</i> | | | | |
| 40087 | Hawk, red-tailed | <i>Buteo jamaicensis</i> | | | | |
| 40088 | Hawk, red-shouldered | <i>Buteo lineatus</i> | | | | |
| 40093 | Eagle, bald | <i>Haliaeetus leucocephalus</i> | 1 | 0 | 0 | 0 |
| 40098 | Kestrel, American | <i>Falco sparverius</i> | | | | |
| 40100 | Bobwhite, northern | <i>Colinus virginianus</i> | | | | |
| 40102 | Turkey, wild | <i>Meleagris gallopavo</i> | | | | |
| 40105 | Rail, king | <i>Rallus elegans</i> | | | | |
| 40107 | Rail, Virginia | <i>Rallus limicola</i> | | | | |
| 40113 | Coot, American | <i>Fulica americana</i> | | | | |
| 40119 | Killdeer | <i>Charadrius vociferus</i> | | | | |
| 40140 | Woodcock, American | <i>Scolopax minor</i> | | | | |
| 40197 | Dove, rock | <i>Larus atricilla</i> | 0 | 1 | 1 | 1 |
| 40198 | Dove, mourning | <i>Columba livia</i> | 1 | 1 | 0 | 1 |
| 40205 | Screech-owl, eastern | <i>Zenaida macroura</i> | | | | |
| 40206 | Owl, great horned | <i>Otus asio</i> | | | | |
| 40209 | Owl, barred | <i>Bubo virginianus</i> | | | | |
| 40220 | Kingfisher, belted | <i>Strix varia</i> | 1 | 0 | 0 | 1 |
| 40221 | Flicker, northern | <i>Ceryle alcyon</i> | | | | |
| 40222 | Woodpecker, pileated | <i>Colaptes auratus</i> | | | | |
| 40223 | Woodpecker, red-bellied | <i>Dryocopus pileatus</i> | | | | |
| 40224 | Woodpecker, red-headed | <i>Melanerpes carolinus</i> | | | | |
| 40226 | Woodpecker, hairy | <i>Picoides villosus</i> | | | | |

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>LC1</u> | <u>LC3</u> | <u>LC4</u> | <u>LC5</u> |
|------------|--------------------------|---------------------------------|------------|------------|------------|------------|
| 40227 | Woodpecker, downy | <i>Picoides pubescens</i> | 1 | 1 | 0 | 0 |
| 40236 | Phoebe, eastern | <i>Sayornis phoebe</i> | | | | |
| 40252 | Jay, blue | <i>Cyanocitta cristata</i> | 1 | 1 | 0 | 0 |
| 40255 | Crow, American | <i>Corvus brachyrhynchos</i> | | | | |
| 40256 | Crow, fish | <i>Corvus ossifragus</i> | | | | |
| 40258 | Chickadee, Carolina | <i>Poecile carolinensis</i> | 1 | 1 | 0 | 0 |
| 40260 | Titmouse, tufted | <i>Baeolophus bicolor</i> | 1 | 1 | 0 | 0 |
| 40261 | Nuthatch, white-breasted | <i>Sitta carolinensis</i> | | | | |
| 40265 | Wren, house | <i>Troglodytes aedon</i> | 1 | 1 | 0 | 0 |
| 40268 | Wren, Carolina | <i>Thryothorus ludovicianus</i> | 1 | 1 | 0 | 0 |
| 40269 | Wren, marsh | <i>Cistothorus palustris</i> | | | | |
| 40271 | Mockingbird, northern | <i>Mimus polyglottos</i> | 1 | 1 | 0 | 1 |
| 40273 | Thrasher, brown | <i>Toxostoma rufum</i> | 1 | 1 | 0 | 0 |
| 40275 | Robin, American | <i>Turdus migratorius</i> | 1 | 1 | 0 | 1 |
| 40282 | Bluebird, eastern | <i>Sialia sialis</i> | | | | |
| 40290 | Waxwing, cedar | <i>Bombycilla cedrorum</i> | 1 | 1 | 0 | 0 |
| 40294 | Starling, European | <i>Sturnus vulgaris</i> | 0 | 1 | 1 | 1 |
| 40342 | Sparrow, house | <i>Passer domesticus</i> | 0 | 1 | 1 | 1 |
| 40344 | Meadowlark, eastern | <i>Sturnella magna</i> | | | | |
| 40346 | Blackbird, red-winged | <i>Agelaius phoeniceus</i> | | | | |
| 40352 | Grackle, common | <i>Quiscalus quiscula</i> | | | | |
| 40353 | Cowbird, brown-headed | <i>Molothrus ater</i> | 1 | 1 | 0 | 1 |
| 40357 | Cardinal, northern | <i>Cardinalis cardinalis</i> | 1 | 1 | 0 | 0 |
| 40367 | Finch, house | <i>Carpodacus mexicanus</i> | 0 | 1 | 0 | 0 |
| 40375 | Towhee, eastern | <i>Pipilo erythrophthalmus</i> | 1 | 1 | 0 | 0 |
| 40397 | Sparrow, swamp | <i>Melospiza georgiana</i> | | | | |
| 40398 | Sparrow, song | <i>Melospiza melodia</i> | 0 | 1 | 0 | 0 |

