Department of Defense

Legacy Resource Management Program

16-816

Develop Resources for Natural Resource Managers to Integrate Downscaled SWAP Information with INRMPs: Case Study for Aberdeen Proving Ground

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1. Determine the Installation Landscape

1.1 Identify spatial units for the installation landscape

Aberdeen Proving Ground (PG) is located near Aberdeen, Maryland in the northern reaches of the Chesapeake Bay. The installation encompasses a total area of approximately 293 km^2 with 99% of that encompassing Aberdeen and Edgewood peninsulas, Spesutie Island, Poole's Island, Grace's Quarters, and Caroll Island. Aberdeen PG also has several separate inland parcels (Churchville Test Area, Atkisson Reservoir and Dam, Van Bibber Water Treatment Plant, and Hanson Reservoir), and well as small tower parcels on the Eastern Shore.

The natural resource managers (NRMs) at Aberdeen PG decided to designate the installation management boundary as their installation landscape for analysis (Figure 1). This includes all the satellite properties, although the vast majority of the installation landscape is comprised of the main facility.
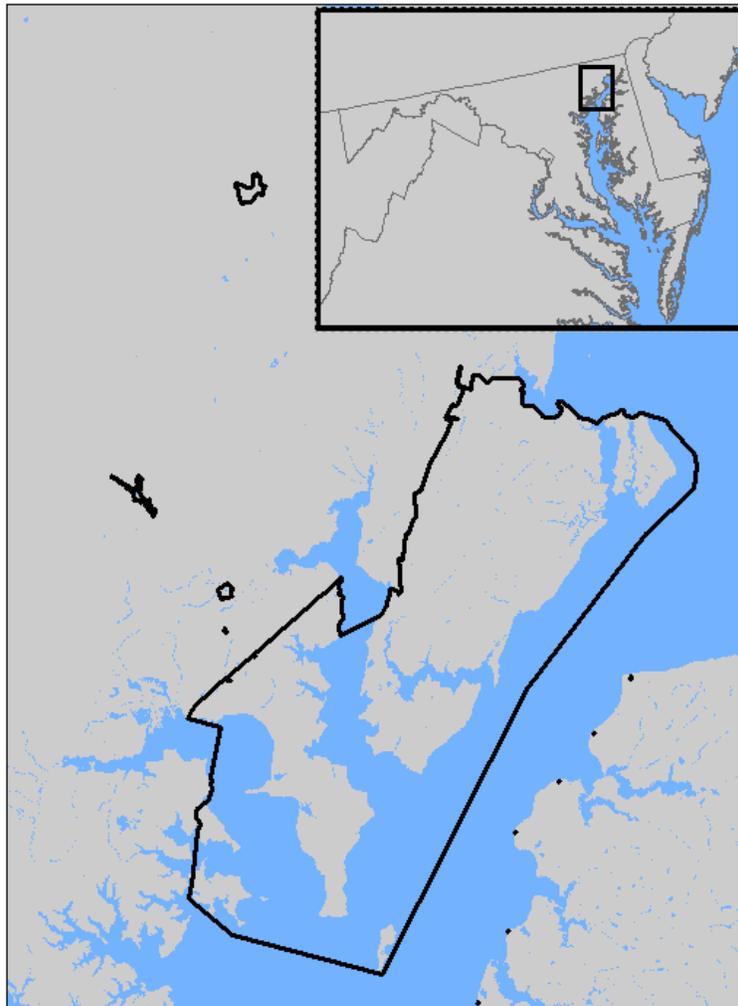

Figure 1. Boundary of Aberdeen PG. The NRMs elected to designate this boundary as the installation landscape for the downscale effort.

1.2 Identify conservation partners and adjacent lands to consider in addition to the installation

The NRMs at Aberdeen PG opted to consider only the installation boundary as part of the landscape. No neighboring properties or regions were included.

1.3 Identify and obtain any existing or needed spatial data to define the installation landscape

The only spatial information necessary to define the installation landscape is the boundary of Aberdeen PG. This information was provided by the installation as a geospatial dataset.

2. Identify Wildlife Action Plan SGCN and Associated Information

2.1 Retrieve and review relevant SWAP for your state

The Maryland Department of Natural Resources (MDDNR) developed Maryland's State Wildlife Action (MD SWAP) Plan. The plan was updated in 2015 and is available online through the MDDNR website (http://dnr.maryland.gov/wildlife/Pages/plants_wildlife/SWAP_home.aspx).

The MD SWAP identified 610 species of greatest conservation need in the 2015 SWAP. The document also describes key wildlife habitats in the state, and outlines both threats and conservation opportunities for these habitats.

2.2 Contact relevant state fish and wildlife office if needed

We communicated with WAP staff at MDDNR about this project both at the proposal stage and early in the downscale process. Building a relationship with the state WAP contact is a very good idea. At the time of project initiation, the MD DNR SWAP coordinator position was vacant so no further direct interactions occurred; however, we stress the value in making contact with the appropriate state agency personnel when initiating a downscale project. This will facilitate communication between the installation NRMs and state agency to ensure the analyses and interpretations are correct. It will also promote a better understanding of how the installation is contributing to SGCN conservation.

2.3 Review list of action plan SGCN

We reviewed the list of WAP SGCN and put all relevant information contained in the Plan about them into an Excel spreadsheet (e.g., common name, scientific name, various state and federal rankings, etc.). The Maryland WAP has over 600 SGCN and includes terrestrial vertebrates, aquatic vertebrates, insects, crustaceans, freshwater mussels, and flatworms (Table 1). Over half of the species listed are invertebrates.

Table 1. Summary of species of greatest conservation need listed in 2015 (adapted from Table 3.3 in the MDSWAP).

Taxa Group	2015 SWAP
Mammals	41
Birds	143
Reptiles	26
Amphibians	19
Fish	31
Beetles	22
Bees, Wasps, and Ants	36
Butterflies and Moths	101
Dragonflies and Damselflies	93
Stoneflies, Mayflies, and Caddisflies	14
Other Insects	6
Crustaceans and Allies	40
Snails	14
Freshwater Mussels	14
Flatworms	10
Total	610

Clearly Aberdeen PG does not harbor all of these species, so our objective is to identify which species are found on the installation and determine which of those can be effectively managed for without encroaching on the military mission.

2.4 Review habitat classification and descriptions

The MD SWAP contains very detailed information on the "key wildlife habitats" (KWH) in Maryland. These KWHs provide information to support habitat conservation and to understand the likely distribution of SGCNs in the state.

A total of 59 KWH were identified in the SWAP (Table 2). These include both terrestrial and aquatic types. The SWAP provides detailed descriptions of each KWH and includes a distribution map for each, compiled from various geospatial data layers (MDNR personal communication). The MD SWAP also contains information on how each SGCN relates to one or more KWH.

2.5 Review threat and conservation action information

Maryland's WAP includes threat and conservation action information at the habitat level. The WAP also includes priorities for conservation action where available and relevant. This information will be necessary when reviewing the installation priority SGCN list to determine what actions are effective.

Table 2. Key wildlife habitats identified in the MD SWAP.