Wintering Birds

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>LC1</u> | <u>LC3</u> | <u>LC4</u> | <u>LC5</u> |
|-------------------|---------------------------|----------------------------------|-------------------|-------------------|-------------------|-------------------|
| 40141 | Snipe, common | <i>Snipe, common</i> | | | | |
| 40165 | Gull, great black-backed | <i>Gull, great black-backed</i> | | | | |
| 40166 | Gull, lesser black-backed | <i>Gull, lesser black-backed</i> | | | | |
| 40167 | Gull, herring | <i>Gull, herring</i> | | | | |
| 40170 | Gull, ring-billed | <i>Gull, ring-billed</i> | | | | |
| 40175 | Gull, Bonaparte's | <i>Gull, Bonaparte's</i> | | | | |
| 40213 | Owl, northern saw-whet | <i>Owl, northern saw-whet</i> | | | | |
| 40225 | Sapsucker, yellow-bellied | <i>Sapsucker, yellow-bellied</i> | | | | |
| 40262 | Nuthatch, red-breasted | <i>Nuthatch, red-breasted</i> | | | | |
| 40264 | Creeper, brown | <i>Creeper, brown</i> | | | | |
| 40266 | Wren, winter | <i>Wren, winter</i> | | | | |
| 40278 | Thrush, hermit | <i>Thrush, hermit</i> | | | | |
| 40285 | Kinglet, golden-crowned | <i>Kinglet, golden-crowned</i> | | | | |
| 40286 | Kinglet, ruby-crowned | <i>Kinglet, ruby-crowned</i> | | | | |
| 40287 | Pipit, American | <i>Pipit, American</i> | | | | |
| 40317 | Warbler, yellow-rumped | <i>Warbler, yellow-rumped</i> | 1 | 1 | 0 | 0 |

Waterfowl

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>LC1</u> | <u>LC3</u> | <u>LC4</u> | <u>LC5</u> |
|------------|---------------------------|--------------------------------|------------|------------|------------|------------|
| 40001 | Loon, common | <i>Gavia immer</i> | | | | |
| 40008 | Grebe, pied-billed | <i>Podilymbus podiceps</i> | | | | |
| 40024 | Cormorant, double-crested | <i>Phalacrocorax auritus</i> | | | | |
| 40044 | Swan, tundra | <i>Cygnus columbianus</i> | | | | |
| 40049 | Goose, lesser snow | <i>Chen caerulescens</i> | | | | |
| 40053 | Gadwall | <i>Anas strepera</i> | | | | |
| 40054 | Pintail, northern | <i>Anas acuta</i> | | | | |
| 40056 | Teal, green-winged | <i>Anas crecca</i> | | | | |
| 40059 | Wigeon, American | <i>Anas americana</i> | | | | |
| 40060 | Shoveler, northern | <i>Anas clypeata</i> | | | | |
| 40062 | Redhead | <i>Aythya americana</i> | | | | |
| 40063 | Duck, ring-necked | <i>Aythya collaris</i> | | | | |
| 40064 | Canvasback | <i>Aythya valisineria</i> | | | | |
| 40065 | Scaup, greater | <i>Aythya marila</i> | | | | |
| 40066 | Scaup, lesser | <i>Aythya affinis</i> | | | | |
| 40067 | Goldeneye, common | <i>Bucephala clangula</i> | | | | |
| 40068 | Bufflehead | <i>Bucephala albeola</i> | | | | |
| 40069 | Oldsquaw | <i>Clangula hyemalis</i> | | | | |
| 40073 | Scoter, white-winged | <i>Melanitta fusca</i> | | | | |
| 40074 | Scoter, surf | <i>Melanitta perspicillata</i> | | | | |
| 40075 | Scoter, black | <i>Melanitta nigra</i> | | | | |
| 40076 | Duck, ruddy | <i>Oxyura jamaicensis</i> | | | | |
| 40078 | Merganser, common | <i>Mergus merganser</i> | | | | |
| 40079 | Merganser, red-breasted | <i>Mergus serrator</i> | | | | |

Reptiles

| Num | Common Name | Scientific Name | L1UB | L2US | P0EM | P0FO | P0SS | P0UB | P0US | R1EM | R1UB | R1US | R2US | R3RS | R3US | RXXX |
|------------|--------------------------------|----------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 30002 | Lizard, northern fence | <i>Sceloporus undulatus</i> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30004 | Skink, five-lined | <i>Eumeces fasciatus</i> | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 30005 | Skink, southeastern five-lined | <i>Eumeces inexpectatus</i> | | | | | | | | | | | | | | |
| 30006 | Skink, broadhead | <i>Eumeces laticeps</i> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30007 | Skink, little brown | <i>Scincella lateralis</i> | | | | | | | | | | | | | | |
| 30016 | Copperhead, northern | <i>Agkistrodon contortrix</i> | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30018 | Racer, northern black | <i>Coluber constrictor</i> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30019 | Snake, eastern worm | <i>Carphophis amoenus</i> | | | | | | | | | | | | | | |
| 30020 | Snake, northern ringneck | <i>Diadophis punctatus</i> | | | | | | | | | | | | | | |
| 30022 | Snake, corn | <i>Elaphe guttata</i> | | | | | | | | | | | | | | |
| 30023 | Snake, black rat | <i>Elaphe obsoleta</i> | | | | | | | | | | | | | | |
| 30026 | Kingsnake, eastern | <i>Lampropeltis getula</i> | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 30027 | Kingsnake, mole | <i>Lampropeltis calligaster</i> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30029 | Snake, eastern milk | <i>Lampropeltis triangulum</i> | | | | | | | | | | | | | | |
| 30033 | Snake, queen | <i>Regina septemvittata</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 30034 | Snake, northern water | <i>Nerodia sipedon</i> | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30038 | Snake, rough green | <i>Opheodrys aestivus</i> | | | | | | | | | | | | | | |
| 30041 | Snake, northern brown | <i>Storeria dekayi</i> | | | | | | | | | | | | | | |
| 30042 | Snake, northern red-bellied | <i>Storeria occipitomaculata</i> | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30044 | Snake, eastern garter | <i>Thamnophis sirtalis</i> | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 30045 | Snake, eastern ribbon | <i>Thamnophis sauritus</i> | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 30049 | Earthsake, eastern smooth | <i>Virginia valeriae</i> | | | | | | | | | | | | | | |
| 30050 | Turtle, eastern snapping | <i>Chelydra serpentina</i> | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30051 | Turtle, eastern mud | <i>Kinosternon subrubrum</i> | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 30052 | Turtle, eastern musk | <i>Sternotherus odoratus</i> | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 30057 | Cooter, northern red-bellied | <i>Pseudemys rubriventris</i> | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| 30058 | Slider, yellowbellied | <i>Trachemys scripta</i> | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 30060 | Turtle, eastern painted | <i>Chrysemys picta</i> | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 30062 | Turtle, wood | <i>Clemmys insculpta</i> | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| 30063 | Turtle, spotted | <i>Clemmys guttata</i> | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 30068 | Turtle, eastern box | <i>Terrapene carolina</i> | 0 | 0 | 2 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30077 | Slider, red-eared | <i>Trachemys scripta</i> | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |

Waterfowl

| Num | Name | Scientific Name | L1UB | L2US | P0EM | P0FO | P0SS | P0UB | P0US | R1EM | R1UB | R1US | R2US | R3RS | R3US | RXXX |
|------------|---------------------------|--------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 40001 | Loon, common | <i>Gavia immer</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40008 | Grebe, pied-billed | <i>Podilymbus podiceps</i> | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 40024 | Cormorant, double-crested | <i>Phalacrocorax auritus</i> | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 40044 | Swan, tundra | <i>Cygnus columbianus</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40049 | Goose, lesser snow | <i>Chen caerulescens</i> | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40053 | Gadwall | <i>Anas strepera</i> | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 40054 | Pintail, northern | <i>Anas acuta</i> | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 40056 | Teal, green-winged | <i>Anas crecca</i> | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 40059 | Wigeon, American | <i>Anas americana</i> | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 40060 | Shoveler, northern | <i>Anas clypeata</i> | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 40062 | Redhead | <i>Aythya americana</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40063 | Duck, ring-necked | <i>Aythya collaris</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40064 | Canvasback | <i>Aythya valisineria</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40065 | Scaup, greater | <i>Aythya marila</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40066 | Scaup, lesser | <i>Aythya affinis</i> | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40067 | Goldeneye, common | <i>Bucephala clangula</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40068 | Bufflehead | <i>Bucephala albeola</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40069 | Oldsquaw | <i>Clangula hyemalis</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40073 | Scoter, white-winged | <i>Melanitta fusca</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40074 | Scoter, surf | <i>Melanitta perspicillata</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40075 | Scoter, black | <i>Melanitta nigra</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40076 | Duck, ruddy | <i>Oxyura jamaicensis</i> | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 40078 | Merganser, common | <i>Mergus merganser</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 40079 | Merganser, red-breasted | <i>Mergus serrator</i> | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

Appendix G. Species modeled by protection status. Status 1 = parklands; status 2 = all other land, mostly residential and commercial.

Amphibians

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Area (ha)</u> | <u>% Status 1</u> | <u>% Status 2</u> |
|------------|---------------------------------|----------------------------------|------------------|-------------------|-------------------|
| 20004 | Bullfrog | <i>Rana catesbeiana</i> | 505 | 19.3 | 80.7 |
| 20006 | Treefrog, Cope's gray | <i>Hyla chrysoscelis</i> | 1105 | 19.9 | 80.1 |
| 20007 | Treefrog, gray | <i>Hyla versicolor</i> | 1070 | 19.3 | 80.7 |
| 20008 | Frog, northern green | <i>Rana clamitans</i> | 82 | 34.9 | 65.1 |
| 20009 | Treefrog, green | <i>Hyla cinerea</i> | 1361 | 16.8 | 83.2 |
| 20012 | Frog, eastern cricket | <i>Acris crepitans</i> | 23 | 9.8 | 90.2 |
| 20013 | Frog, pickerel | <i>Rana palustris</i> | 651 | 19.8 | 80.2 |
| 20016 | Frog, southern leopard | <i>Rana sphenocephala</i> | 2058 | 15.3 | 84.7 |
| 20018 | Frog, southeastern chorus | <i>Pseudacris feriarum</i> | 78 | 36.4 | 63.6 |
| 20019 | Frog, wood | <i>Rana sylvatica</i> | 1529 | 16.1 | 83.9 |
| 20029 | Salamander, four-toed | <i>Hemidactylium scutatum</i> | 703 | 25.1 | 74.9 |
| 20035 | Salamander, marbled | <i>Ambystoma opacum</i> | 712 | 24.9 | 75.1 |
| 20038 | Salamander, northern dusky | <i>Desmognathus fuscus</i> | 409 | 36.6 | 63.4 |
| 20043 | Salamander, northern red-backed | <i>Plethodon cinereus</i> | 703 | 25.1 | 74.9 |
| 20049 | Salamander, spotted | <i>Ambystoma maculatum</i> | 812 | 24.8 | 75.2 |
| 20051 | Salamander, three-lined | <i>Eurycea guttolineata</i> | 409 | 36.6 | 63.4 |
| 20053 | Salamander, northern two-lined | <i>Eurycea bislineata</i> | 205 | 48.0 | 52.0 |
| 20059 | Toad, American | <i>Bufo americanus</i> | 3760 | 10.9 | 89.1 |
| 20065 | Newt, red-spotted | <i>Notophthalmus viridescens</i> | 747 | 24.4 | 75.6 |
| 20069 | Salamander, eastern mud | <i>Pseudotriton montanus</i> | 172 | 52.6 | 47.4 |
| 20070 | Salamander, northern red | <i>Pseudotriton ruber</i> | 333 | 40.4 | 59.6 |
| 20071 | Peeper, northern spring | <i>Pseudacris crucifer</i> | 628 | 29.7 | 70.3 |
| 20080 | Salamander, white-spotted slimy | <i>Plethodon cylindraceus</i> | 1840 | 12.5 | 87.5 |