Key Wildlife Habitat (Terrestrial)	Key Wildlife Habitat (Wetland and Aquatic)
High Elevation Ridge Forest	Montane Bog and Fen
Hemlock-Northern Hardwood Forest	Montane-Piedmont Acidic Seepage Swamp
Cove Forest	Montane-Piedmont Basic Seepage Swamp
Montane - Piedmont Oak-Pine Forest	Piedmont Seepage Wetland
Oak-Hickory Forest	Piedmont Upland Depression Swamp
Basic Mesic Forest	Coastal Plain Flatwood and Depression Swamp
Mesic Mixed Hardwood Forest	Coastal Plain Seepage Swamp
Coastal Plain Oak-Pine Forest	Coastal Plain Seepage Bog and Fen
Coastal Plain Pitch Pine Forest	Delmarva Bay
Maritime Forest and Shrubland	Maritime Swamp
Serpentine Barren	Vernal Pool
Shale Barren	Spring
Acidic Glade and Barren	Tidal Forest
Basic Glade and Barren	Tidal Freshwater Marsh and Shrubland
Cliff and Rock Outcrop	Tidal Brackish Marsh and Shrubland
Coastal Bluff	Tidal Salt Marsh and Shrubland
Coastal Beach	Intertidal Mudflat and Sand Flat
Maritime Dune and Grassland	Coldwater Stream
Montane-Piedmont Floodplain	Limestone Stream
Coastal Plain Floodplain	Highland Stream
Cave and Karst	Piedmont Stream
Managed Montane Conifer Forest	Coastal Plain Stream
Managed Successional Forest	Blackwater Stream
Managed Grassland	Highland River
Roadside and Utility Right-of-way	Piedmont River
Artificial Impoundment and Wetland	Coastal Plain River
Artificial Structure – Buildings and Other Structures	Shellfish Bed
Artificial Structure – Mine and Tunnel	Hard bottom (Living and Non-living)
	Submerged Aquatic Vegetation
	Macroalgae
	Pelagic-Open Water

2.6 Obtain relevant spatial data if available

The distribution maps of each KWH are compilations of several different datasets and are not available for direct use in the downscaling effort. The MD SWAP does not provide spatial distributions of SGCNs as part of their analysis either. Thus, in order to determine which of the SGCNs might occur within the installation landscape, we will need to identify a surrogate dataset that will allow us to understand which KWHs are present, and calculate their relative abundance within a reference landscape. Using the

information in the SWAP connecting each SGCN with the KWHs, we can produce potential species distribution maps for our installation landscape.

This will allow us to reduce the list of potential SGCNs found in the installation landscape and help us identify which SGCNs could be prioritized by NRMS at Aberdeen PG for conservation actions.

3. Identify Species on Installation

3.1 Retrieve and review INRMPS from installation

The INRMP for Aberdeen PG contained information on the species known to occur on the installation as identified through dedicated surveys and direct observation. We can compare this information to the list of SGCN from the SWAP to determine which SGCN have been documented within the installation landscape (Table 3).

A total of 49 SGCNs are known to occur, or have occurred, at Aberdeen PG. The majority of these are birds (35), followed by mammals and fish (5 each), reptiles (3), and amphibians (1). This list represents those species known to occur within the installation; however, there may be some species occurring on the installation that were undetected by the surveys conducted. For example, other taxa such as fish or freshwater mussels are not included in the INRMP. We do not know if dedicated surveys for those species have been completed.

Using the information contained in the SWAP, we can examine the habitat used by each species and build potential distribution maps for both the state and installation landscape. With these, we can create a potential SGCN list and compare that to the list of known species above to determine if additional SGCNs may occur on the installation.

4. Identify Action Plan Priority SGCN that Occur on Installation

We want to use the information from the SWAP to provide some context for the SGCN that occur within the installation landscape. Some questions we wanted to consider for Aberdeen PG were:

> *- How many SGCN are predicted to occur within the installation landscape?*
> *- How much of this species' habitat occurs within the installation landscape?*
> *- Which habitats on the installation help the greatest number of SGCN?*
> *- What other factors are important for identifying a SGCN as a priority for this installation?*

We will answer these questions by using the information contained in the SWAP to connect species with habitats, and then map those across the landscape. With that information, we can determine how much of the species statewide range occurs within the installation landscape, and determine whether the species should be a management priority for Aberdeen PG.

Table 3. List of SGCN that occur on Aberdeen PG according to information in the INRMP.

Taxa	SGCN in Aberdeen PG INRMP	Scientific name
Amphibian	Upland chorus frog	*Pseudacris feriarum*
Bird	Acadian flycatcher	*Empidonax virescens*
Bird	American kestrel	*Falco sparverius*
Bird	American redstart	*Setophaga ruticilla*
Bird	American woodcock	*Scolopax minor*
Bird	Blue-winged teal	*Anas discors*
Bird	Bald eagle	*Haliaeetus leucocephalus*
Bird	Barn owl	*Tyto alba*
Bird	Black duck	*Anas rubripes*
Bird	Black-crowned night heron	*Nycticorax nycticorax*
Bird	Brown creeper	*Certhia americana*
Bird	Chimney swift	*Chaetura pelagica*
Bird	Coastal plain swamp sparrow	*Melospiza georgiana nigrescens*
Bird	Common nighthawk	*Chordeiles minor*
Bird	Dark-eyed junco	*Junco hyemalis*
Bird	Eastern meadowlark	*Sturnella magna*
Bird	Eastern whip-poor-will	*Antrostomus vociferus*
Bird	Golden eagle	*Aquila chrysaetos*
Bird	Grasshopper sparrow	*Ammodramus savannarum*
Bird	Great blue heron	*Ardea herodias*
Bird	Great egret	*Ardea alba*
Bird	Kentucky warbler	*Geothlypis formosa*
Bird	King rail	*Rallus elegans*
Bird	Northern bobwhite	*Colinus virginianus*
Bird	Northern harrier	*Circus cyaneus*
Bird	Northern parula	*Setophaga Americana*
Bird	Ovenbird	*Seiurus aurocapillus*
Bird	Prairie warbler	*Setophaga discolor*
Bird	Prothonotary warbler	*Protonotaria citrea*
Bird	Scarlet tanager	*Piranga olivacea*
Bird	Sharp-shinned hawk	*Accipiter striatus*
Bird	Snowy egret	*Egretta thula*
Bird	Wood thrush	*Hylocichla mustelina*
Bird	Worm-eating warbler	*Helmitheros vermivorus*
Bird	Yellow-breasted chat	*Icteria virens*
Bird	Yellow-throated vireo	*Vireo flavifrons*
Fish	American shad	*Alosa sapidissima*
Fish	Atlantic sturgeon	*Acipenser oxyrinchus*
Fish	Hickory shad	*Alosa mediocris*

Table 3 (continued)		
Fish	Shortnose sturgeon	*Acipenser brevirostrum*
Fish	White catfish	*Ameiurus catus*
Mammal	Eastern red bat	*Lasiurus borealis*
Mammal	Hoary bat	*Lasiurus cinereus*
Mammal	Tricolored bat	*Perimyotis subflavus*
Mammal	Big brown bat	*Eptesicus fuscus*
Mammal	Little brown bat	*Myotis lucifugus*
Reptile	Spotted turtle	*Clemmys guttata*
Reptile	Eastern box turtle	*Terrapene carolina*
Reptile	Eastern ribbonsnake	*Thamnophis sauritus*

4.1 Represent SGCN spatially on the landscape

Information on SGCN is not readily available for the installation landscape. We developed an estimate of SGCN occurrence by connecting each SGCN to a habitat type, then mapping the types across the state in a geographic information system (GIS).

Information on SGCN habitat associations were provided in the Maryland SWAP. Maryland identified 59 different key wildlife habitat types, and then listed each type of habitat used for each SGCN (Appendix 4 in MD SWAP). As previously mentioned, a map representation of these 59 types was not readily available; however, the MD SWAP does provide a crosswalk of the KWHs to the Northeastern Terrestrial Wildlife Habitat Classification (NETWHC), which does have an associated map that was available for Maryland. Therefore, we were able to connect each KWH to a corresponding type in the NETHC map and use that to produce potential species distributions for the state of Maryland.

It is important to note that the resulting potential distribution maps do not contain other critical information that dictates whether a species is actually present. Other factors such as land use history, ranges, etc. are significant drivers of species occurrence across the landscape. Our objectives for including this information are to capture the potential SGCNs that may occur within the installation landscape, and then use that information to evaluate those species that appear. It is during that process that SGCNs are evaluated to determine potential presence within the landscape and relative importance for prioritization.

We created a spreadsheet listing each SGCN in the first column and each habitat type in the following columns. In each cell, we entered a "1" if the species used the type and a "0" if not. This tabular structure was chosen so that we could then import the species-habitat matrix into the GIS and join it to the Maryland habitat layer. This format also allowed us to easily summarize the total number of SGCN attributed to each habitat type and create a species distribution.