Reptiles

| Num | Common Name | Scientific Name | Area (ha) | % Status 1 | % Status 2 |
|------------|--------------------------------|----------------------------------|------------------|-------------------|-------------------|
| 30002 | Lizard, northern fence | <i>Sceloporus undulatus</i> | 1978 | 12.6 | 87.4 |
| 30004 | Skink, five-lined | <i>Eumeces fasciatus</i> | 414 | 34.6 | 65.4 |
| 30005 | Skink, southeastern five-lined | <i>Eumeces inexpectatus</i> | 2054 | 14.4 | 85.6 |
| 30006 | Skink, broadhead | <i>Eumeces laticeps</i> | 1840 | 12.5 | 87.5 |
| 30007 | Skink, little brown | <i>Scincella lateralis</i> | 1915 | 14.5 | 85.5 |
| 30016 | Copperhead, northern | <i>Agkistrodon contortrix</i> | 2102 | 14.8 | 85.2 |
| 30018 | Racer, northern black | <i>Coluber constrictor</i> | 1978 | 12.6 | 87.4 |
| 30019 | Snake, eastern worm | <i>Carphophis amoenus</i> | 1915 | 14.5 | 85.5 |
| 30020 | Snake, northern ringneck | <i>Diadophis punctatus</i> | 1915 | 14.5 | 85.5 |
| 30022 | Snake, corn | <i>Elaphe guttata</i> | 2054 | 14.4 | 85.6 |
| 30023 | Snake, black rat | <i>Elaphe obsoleta</i> | 2054 | 14.4 | 85.6 |
| 30026 | Kingsnake, eastern | <i>Lampropeltis getula</i> | 2067 | 14.4 | 85.6 |
| 30027 | Kingsnake, mole | <i>Lampropeltis calligaster</i> | 1840 | 12.5 | 87.5 |
| 30029 | Snake, eastern milk | <i>Lampropeltis triangulum</i> | 1915 | 14.5 | 85.5 |
| 30033 | Snake, queen | <i>Regina septemvittata</i> | 1 | 69.2 | 30.8 |
| 30034 | Snake, northern water | <i>Nerodia sipedon</i> | 323 | 36.1 | 63.9 |
| 30038 | Snake, rough green | <i>Ophiodrys aestivus</i> | 2422 | 13.7 | 86.3 |
| 30041 | Snake, northern brown | <i>Storeria dekayi</i> | 2422 | 13.7 | 86.3 |
| 30042 | Snake, northern red-bellied | <i>Storeria occipitomaculata</i> | 1928 | 14.5 | 85.5 |
| 30044 | Snake, eastern garter | <i>Thamnophis sirtalis</i> | 2637 | 14.1 | 85.9 |
| 30045 | Snake, eastern ribbon | <i>Thamnophis sauritus</i> | 65 | 38.8 | 61.2 |
| 30049 | Earthsnake, eastern smooth | <i>Virginia valeriae</i> | 2054 | 14.4 | 85.6 |
| 30050 | Turtle, eastern snapping | <i>Chelydra serpentina</i> | 178 | 22.2 | 77.8 |
| 30051 | Turtle, eastern mud | <i>Kinosternon subrubrum</i> | 209 | 48.4 | 51.6 |
| 30052 | Turtle, eastern musk | <i>Sternotherus odoratus</i> | 177 | 22.0 | 78.0 |
| 30057 | Cooter, northern red-bellied | <i>Pseudemys rubriventris</i> | 159 | 18.1 | 81.9 |
| 30058 | Slider, yellowbellied | <i>Trachemys scripta</i> | 160 | 17.9 | 82.1 |
| 30060 | Turtle, eastern painted | <i>Chrysemys picta</i> | 177 | 22.0 | 78.0 |
| 30062 | Turtle, wood | <i>Clemmys insculpta</i> | 169 | 52.6 | 47.4 |
| 30063 | Turtle, spotted | <i>Clemmys guttata</i> | 240 | 43.1 | 56.9 |
| 30068 | Turtle, eastern box | <i>Terrapene carolina</i> | 1915 | 14.5 | 85.5 |
| 30077 | Slider, red-eared | <i>Trachemys scripta</i> | 158 | 17.7 | 82.3 |

Mammals

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Area (ha)</u> | <u>% Status 1</u> | <u>% Status 2</u> |
|------------|--------------------------------|--|------------------|-------------------|-------------------|
| 50001 | Opossum, Virginia | <i>Didelphis virginiana virginiana</i> | 8998 | 6.9 | 93.1 |
| 50007 | Shrew, southeastern | <i>Sorex longirostris longirostris</i> | 4405 | 10.3 | 89.7 |
| 50013 | Shrew, Kirtland's short-tailed | <i>Blarina brevicauda kirtlandi</i> | 95 | 57.8 | 42.2 |
| 50017 | Mole, eastern | <i>Scalopus aquaticus aquaticus</i> | 4247 | 10.4 | 89.6 |
| 50019 | Mole, star-nosed | <i>Condylura cristata cristata</i> | 135 | 51.1 | 48.9 |
| 50028 | Bat, big brown | <i>Eptesicus fuscus fuscus</i> | 9092 | 6.8 | 93.2 |
| 50029 | Bat, eastern red | <i>Lasiurus borealis borealis</i> | 2997 | 11.1 | 88.9 |
| 50038 | Raccoon | <i>Procyon lotor lotor</i> | 7590 | 6.5 | 93.5 |
| 50042 | Mink, common | <i>Mustela vison mink</i> | 175 | 37.4 | 62.6 |
| 50047 | Skunk, striped | <i>Mephitis mephitis nigra</i> | 8998 | 6.9 | 93.1 |
| 50049 | Fox, red | <i>Vulpes vulpes fulva</i> | 1385 | 16.2 | 83.8 |
| 50050 | Fox, eastern gray | <i>Urocyon cinereoargenteus .c</i> | 1385 | 16.2 | 83.8 |
| 50054 | Woodchuck | <i>Marmota monax monax</i> | 594 | 13.5 | 86.5 |
| 50055 | Chipmunk, Fisher's eastern | <i>Tamias striatus fisheri</i> | 7399 | 6.7 | 93.3 |
| 50058 | Squirrel, northern gray | <i>Sciurus carolinensis pennsylvanicus</i> | 7399 | 6.7 | 93.3 |
| 50065 | Squirrel, southern flying | <i>Glaucomys volans volans</i> | 2176 | 13.7 | 86.3 |
| 50069 | Beaver | <i>Castor canadensis</i> | 178 | 34.1 | 65.9 |
| 50073 | Mouse, northern white-footed | <i>Peromyscus leucopus noveboracensis</i> | 2176 | 13.7 | 86.3 |
| 50082 | Vole, meadow | <i>Microtus pennsylvanicus p</i> | 1 | 31.3 | 68.8 |
| 50092 | Muskrat, common | <i>Ondatra zibethicus zibethicus</i> | 211 | 33.2 | 66.8 |
| 50095 | Rat, Norway | <i>Rattus norvegicus norvegicus</i> | 7249 | 3.2 | 96.8 |
| 50098 | Mouse, house | <i>Mus musculus musculus</i> | 7249 | 3.2 | 96.8 |
| 50099 | Mouse, meadow jumping | <i>Zapus hudsonius americanus</i> | 116 | 25.8 | 74.2 |
| 50103 | Cottontail, eastern | <i>Sylvilagus floridanus mallurus</i> | 8657 | 7.0 | 93.0 |
| 50108 | Deer, white-tailed | <i>Odocoileus virginianus</i> | 6413 | 7.8 | 92.2 |

Breeding Birds

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Area (ha)</u> | <u>% Status 1</u> | <u>% Status 2</u> |
|------------|-----------------------------|-----------------------------------|------------------|-------------------|-------------------|
| 40028 | Heron, green | <i>Butorides virescens</i> | 239 | 32.2 | 67.8 |
| 40032 | Egret, great | <i>Ardea alba</i> | 300 | 34.4 | 65.6 |
| 40036 | Night-heron, yellow-crowned | <i>Nyctanassa violacea</i> | 171 | 42.5 | 57.5 |
| 40037 | Bittern, least | <i>Ixobrychus exilis</i> | 8 | 0.0 | 100.0 |
| 40038 | Bittern, American | <i>Botaurus lentiginosus</i> | 8 | 0.0 | 100.0 |
| 40095 | Osprey | <i>Pandion haliaetus</i> | 100 | 0.2 | 99.8 |
| 40112 | Moorhen, common | <i>Gallinula chloropus</i> | 8 | 0.0 | 100.0 |
| 40134 | Sandpiper, spotted | <i>Actitis macularia</i> | 82 | 2.4 | 97.6 |
| 40202 | Cuckoo, yellow | <i>Coccyzus americanus</i> | 1287 | 16.2 | 83.8 |
| 40214 | Chuck-will's-widow | <i>Caprimulgus carolinensis</i> | 1287 | 16.2 | 83.8 |
| 40215 | Whip-poor-will | <i>Caprimulgus vociferus</i> | 1287 | 16.2 | 83.8 |
| 40217 | Swift, chimney | <i>Chaetura pelagica</i> | 7249 | 3.2 | 96.8 |
| 40218 | Hummingbird, ruby-throated | <i>Archilochus colubris</i> | 1287 | 16.2 | 83.8 |
| 40229 | Kingbird, eastern | <i>Tyrannus tyrannus</i> | 382 | 16.2 | 83.8 |
| 40234 | Flycatcher, great-crested | <i>Myiarchus crinitus</i> | 2200 | 14.0 | 86.0 |
| 40239 | Flycatcher, Acadian | <i>Empidonax virescens</i> | 843 | 19.6 | 80.4 |
| 40240 | Flycatcher, willow | <i>Empidonax traillii</i> | 249 | 28.6 | 71.4 |
| 40243 | Pewee, eastern | <i>Contopus virens</i> | 2176 | 13.7 | 86.3 |
| 40246 | Swallow, tree | <i>Tachycineta bicolor</i> | 169 | 17.7 | 82.3 |
| 40248 | Swallow, north | <i>Stelgidopteryx serripennis</i> | 162 | 18.3 | 81.7 |
| 40249 | Swallow, barn | <i>Hirundo rustica</i> | 479 | 14.0 | 86.0 |
| 40251 | Martin, purple | <i>Progne subis</i> | 610 | 12.3 | 87.7 |
| 40272 | Catbird, gray | <i>Dumetella carolinensis</i> | 2422 | 13.7 | 86.3 |
| 40277 | Thrush, wood | <i>Hylocichla mustelina</i> | 1765 | 15.2 | 84.8 |
| 40281 | Veery | <i>Catharus fuscescens</i> | 752 | 14.8 | 85.2 |
| 40284 | Gnatcatcher, blue-gray | <i>Poliophtila caerulea</i> | 0 | 0.0 | 100.0 |
| 40295 | Vireo, white-eyed | <i>Vireo griseus</i> | 87 | 58.7 | 41.3 |
| 40297 | Vireo, yellow-throated | <i>Vireo flavifrons</i> | 300 | 40.1 | 59.9 |
| 40299 | Vireo, red-eyed | <i>Vireo olivaceus</i> | 1459 | 16.3 | 83.7 |
| 40301 | Vireo, warbling | <i>Vireo gilvus</i> | 9 | 14.1 | 85.9 |
| 40302 | Warbler, black-and-white | <i>Mniotilta varia</i> | 61 | 59.0 | 41.0 |
| 40303 | Warbler, prothonotary | <i>Protonotaria citrea</i> | 61 | 59.0 | 41.0 |
| 40305 | Warbler, worm-eating | <i>Helmitheros vermivorus</i> | 61 | 59.0 | 41.0 |
| 40312 | Parula, northern | <i>Parula americana</i> | 61 | 59.0 | 41.0 |
| 40313 | Warbler, yellow | <i>Dendroica petechia</i> | 382 | 33.1 | 66.9 |
| 40320 | Warbler, cerulean | <i>Dendroica cerulea</i> | 61 | 59.0 | 41.0 |