Preparing the Key Wildlife Habitats map

We obtained the NETHC map ([link](#)) from The Nature Conservancy Internet site and clipped it to the boundary of the state of Maryland. Using the cross-referencing information provided in the MD SWAP, we determined which of the KWH should be matched to classes in the NETHC map (Table 4). We did not attempt to cross-reference aquatic types similarly due to a lack of specificity in these types and the location of Aberdeen PG, which does not have multiple types of rivers on the installation landscape. We did retain an "Open water-pelagic" type to represent all water in the NETHC map.

Table 4. List of cross-references used to map Key Wildlife Habitats from the MD SWAP to classes in the NETHC. Note: aquatic classes are omitted.

Code	Key Wildlife Habitat	NETWHC
1	High Elevation Ridge Forest	Central and Southern Appalachian Montane Oak Forest (CES202.596)
2	Hemlock-Northern Hardwood Forest	Appalachian (Hemlock)-Northern Hardwood Forest (CES202.593)
3	Cove Forest	Southern and Central Appalachian Cove Forest (CES202.373)
4	Montane - Piedmont Oak-Pine Forest	Central Appalachian Dry Oak-Pine Forest (CES202.591)
5	Oak-Hickory Forest	Northeastern Interior Dry-Mesic Oak Forest (CES202.592)
6	Basic Mesic Forest	Southern and Central Appalachian Cove Forest (CES202.231)
7	Mesic Mixed Hardwood Forest	Southern Atlantic Coastal Plain Mesic Hardwood Forest (CES203.242)
8	Coastal Plain Oak-Pine Forest	Northern Atlantic Coastal Plain Hardwood Forest (CES203.475)
9	Coastal Plain Pitch Pine Forest	Northern Atlantic Coastal Plain Pitch Pine Barrens (CES203.269)
10	Maritime Forest and Shrubland	Northern Atlantic Coastal Plain Maritime Forest (CES203.302)
11	Serpentine Barren	Eastern Serpentine Woodland (CES202.347)
12	Shale Barren	Appalachian Shale Barrens (CES202.598)
13	Acidic Glade and Barren	Central Appalachian Pine-Oak Rocky Woodland (CES202.600)
14	Basic Glade and Barren	Piedmont Hardpan Woodland and Forest (CES202.268)
15	Cliff and Rock Outcrop	North-Central Appalachian Circumneutral Cliff and Talus (CES202.603)
16	Coastal Bluff	Northeastern Erosional Bluff (CES203.498) Coastal Beaches and Dunes
17	Coastal Beach	Northern Atlantic Coastal Plain Sandy Beach (CES203.301)
18	Maritime Dune and Grassland	Northern Atlantic Coastal Plain Dune and Swale (CES203.264)
19	Montane-Piedmont Floodplain	Central Appalachian Stream and Riparian (CES202.609)
20	Coastal Plain Floodplain	Northern Atlantic Coastal Plain Stream and River (CES203.070)
21	Montane Bog and Fen	High Allegheny Wetland (CES202.069)

Table 4 (continued)		
22	Montane-Piedmont Acidic Seepage Swamp	North-Central Appalachian Acidic Swamp (CES202.604)
23	Montane-Piedmont Basic Seepage Swamp	North-Central Interior and Appalachian Rich Swamp (CES202.605)
24	Piedmont Seepage Wetland	Piedmont Seepage Wetland (CES202.298), Laurentian-Acadian Wet Meadow-Shrub Swamp (CES201.582)
25	Piedmont Upland Depression Swamp	Piedmont Upland Depression Swamp (CES202.336)
26	Coastal Plain Flatwood and Depression Swamp	Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest (CES203.520)
27	Coastal Plain Seepage Swamp	Northern Atlantic Coastal Plain Stream and River (CES203.070)
28	Coastal Plain Seepage Bog and Fen	Northern Atlantic Coastal Plain Basin Peat Swamp (CES203.522)
29	Delmarva Bay	Northern Atlantic Coastal Plain Pond (CES203.518)
30	Maritime Swamp	Northern Atlantic Coastal Plain Maritime Forest (CES203.302)
31	Vernal Pool	(Habitat found within many NETWHCS types); fine scale
32	Spring	(Habitat found within many NETWHCS types); fine scale
33	Tidal Forest	Northern Atlantic Coastal Plain Tidal Swamp (CES203.282)
34	Tidal Freshwater Marsh and Shrubland	Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh (CES203.516)
35	Tidal Brackish Marsh and Shrubland	Northern Atlantic Coastal Plain Brackish Tidal Marsh (CES203.894)
36	Tidal Salt Marsh and Shrubland	Northern Atlantic Coastal Plain Tidal Salt Marsh (CES203.519)
37	Intertidal Mudflat and Sand Flat	Northern Atlantic Intertidal Mudflat (CES201.050)
51	Open water- pelagic	Open water
53	Managed Montane Conifer Forest	Managed Tree Plantation; structural modifier
54	Managed Successional Forest	Ruderal Forest - Northern and Central Hardwood and Conifer
55	Managed Grassland	Ruderal Upland – Old Field, Pasture/Hay
56	Roadside and Utility Right-of-way	Powerline ROW
57	Artificial Impoundment and Wetland	Modified/Managed Marsh
58	Artificial Structure – Buildings and Other Structures	Commercial/Industrial, Residential-High Intensity, Residential-Medium Intensity, Residential-Low Intensity, Residential-Rural/Sparse
59	Artificial Structure – Mine and Tunnel	n/a

We used this table of information to reclassify the NETHC map in the GIS for the entire state. The resulting map was used to examine both the installation landscape (Figure 2) and the entire state of Maryland which was designated as the reference area.

With this information, we examined the installation area and compared the distribution of each KWH present to the total within the reference area (i.e., the state). The most abundant KWH within the installation landscape was Open Water-Pelagic followed by Coastal Plain Flatwood and Depression Swamp (Table 5). We also generated a table with the total area of habitat in each class from the MD Key Wildlife Habitats map we created from the NETWHC map (Table 6).

Table 5. Summary of the KWHs found within the installation landscape. Area is in Km^2.

MD Code	Name	Area	Prop. Of Installation
2	Hemlock-Northern Hardwood Forest	0.5	0.2%
5	Oak-Hickory Forest	0.2	0.1%
7	Mesic Mixed Hardwood Forest	13.4	4.6%
8	Coastal Plain Oak-Pine Forest	31.6	10.8%
19	Montane-Piedmont Floodplain	4.8	1.7%
22	Montane-Piedmont Acidic Seepage Swamp	0.0	0.0%
24	Piedmont Seepage Wetland	0.5	0.2%
26	Coastal Plain Flatwood and Depression Swamp	35.2	12.0%
33	Tidal Forest	2.2	0.7%
36	Tidal Salt Marsh and Shrubland	27.5	9.4%
51	Pelagic-Open Water	132.6	45.2%
55	Managed Grassland	22.5	7.7%
58	Artificial Structure – Buildings and Other Structures	22.4	7.6%
	Total	293.5	100%

Building SGCN potential distribution maps

With a map of the KWH and a table connecting the SGCNs to the KWH they utilize, we can are able to construct potential distribution maps for each species. We added the table to the GIS and joined it to the statewide habitat map using the MD habitat code. We used the same steps to join the table to the habitat map clipped to the installation boundary. We exported the installation boundary map with the species habitat distribution attached to create the potential species list for the installation in the spreadsheet software.
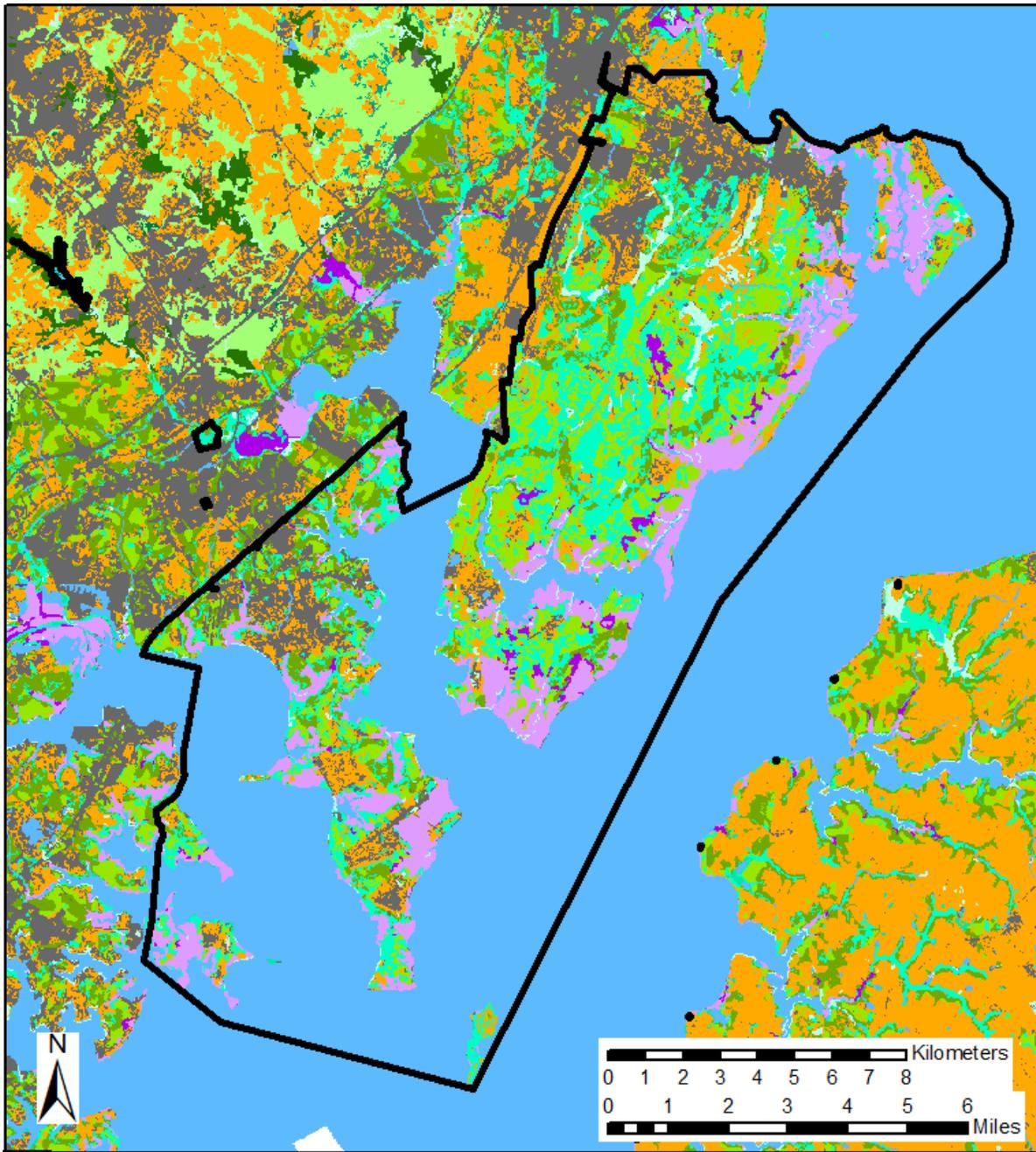
Figure 2. Map of Key Wildlife Habitats in the installation landscape derived from the NETHC map of the Northeast region.

Table 6. Summary of KWH for the reference area (state of Maryland). Area is in km².

MD Code	Key Wildlife Habitats	Area	Prop. Reference Area
55	Hemlock-Northern Hardwood Forest	10,109.6	32.80%
51	Cove Forest	5,652.8	18.34%
58	Montane - Piedmont Oak-Pine Forest	3,260.3	10.58%
5	Oak-Hickory Forest	2,799.9	9.08%
7	Mesic Mixed Hardwood Forest	2,301.8	7.47%
8	Coastal Plain Oak-Pine Forest	1,580.5	5.13%
26	Serpentine Barren	1,412.0	4.58%
2	Shale Barren	1,148.8	3.73%
36	Acidic Glade and Barren	888.8	2.88%
4	Basic Glade and Barren	516.6	1.68%
19	Cliff and Rock Outcrop	477.4	1.55%
33	Maritime Dune and Grassland	291.1	0.94%
13	Montane-Piedmont Floodplain	113.6	0.37%
14	Montane-Piedmont Acidic Seepage Swamp	101.6	0.33%
24	Montane-Piedmont Basic Seepage Swamp	87.1	0.28%
11	Piedmont Seepage Wetland	23.9	0.08%
22	Coastal Plain Flatwood and Depression Swamp	18.2	0.06%
18	Coastal Plain Seepage Bog and Fen	12.7	0.04%
12	Maritime Swamp	8.6	0.03%
23	Tidal Forest	6.3	0.02%
30	Tidal Salt Marsh and Shrubland	4.7	0.02%
28	Pelagic-Open Water	4.0	0.01%
15	Managed Grassland	3.5	0.01%
3	Artificial Structure – Buildings and Other Structures	1.1	0.00%
	Total	30,825.0	100.00%

In the spreadsheet software, we opened the installation SGCN distribution table and added a column to sum all the habitats present for each SGCN. Columns with a sum of zero were removed, leaving a list of potential SGCN for the installation landscape.

For Aberdeen PG, the potential SGCN list included 219 species. That represents a 65% reduction in the number of SGCNs from the state total. It is important to note that this list is based solely on habitat associations, and is almost certainly a conservative number. It does not use known range distribution information or other factors that affect whether an SGCN actually occurs within the installation landscape. In all likelihood the actual number of SGCNs present on the installation landscape is even lower.

For example, the rainbow snake is a potential SGCN for the installation landscape but this species is not known to occur within the same hydrologic unit as Aberdeen PG (Figure 3). Without additional, accessible range information, it will be difficult to filter out species like the rainbow snake from the analysis. In this instance, we have elected to consider each species more thoroughly after completing the downscaled priority list. Then, we will allocate more effort to those species identified as potential priorities and expect they can be removed from the list at that point. This approach will be more time-efficient than trying to filter 219 species at this stage of the analysis.
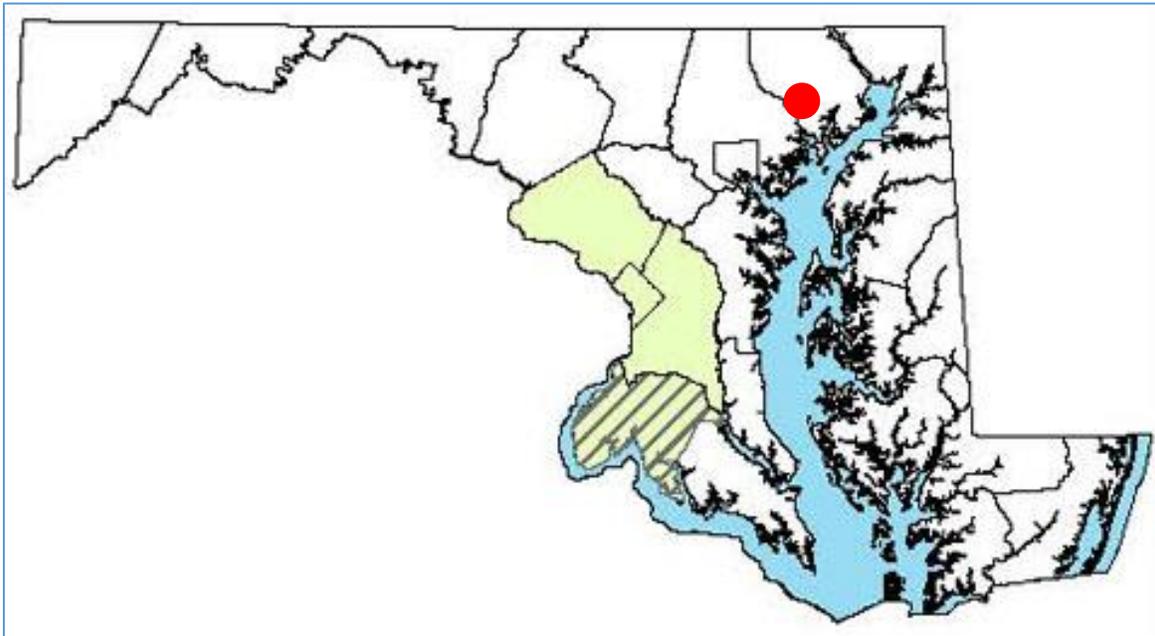

Figure 3. Image taken from the MDDNR website showing the known (hatched) and potential (green) distribution of the rainbow snake in Maryland. The Aberdeen PG is indicated by the red dot.