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Area (ha)</u> | <u>% Status 1</u> | <u>% Status 2</u> |
|------------|--------------------------|-----------------------------|------------------|-------------------|-------------------|
| 40322 | Warbler, yellow-throated | <i>Dendroica dominica</i> | 87 | 58.7 | 41.3 |
| 40326 | Warbler, pine | <i>Dendroica pinus</i> | 1287 | 16.2 | 83.8 |
| 40330 | Ovenbird | <i>Seiurus aurocapillus</i> | 1085 | 17.7 | 82.3 |
| 40332 | Waterthrush, Louisiana | <i>Seiurus motacilla</i> | 116 | 36.9 | 63.1 |
| 40333 | Warbler, Kentucky | <i>Oporornis formosus</i> | 0 | 0.0 | 100.0 |
| 40336 | Yellowthroat, | <i>Geothlypis trichas</i> | 12 | 6.8 | 93.2 |
| 40338 | Warbler, hooded | <i>Wilsonia citrina</i> | 1287 | 16.2 | 83.8 |
| 40341 | Redstart, American | <i>Setophaga ruticilla</i> | 61 | 59.0 | 41.0 |
| 40348 | Oriole, Baltimore | <i>Icterus galbula</i> | 1706 | 15.7 | 84.3 |
| 40355 | Tanager, scarlet | <i>Piranga olivacea</i> | 908 | 18.4 | 81.6 |
| 40360 | Grosbeak, blue | <i>Guiraca caerulea</i> | 382 | 16.2 | 83.8 |
| 40389 | Sparrow, chipping | <i>Spizella passerina</i> | 7399 | 6.7 | 93.3 |