For example, the eastern harvest mouse occurs in MD habitat types of 8-9, 54-55. Our mapped KWH includes type 8 and 55, so we estimate that the eastern harvest mouse has about 11,690 km^2 (10,110 + 1,581) of potential habitat in Maryland (Figure 4).

4.2 Downscale priority SGCN to installation landscape

Similarly, we can use the habitat subset to determine how much eastern harvest mouse habitat occurs within the installation landscape. In most cases, the installation landscape will not contain all the habitats that occur across the state. The Aberdeen PG installation landscape (Table 7) represents approximately 1.0% of the area in Maryland (including open water) and includes 13 KWH (terrestrial).

We can better-understand the importance of habitat within the Aberdeen PG landscape by comparing the total area on the installation to the total found in the state. The importance score is calculated by

dividing the total area of habitat on the installation by the total area in the state and represents the proportion of that SGCN's total distribution in Maryland that can be found within the installation landscape.

$$\frac{Area\ (installation)}{Area\ (state)}$$

The maximum score would be 1.0 that occurs when all of the potential habitat within a state is found on the installation. If the species distribution does not occur within the installation landscape then the score is 0.

Once the value is calculated for the entire set of potential SGCN, we sorted the list in descending order by the proportion. For the Aberdeen PG landscape, the highest proportion score was 3.10% (several species; Appendix A) indicating that Aberdeen PG comprises a relatively small proportion of the total potential distribution of these SGCNs when compared to the entire state. The threshold importance score is something that can be decided on by the installation in cooperation with other natural resource management groups, or individually. In other downscaling efforts, we elected to use a value of 0.1 to classify an SGCN as a priority within a given landscape.

For additional context, the installation landscape comprises approximately 1.0% of the entire state. Thus, any value greater than 1.0% demonstrates a "more than expected" amount of habitat. The higher that proportion, the more important the installation landscape is in protecting the KWHs of that SGCN.
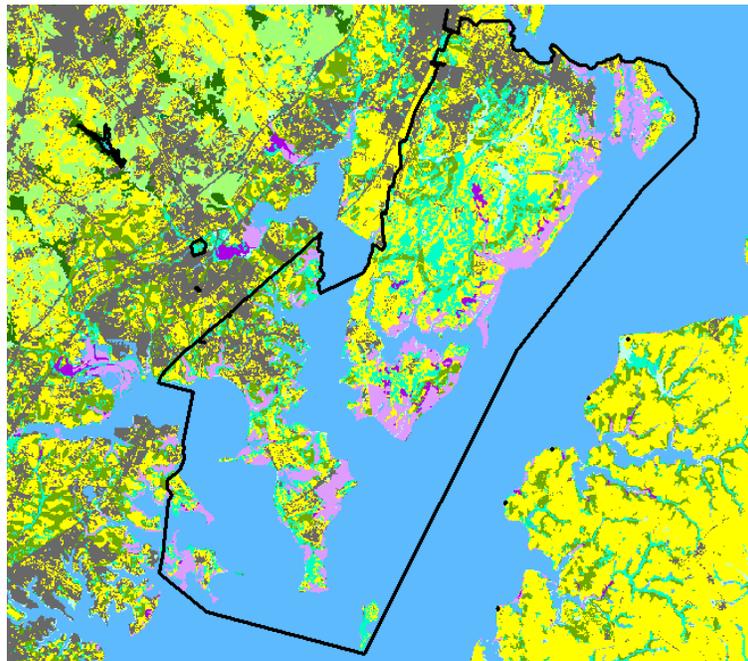

Figure 4. Potential distribution for eastern harvest mouse (yellow) based on the cross-referencing of MD SWAP information and KWH mapped for the state of Maryland.

Clearly, the size of the installation landscape relative to the entire area of the state is important, and while the habitat of an individual SGCN might be small relative to the whole, it still may warrant consideration for management. Using the same information, we can examine the amount of habitat within an installation landscape relative to what might be expected. That is, we can look at the size of the installation landscape as a proportion of the state then use that value to compare the amount of KWHs observed to the amount "expected" to occur based on area.

For example, we see that the Tidal Marsh and Shrubland KWH comprises approximately 9.4% of the installation landscape (Table 7). This same KWH comprises about 2.9% of the state of Maryland. This suggests that the Tidal Marsh and Shrubland habitats on the installation may provide a conservation opportunity since these types are found at over three times the expected value for a similar sized area in Maryland.

Table 7. Summary of Aberdeen PG KWHs compared to the total amount of that type in the reference area (Km²).

Name	Area	Area MD	Ratio
Tidal Salt Marsh and Shrubland	27.53	888.76	0.0310
Coastal Plain Flatwood and Depression Swamp	35.19	1,411.99	0.0249
Pelagic-Open Water	132.61	5,652.79	0.0235
Coastal Plain Oak-Pine Forest	31.60	1,580.52	0.0200
Montane-Piedmont Floodplain	4.84	477.43	0.0101
Tidal Forest	2.16	291.14	0.0074
Artificial Structure – Buildings and Other Structures	22.36	3,260.33	0.0069
Mesic Mixed Hardwood Forest	13.42	2,301.81	0.0058
Piedmont Seepage Wetland	0.48	87.13	0.0055
Montane-Piedmont Acidic Seepage Swamp	0.05	18.21	0.0025
Managed Grassland	22.47	10,109.61	0.0022
Hemlock-Northern Hardwood Forest	0.55	1,148.81	0.0005
Oak-Hickory Forest	0.21	2,799.88	0.0001
Totals	293.47	30,028.40	0.0098

When we examine the SGCNs utilizing this habitat type, we see that 66 species of the 219 identified within the installation landscape are associated with it. Therefore, efforts to mitigate threats to Tidal Salt Marsh and Shrubland within the installation landscape will be beneficial to a suite of SGCNs. Conversely, types like Mesic Mixed Hardwood Forest found within the installation landscape comprise a relatively small area compared to expected values (4.6% observed versus 7.6% expected). This suggests that the Aberdeen PG installation landscape is not as important for this type.

This same sort of approach can be used to develop a regional context for habitats and SGCN. For example, NRMs may be interested to note how much of the Tidal Salt Marsh and Shrubland type is found in the upper Chesapeake Bay, and how much of that is within the Aberdeen PG installation landscape (Figure 5). Once the area comprising the upper Chesapeake Bay has been defined, it is a

simple task to calculate the proportion of the total habitat type occurs on the installation landscape. In that context, the Tidal Marsh and Shrublands on Aberdeen PG take on an increased importance, as these types are relatively rare in the surrounding area.
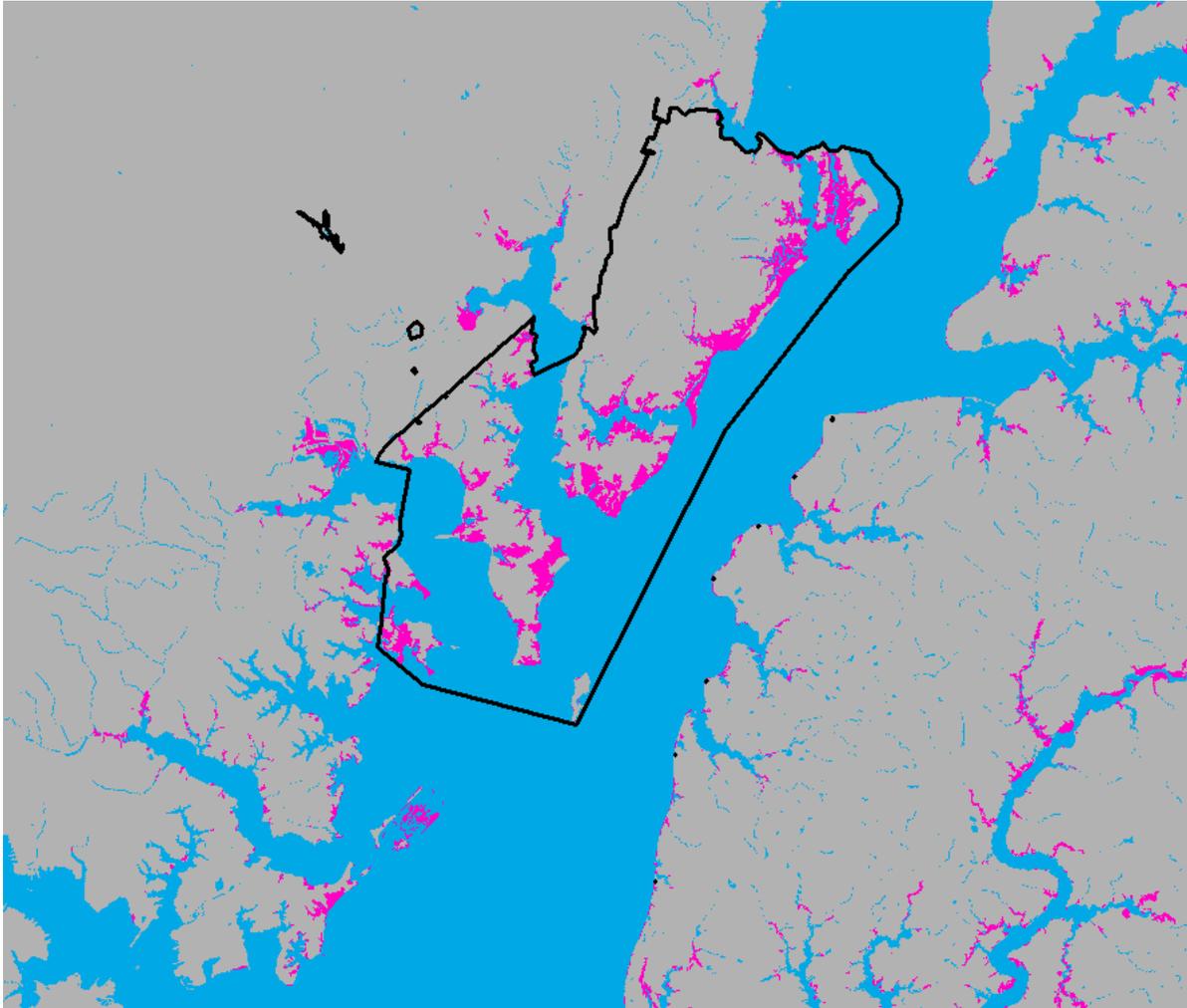
Figure 5. Distribution of the Tidal Salt Marsh and Shrubland KWH (pink) in the upper Chesapeake Bay.

5. Determine Installation Priority SCGN

Actually choosing priority species for Aberdeen PG is beyond the scope of this project. Additional information on installation training objectives, available resources, historical/cultural resource priorities, and other considerations should also be incorporated into identifying which SGCN should be prioritized. Generally, you can consider a variety of factors when evaluating which priority SGCN identified during the downscaling process may also be installation priorities. They include the following:

       1) Are there endemic SGCN to the installation?

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2) Do you hold a significant portion of a habitat within the state or region?
3) Do you have multiple species in one habitat?
4) Does the Action Plan provide a prioritization process based on distribution within the state?
5) Does the Action Plan provide a ranking system of SGCN within the Plan?
6) What are the SGCNs' legal status?
7) Are there other factors that may come into play specific to the installation?

The following sections provide some basic information or suggestions for incorporating these factors when considering which SGCN should be prioritized. *Note: the examples provided in the following sections should not be considered as recommendations, nor construed as accepted priorities for the Aberdeen PG.*

5.1 Consider all Action Plan priority SGCN occurring on installation

Based on the species/ habitat association downscale process just described, there are 219 SGCN Action Plan priority SGCN potentially occurring on the installation landscape. As a first step, Aberdeen PG could elect to review and consider these 219 as installation priority SGCN, further reducing the list by identifying those SGCN that are not found on the installation landscape using ancillary range information.

5.2 Consider species endemic to your installation

It is extremely rare for an installation to contain a species found nowhere else outside of the installation boundaries. However, examples exist, especially for plants. The installation landscape for Aberdeen PG does not have any endemic fish or wildlife species.

5.3 Develop a tier or ranking system for the SGCN that occur on your landscape

The list of potential installation priority SGCN is long. The primary reason is that this list includes all possible SGCN that occur in the habitats located within the installation. In reality, not all 219 can, or should, be considered priority installation species (at other bases if this number is smaller, then this would be more feasible). However, the species/ habitat association method of downscaling allows managers to determine which species are associated with the most valuable habitats, as well as those that have the greatest proportional area on the installation. This proportion could be used for ranking SGCN to help in determining priority for the installation as well as for comparing to SGCN listed in INRMPs. For example, NRMs might choose to prioritize those SGCNs by ratio of observed-to-expected amount of potential habitat (Table 8). These could be tiered such that SGCN with the highest ratio are prioritized

5.4 Compare downscaled list of action plan priority SGCN for the installation with species listed in the INRMP

For Aberdeen, we first considered how many top tier SGCN overlapped with INRMP species. Of these 26 SGCN (Table 8), only two overlapped with the 45 WAP species listed in Aberdeen's INRMP. We then compared the SGCN in the INRMP to the second-tier priority SGCN. No priority SGCN overlapped with species in the INRMP. Finally, of the 38 third-tier priority SGCN, six overlapped with species in the

INRMP (Table 9). Those six species are blue-winged teal, snowy egret, prothonotary warbler, great blue heron, great egret, and bald eagle.

Table 8. Example of how the proportion of the SGCN distribution on the installation could be used to prioritize SGCN.

Priority SGCN Tier (Proportion)	# Priority SGCN on Installation
1st Tier (> 3.0)	26
2nd Tier (3.0 – 2.0)	47
3rd Tier (2.0 – 1.0)	38

Table 9. Summary of overlap between priority SGCN identified and species known to occur on Aberdeen PG.

Priority SGCN Tier	# Priority SGCN on Installation	# SGCN Overlap with INRMP
1st Tier (> 3.0)	26	2
2nd Tier (3.0 – 2.0)	47	0
3rd Tier (2.0 – 1.0)	38	4
Total	111	6

Using this method helps an installation narrow a longer list of potential installation priority SGCN. An installation could consider various combinations of these; for example, all top tier SGCN or all SGCN that overlap with the INRMP SGCN, or just the top seven that overlap with the INRMP. Further, conserving habitat for these six SGCN would provide additive benefit to SGCNs using similar habitats that have not been documented on the installation but may occur there, or occur there in the future.

5.5 Consider SGCN's that occur within a habitat that is in high abundance within your installation

Much of the installation is comprised of Tidal Salt Marsh. This is a KWH with a diverse array of SGCNs associated with it. These marshes are important and worthy of continued protection especially when considering how few instances of this type occur on managed land in the upper Chesapeake Bay

5.6 Consider SGCN in habitats where some level of efficiency exists

On Aberdeen, the habitat with the highest importance value (0.031; Table 7) is Tidal Marsh and Shrubland. There are 66 SGCN associated with this habitat (Table 10). Because this habitat type is found on the installation at a rate three times than that expected based on that habitat's distribution throughout the state, and given that this habitat is relatively rare, SGCN associated with this habitat type may be considered as installation priority SGCN. Many of these species are shore and water birds. The next highest importance value is Coastal Plain Flatwoods and Swamp, which has some similar and overlapping SGCN to the Tidal Marsh and Shrubland habitat type. The habitat type with next highest importance is Pelagic and Open Water, which includes all the marine mammals, and reptiles.