Resident Birds

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Area (ha)</u> | <u>% Status 1</u> | <u>% Status 2</u> |
|------------|----------------------------|---------------------------------|------------------|-------------------|-------------------|
| 40027 | Heron, great blue | <i>Ardea herodias</i> | 323 | 36.1 | 63.9 |
| 40035 | Night-heron, black-crowned | <i>Nycticorax nycticorax</i> | 103 | 15.5 | 84.5 |
| 40045 | Goose, Canada | <i>Branta canadensis</i> | 277 | 13.1 | 86.9 |
| 40051 | Mallard | <i>Anas platyrhynchos</i> | 129 | 16.2 | 83.8 |
| 40052 | Duck, American black | <i>Anas rubripes</i> | 200 | 32.5 | 67.5 |
| 40057 | Teal, blue-winged | <i>Anas discors</i> | 112 | 12.3 | 87.7 |
| 40061 | Duck, wood | <i>Aix sponsa</i> | 894 | 20.3 | 79.7 |
| 40077 | Merganser, hooded | <i>Lophodytes cucullatus</i> | 773 | 21.4 | 78.6 |
| 40080 | Vulture, turkey | <i>Cathartes aura</i> | 1915 | 14.5 | 85.5 |
| 40081 | Vulture, black | <i>Coragyps atratus</i> | 1915 | 14.5 | 85.5 |
| 40085 | Hawk, sharp-shinned | <i>Accipiter striatus</i> | 1287 | 16.2 | 83.8 |
| 40087 | Hawk, red-tailed | <i>Buteo jamaicensis</i> | 1915 | 14.5 | 85.5 |
| 40088 | Hawk, red-shouldered | <i>Buteo lineatus</i> | 0 | 0.0 | 100.0 |
| 40093 | Eagle, bald | <i>Haliaeetus leucocephalus</i> | 106 | 0.2 | 99.8 |
| 40098 | Kestrel, American | <i>Falco sparverius</i> | 382 | 16.2 | 83.8 |
| 40100 | Bobwhite, northern | <i>Colinus virginianus</i> | 1287 | 16.2 | 83.8 |
| 40102 | Turkey, wild | <i>Meleagris gallopavo</i> | 1287 | 16.2 | 83.8 |
| 40105 | Rail, king | <i>Rallus elegans</i> | 8 | 0.0 | 100.0 |
| 40107 | Rail, Virginia | <i>Rallus limicola</i> | 8 | 0.0 | 100.0 |
| 40113 | Coot, American | <i>Fulica americana</i> | 140 | 11.8 | 88.2 |
| 40119 | Killdeer | <i>Charadrius vociferus</i> | 392 | 15.9 | 84.1 |
| 40140 | Woodcock, American | <i>Scolopax minor</i> | 1287 | 16.2 | 83.8 |
| 40173 | Gull, laughing | <i>Larus atricilla</i> | 113 | 9.3 | 90.7 |
| 40197 | Dove, rock | <i>Columba livia</i> | 8657 | 4.1 | 95.9 |
| 40198 | Dove, mourning | <i>Zenaida macroura</i> | 6171 | 4.2 | 95.8 |
| 40205 | Screech-owl, eastern | <i>Otus asio</i> | 1287 | 16.2 | 83.8 |
| 40206 | Owl, great horned | <i>Bubo virginianus</i> | 2176 | 13.7 | 86.3 |
| 40209 | Owl, barred | <i>Strix varia</i> | 2176 | 13.7 | 86.3 |
| 40220 | Kingfisher, belted | <i>Ceryle alcyon</i> | 599 | 29.9 | 70.1 |
| 40221 | Flicker, northern | <i>Colaptes auratus</i> | 1287 | 16.2 | 83.8 |
| 40222 | Woodpecker, pileated | <i>Dryocopus pileatus</i> | 313 | 15.3 | 84.7 |
| 40223 | Woodpecker, red-bellied | <i>Melanerpes carolinus</i> | 2176 | 13.7 | 86.3 |
| 40226 | Woodpecker, hairy | <i>Picoides villosus</i> | 1081 | 17.7 | 82.3 |
| 40227 | Woodpecker, downy | <i>Picoides pubescens</i> | 2422 | 13.7 | 86.3 |
| 40236 | Phoebe, eastern | <i>Sayornis phoebe</i> | 382 | 16.2 | 83.8 |
| 40252 | Jay, blue | <i>Cyanocitta cristata</i> | 2422 | 13.7 | 86.3 |

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Area (ha)</u> | <u>% Status 1</u> | <u>% Status 2</u> |
|------------|--------------------------|---------------------------------|------------------|-------------------|-------------------|
| 40255 | Crow, American | <i>Corvus brachyrhynchos</i> | 1916 | 14.5 | 85.5 |
| 40256 | Crow, fish | <i>Corvus ossifragus</i> | 252 | 10.4 | 89.6 |
| 40258 | Chickadee, Carolina | <i>Poecile carolinensis</i> | 7399 | 6.7 | 93.3 |
| 40260 | Titmouse, tufted | <i>Baeolophus bicolor</i> | 7399 | 6.7 | 93.3 |
| 40261 | Nuthatch, white-breasted | <i>Sitta carolinensis</i> | 1388 | 15.6 | 84.4 |
| 40265 | Wren, house | <i>Troglodytes aedon</i> | 2422 | 13.7 | 86.3 |
| 40268 | Wren, Carolina | <i>Thryothorus ludovicianus</i> | 2422 | 13.7 | 86.3 |
| 40269 | Wren, marsh | <i>Cistothorus palustris</i> | 10 | 3.4 | 96.6 |
| 40271 | Mockingbird, northern | <i>Mimus polyglottos</i> | 6171 | 4.2 | 95.8 |
| 40273 | Thrasher, brown | <i>Toxostoma rufum</i> | 2422 | 13.7 | 86.3 |
| 40275 | Robin, American | <i>Turdus migratorius</i> | 8657 | 7.0 | 93.0 |
| 40282 | Bluebird, eastern | <i>Sialia sialis</i> | 382 | 16.2 | 83.8 |
| 40290 | Waxwing, cedar | <i>Bombycilla cedrorum</i> | 2422 | 13.7 | 86.3 |
| 40294 | Starling, European | <i>Sturnus vulgaris</i> | 8657 | 4.1 | 95.9 |
| 40342 | Sparrow, house | <i>Passer domesticus</i> | 8657 | 4.1 | 95.9 |
| 40344 | Meadowlark, eastern | <i>Sturnella magna</i> | 382 | 16.2 | 83.8 |
| 40346 | Blackbird, red-winged | <i>Agelaius phoeniceus</i> | 12 | 6.8 | 93.2 |
| 40352 | Grackle, common | <i>Quiscalus quiscula</i> | 2178 | 13.7 | 86.3 |
| 40353 | Cowbird, brown-headed | <i>Molothrus ater</i> | 8998 | 6.9 | 93.1 |
| 40357 | Cardinal, northern | <i>Cardinalis cardinalis</i> | 7590 | 6.5 | 93.5 |
| 40367 | Finch, house | <i>Carpodacus mexicanus</i> | 4593 | 3.6 | 96.4 |
| 40375 | Towhee, eastern | <i>Pipilo erythrophthalmus</i> | 2422 | 13.7 | 86.3 |
| 40397 | Sparrow, swamp | <i>Melospiza georgiana</i> | 12 | 6.8 | 93.2 |
| 40398 | Sparrow, song | <i>Melospiza melodia</i> | 4593 | 3.6 | 96.4 |