This approach can be combined with other factors to develop additional subsets and priority SGCN lists. These may include incorporating federal or state status values, or alignment with ongoing INRMP actions. Again, the point is to refine the SGCN list to a set that makes sense and allows the NRMs to demonstrate active conservation and contribution to SWAP goals.

Table 10. Example showing the number of SGCN affected by protecting specific KWH on Aberdeen PG.

Type	Total # SGCN Associated	# Unique to the KWH at Aberdeen PG
Tidal Salt Marsh and Shrubland	66	42
Open water - Pelagic	53	39
Coastal Plain Flatwood and Depression Swamp	49	39
Total		120

5.7 Use state's WAP SGCN ranking system to determine installation priority SGCN

Maryland uses NatureServe's G and S ranking system, as well as a variety of other systems, to rank SGCN. They also provide an overall "status" ranking of A to E that compiles the G and S ranking system into a simpler format. This information can be used in concert with any one of the other suggested techniques to refine a priority species list for Aberdeen PG.

5.8 Use legal status or another designation to help determine installation priority SGCN

SGCN that also have designation as threatened or endangered at the state or federal level may also be candidates for prioritization. These species are likely already addressed in the INRMP but prioritizing them may provide additional protections for other SGCN using the same habitats or with similar threats.

5.9 Work with experts (within installation and partners) to determine which priority WAP SGCN to consider as installation priorities.

There are likely some species found on the installation that have some local significance either in light of the military mission, or to the local communities. This information also constitutes a priority and can contribute to the final list of priority SGCN for the installation. For example, species of local importance might include traditionally hunted waterfowl species. The NRMs may wish to include those specifically as priorities regardless of habitat importance or KWH type.

6. Identify Associated Threats and Conservation Actions

The primary reason for identifying priority SGCN is to use that information to enhance their conservation. This requires a recognition of what factors are contributing to the species decline (threats) and how to mitigate them (conservation actions).

The SWAP includes this information and relates it to each SGCN. Thus, once the installation has identified a list of priority SGCN, it should be a straightforward process to identify both threats and conservation actions.

6.1 Organize threats to installation priority SGCN

Once the installation priority SGCN were determined, we listed them in a spreadsheet in order of those that occupy the most habitat within the installation. Along the top row, column headers include Common Name, Scientific Name, Habitat number, Threats, and Conservation Actions.

We used threat and conservation information included in Maryland's WAP to complete the spreadsheet. This information is in Appendix 7 of Maryland's WAP, listed in tabular format. The WAP threat and conservation action tables are organized by habitats and by taxa groups. In some cases, the taxa tables list threats and actions for a specific SGCN or a group of SGCN within that taxa group (Table 11).

6.2 Review list of threats and actions to determine which are applicable on installation and remove those that are not

Once we organized threat and conservation action data from Maryland's WAP for the installation priority SGCN, we reviewed the threats and actions listed for each species. We removed any threats that are not relevant to Aberdeen PG. We also reviewed the corresponding actions and removed any that did not apply. Please note that you can implement this step as you conduct Step 6.2 – removing any irrelevant threats and actions as you list them in the spreadsheet.

Table 11. Example of how to organize threat and conservation action information based on SWAP.

Common	Habitat	Threats	Conservation Actions
American bittern	21, 34-36, 57	Recreational activities	Minimize off road vehicle use in sensitive habitats and at critical times of year (breeding season, seasonal migrations/movements).
			Protect sandflats, mudflats and shallow tidal water habitats from human disturbance.
		Fire and fire suppression: increase in fire frequency/ intensity	Determine the impact of the frequency and extent of winter burning practices on obligate salt marsh breeding bird species.
		Invasive non-native terrestrial/wetland plants: Phragmites	Control common reed (*Phragmites*) wherever practical in large wetland complexes. Target new invasions vs. those that are long-established and identify best locations to expend efforts and funds.
		Problematic native species	Manage predator pressure (fox, crow, gull) in areas of critical nesting habitat.
		Air-borne pollutants: herbicides and pesticides	Determine the impact of mosquito control pesticide use on obligate salt marsh breeding bird species and take measures to avoid/minimize impacts.
		Habitat shifting or alteration: sea-level rise	Evaluate habitat change and loss to predicted changes in sea level.
			Take measures to mitigate habitat change resulting from sea-level rise.
			Prevent conversion of tidal high marsh to tidal low marsh due to sea level rise or create additional shallow marsh habitat via thin layering or similar technologies
Black skimmer	17-18, 36-37, 51	Storms and flooding	Create replacement nesting habitat for royal tern, common tern and black skimmer using dredged material.
Brown pelican	17, 34-37, 51	Lack of up-to-date existing information	Monitor breeding populations of listed species and species of special conservation interest (brown pelican, double-crested cormorant) - annually
Common tern	17-18, 36-37, 51	Storms and flooding	Create replacement nesting habitat for royal tern, common tern and black skimmer using dredged material.

Examples of threats for the American bittern that were not relevant on Aberdeen PG include those related to offshore wind, livestock management practices, and off road recreational use of beaches and dunes. Thus, we also removed the related conservation actions that were not applicable. Marine mammals also had listed threats that were not applicable in the context of Aberdeen PG. Example those that relate to wind power and oil drilling. These were not included in the spreadsheet.

We also highlighted specific threats and/ or actions that relate to military installations. For example, the WAP lists military exercises as a specific threat to marine mammals, and reducing the impact of military exercises on the marine environment and mammals as the corresponding action. This threat may be important to highlight, and to address in the next step.

6.3 Add any additional threats and actions specific to the installation

We also added threats that the WAP does not include but that we know exist for the installation. You may work with the NRMs or other staff, as well as consult other installation sources/ documents/ plans for this step. For example, the use chemicals/salt in winter has been demonstrated to degrade vernal pools in close proximity to roads. Installation NRMs may wish to identify specific areas where chemicals/salt should not be used in winter and work with appropriate installation departments to ensure these areas remain unaffected.

7. Determine Conservation Opportunities, Existing Efforts, and Potential Mission Conflicts

7.1 Identify common/ overlapping conservation management opportunities from the action plan and INRMP for installation priority species (and habitats)

Aberdeen's INRMP has a section on the Maryland WAP, noting the primary threats and action categories as well as listing out specific threats and actions that relate to the installation. This section of the INRMP is extremely useful to the installation, as well as the state fish and wildlife agency. Additionally, in listing species occurring on Aberdeen, the INRMP marks species that are also named in the WAP. It also includes a section on threatened and endangered species and species of concern. This provides a good starting point for determining where opportunities exist for the installation to implement the WAP. Examples include the following (Page 3-26 of Maryland's WAP):

> *Action Plan Goal: Direct management of natural resources*
- *Aberdeen PG Forest Management: Enhancement of forest stands with emphasis on native species and control of invasive species.*
- *Aberdeen PG Wetlands Management: Protection of wetlands to include mitigation to offset unavoidable impacts.*

> *Action Plan Goal: Data Collection and Management*
- *Aberdeen PG Forest Management: Inventorying of forest stands for habitat and mission sustainability*

The INRMP's chapter on Natural Resource Program Areas (Chapter 4), includes various management activities that are in line with what Maryland's WAP recommends for its SGCN and habitats, but the INRMP does not specifically highlight them in relation to the WAP. Thus, in addition to areas of overlap specifically highlighted within the INRMP, several key management practices serve as conservation

opportunities for the installation. The management sections include those on wetlands, forests, soil, threatened and endangered species, fire, the Chesapeake Bay, vegetation, etc. Examples of management actions in-line with those of the Action Plan include:

> ***Strategy: Improve sustainable landscaping of cantonment areas***
- *Recommended Action: Incorporate BayScaping practices into landscape projects with emphasis on native only plant species and minimal herbicidal use*
- *Recommended Action: Incorporate pollinator gardens into landscape projects with emphasis on native only plant species that benefit pollinators (e.g., butterflies, moths, bees, bats, birds)*
> ***Strategy: Manage for "no net loss of wetlands"***
- *Recommended Action: Develop wetlands management plan*
- *Recommended Action: Apply for new programmatic 10-year shoreline stabilization permit to support mission sustainment*
- *Recommended Action: Employ off-site mitigation banks for wetlands mitigation*