Wintering Birds

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Area (ha)</u> | <u>% Status 1</u> | <u>% Status 2</u> |
|------------|---------------------------|--------------------------------|------------------|-------------------|-------------------|
| 40141 | Snipe, common | <i>Gallinago gallinago</i> | 6 | 0.0 | 100.0 |
| 40165 | Gull, great black-backed | <i>Larus marinus</i> | 107 | 9.4 | 90.6 |
| 40166 | Gull, lesser black-backed | <i>Larus fuscus</i> | 107 | 9.4 | 90.6 |
| 40167 | Gull, herring | <i>Larus argentatus</i> | 107 | 9.4 | 90.6 |
| 40170 | Gull, ring-billed | <i>Larus delawarensis</i> | 107 | 9.4 | 90.6 |
| 40175 | Gull, Bonaparte's | <i>Larus philadelphia</i> | 107 | 9.4 | 90.6 |
| 40213 | Owl, northern saw-whet | <i>Aegolius acadicus</i> | 1287 | 16.2 | 83.8 |
| 40225 | Sapsucker, yellow-bellied | <i>Sphyrapicus varius</i> | 2176 | 13.7 | 86.3 |
| 40262 | Nuthatch, red-breasted | <i>Sitta canadensis</i> | 2176 | 13.7 | 86.3 |
| 40264 | Creepers, brown | <i>Certhia americana</i> | 1287 | 16.2 | 83.8 |
| 40266 | Wren, winter | <i>Troglodytes troglodytes</i> | 1287 | 16.2 | 83.8 |
| 40278 | Thrush, hermit | <i>Catharus guttatus</i> | 1287 | 16.2 | 83.8 |
| 40285 | Kinglet, golden-crowned | <i>Regulus satrapa</i> | 1287 | 16.2 | 83.8 |
| 40286 | Kinglet, ruby-crowned | <i>Regulus calendula</i> | 1915 | 14.5 | 85.5 |
| 40287 | Pipit, American | <i>Anthus rubescens</i> | 181 | 20.1 | 79.9 |
| 40317 | Warbler, yellow-rumped | <i>Dendroica coronata</i> | 2422 | 13.7 | 86.3 |

Waterfowl

| <u>Num</u> | <u>Common Name</u> | <u>Scientific Name</u> | <u>Area (ha)</u> | <u>% Status 1</u> | <u>% Status 2</u> |
|-------------------|---------------------------|--------------------------------|-------------------------|--------------------------|--------------------------|
| 40001 | Loon, common | <i>Gavia immer</i> | 87 | 10.0 | 90.0 |
| 40008 | Grebe, pied-billed | <i>Podilymbus podiceps</i> | 106 | 10.7 | 89.3 |
| 40024 | Cormorant, double-crested | <i>Phalacrocorax auritus</i> | 106 | 10.7 | 89.3 |
| 40044 | Swan, tundra | <i>Cygnus columbianus</i> | 87 | 10.0 | 90.0 |
| 40049 | Goose, lesser snow | <i>Chen caerulescens</i> | 87 | 10.0 | 90.0 |
| 40053 | Gadwall | <i>Anas strepera</i> | 106 | 10.7 | 89.3 |
| 40054 | Pintail, northern | <i>Anas acuta</i> | 106 | 10.7 | 89.3 |
| 40056 | Teal, green-winged | <i>Anas crecca</i> | 106 | 10.7 | 89.3 |
| 40059 | Wigeon, American | <i>Anas americana</i> | 106 | 10.7 | 89.3 |
| 40060 | Shoveler, northern | <i>Anas clypeata</i> | 106 | 10.7 | 89.3 |
| 40062 | Redhead | <i>Aythya americana</i> | 87 | 10.0 | 90.0 |
| 40063 | Duck, ring-necked | <i>Aythya collaris</i> | 87 | 10.0 | 90.0 |
| 40064 | Canvasback | <i>Aythya valisineria</i> | 87 | 10.0 | 90.0 |
| 40065 | Scaup, greater | <i>Aythya marila</i> | 87 | 10.0 | 90.0 |
| 40066 | Scaup, lesser | <i>Aythya affinis</i> | 104 | 10.8 | 89.2 |
| 40067 | Goldeneye, common | <i>Bucephala clangula</i> | 87 | 10.0 | 90.0 |
| 40068 | Bufflehead | <i>Bucephala albeola</i> | 87 | 10.0 | 90.0 |
| 40069 | Oldsquaw | <i>Clangula hyemalis</i> | 87 | 10.0 | 90.0 |
| 40073 | Scoter, white-winged | <i>Melanitta fusca</i> | 87 | 10.0 | 90.0 |
| 40074 | Scoter, surf | <i>Melanitta perspicillata</i> | 87 | 10.0 | 90.0 |
| 40075 | Scoter, black | <i>Melanitta nigra</i> | 87 | 10.0 | 90.0 |
| 40076 | Duck, ruddy | <i>Oxyura jamaicensis</i> | 106 | 10.7 | 89.3 |
| 40078 | Merganser, common | <i>Mergus merganser</i> | 87 | 10.0 | 90.0 |
| 40079 | Merganser, red-breasted | <i>Mergus serrator</i> | 83 | 10.5 | 89.5 |