> ***Strategy: Reduce nutrient and sediment loads into the Chesapeake Bay***
- *Recommended Action: Develop, design, and construct new stormwater BMPs in areas with little or no stormwater treatment and retrofit existing stormwater BMPs to meet water quality standards*

> ***Strategy: Ensure stormwater BMPs are constructed and operating as designed***
- *Recommended Action: Develop stormwater BMP inspection/maintenance plan*

> ***Strategy: Determine presence/absence of other threatened and endangered species***
- *Recommended Action: Conduct acoustical surveys for northern long-eared bat using USFWS-approved methodology*
- *Recommended Action: Conduct surveys for other threatened and endangered fauna species on Aberdeen PG*

7.2 Look for SGCN that share habitat and determine whether the INRMP or other management activities on the installation address these habitats

Consider whether a suite of installation priority SGCN are located in a common habitat type, and if this habitat type is widespread or of high value within the installation boundary. If this is the case, you can determine which threats are most pervasive, immediate, and/ or feasible to address. You can determine conservation actions that are realistic for the installation to implement at the habitat level. By doing only one or two actions for a high value habitat with multiple SGCN, the installation will be addressing multiple threats and SGCN in an effective and more efficient manner.

On Aberdeen PG, Tidal Marsh and Scrubland is an important KWH. Thus, considering the threats to the marsh from training, and whether the installation can control these threats, is important. Some marshes on Aberdeen contained unexploded ordinance, so very little ground training occurs in them. This provides a conservation opportunity for the installation.

For the other areas, Aberdeen PG's INRMP notes a no net loss of wetlands policy, and perhaps there are areas where training and other activities may be limited within its salt marshes, thereby protecting this

KWH and the species that utilize it. Following action already outlined in the INRMP (e.g., monitoring for invasive species), directly addresses threats outlined in the SWAP. The INRMP also notes that the installation may need to monitor migratory birds during military exercises. We recommend providing this information to the DNR and other conservation partners so that they understand how the NRMs at Aberdeen PG are actively contributing to SWAP goals.

7.3 Consider if installation contains significant portion of rare habitats and associated SGCN for the state/ region

If an installation has only a small percent of a specific habitat type, but that type is rare within the state, then NRMs may want to identify and manage the type for both conservation opportunities and challenges. It is important to determine what threats training may pose. If training is already limited in the areas, then perhaps little additional conservation will need be required to provide benefit. Alternatively, management actions may require minimal effort to protect a high value area.

7.4 Consider SGCN that installation did not know were or could be present

One advantage of this downscaling approach is it can provide information on species that may be present within the installation but have never been confirmed through surveys. Some species are difficult to document without dedicated surveys, but we can determine if the habitats they require are present, and examine which threats/conservation actions are likely to benefit those habitats.

Identifying potential SGCNs that would benefit from conservation actions targeting other species can bolster justifications for these actions. Further, even if these species are not currently utilizing these habitats there may be opportunities for them in the future either through natural migration or through introduction.

7.5 Consider current land management activities and potential conservation opportunities for installation priority SGCN

As we have mentioned, the current management of lands at Aberdeen PG has created unique instances where lands are protected for SGCN. The maintenance of tidal wetlands is unique in this portion of the upper Chesapeake Bay and benefits a large number of SGCNs. It is important for NRMs to identify those ongoing benefits of training management and communicate them to collaborating agencies.

7.6 Consider plans for the installation and whether new/ different training or activities could threaten installation priority SGCN

It is also beneficial to understand how changes to training area management activities might change the benefits to SGCN. While range management activities like timber harvest, prescribed fire, and road maintenance are critical for the training mission, we can use information from the SWAP to understand potential impacts on SGCN and plan accordingly. Often, changes in training management activities can benefit SGCNs if those linkages are identified early in the planning process and are included in the overall plan.

7.7 Determine whether there are other Action Plan SGCN that are not within the installation priority SGCN list that may benefit from actions for the priority SCGN

While much of our downscaling effort has focused on identifying priority SGCN for the installation, we should understand that any conservation actions implemented will likely benefit other SGCN. For example, we have demonstrated how protecting the tidal marsh habitat will benefit several priority SGCN, but we can also now use that information to gain a bigger picture of the other SGCNs likely to benefit as well. There are 219 potential species of SGCN identified for the installation area and surroundings, and many more species of aquatic and terrestrial species will benefit. Quantifying that number by reviewing the habitat and species information with MD DNR partners will further support the conservation actions taken in this area.

8. Conclusion

The SWAP is a powerful tool for identifying species at risk of endangerment in Maryland. The process we have outlined for Aberdeen PG demonstrates how readily available information from the SWAP can inform conservation actions on the installation, and vice-versa. Aberdeen PG plays a significant role in providing and maintaining SGCN habitat in this landscape. Further, these lands can continue to support both military training and SGCNs through sound management.

Appendix A.

This appendix contains a table with the complete list of species distribution values created for the Aberdeen PG downscale. The values for total area on Aberdeen PG and in MD are given in square kilometers.

Table 12. A complete list of Maryland SGCN distribution models created for this downscale.

MS SppID	Common Name	Scientific Name	KWHs	Total on Aberdeen PG	Total in MD	Prop of Total
44	American bittern	*Botaurus lentiginosus*	21, 34-36, 57	27.5	888.8	3.10%
47	American oystercatcher	*Haematopus palliatus*	17-18, 36-37	27.5	888.8	3.10%
56	Black rail	*Laterallus jamaicensis*	34-36, 57	27.5	888.8	3.10%
66	Blue-winged teal	*Anas discors*	34-37, 46, 57	27.5	888.8	3.10%
68	Boat-tailed grackle	*Quiscalus major*	10, 18, 35-36	27.5	888.8	3.10%
80	Common gallinule	*Gallinula galeata*	35-36, 57	27.5	888.8	3.10%
88	Dunlin	*Calidris alpina*	17, 34-37, 57	27.5	888.8	3.10%
92	Gadwall	*Anas strepera*	34-37, 46, 49-50, 57	27.5	888.8	3.10%
93	Glossy ibis	*Plegadis falcinellus*	10, 30, 34-37, 57	27.5	888.8	3.10%
109	Least bittern	*Ixobrychus exilis*	34-36, 57	27.5	888.8	3.10%
113	Little blue heron	*Egretta caerulea*	10, 30, 34-37, 57	27.5	888.8	3.10%
119	Marsh wren	*Cistothorus palustris*	34-36	27.5	888.8	3.10%
122	Nelson's sparrow	*Ammodramus nelsoni*	35-36	27.5	888.8	3.10%
137	Red knot	*Calidris canutus*	17, 36-37, 57	27.5	888.8	3.10%
148	Ruddy turnstone	*Arenaria interpres*	17, 34-37, 57	27.5	888.8	3.10%
151	Saltmarsh sparrow	*Ammodramus caudacutus*	35-36	27.5	888.8	3.10%
152	Sanderling	*Calidris alba*	17, 34-37, 57	27.5	888.8	3.10%
156	Seaside sparrow	*Ammodramus maritimus*	35-36	27.5	888.8	3.10%
158	Semipalmated sandpiper	*Calidris pusilla*	17, 34-37, 57	27.5	888.8	3.10%
160	Short-billed dowitcher	*Limnodromus griseus*	35-37, 57	27.5	888.8	3.10%
162	Snowy egret	*Egretta thula*	10, 30, 34-37, 57	27.5	888.8	3.10%

Table 12 (continued)						
163	Sora	*Porzana carolina*	21, 34-37, 57	27.5	888.8	3.10%
168	Tricolored heron	*Egretta tricolor*	10, 30, 34-37, 57	27.5	888.8	3.10%
173	Whimbrel	*Numenius phaeopus*	17-18, 35-37	27.5	888.8	3.10%
175	Willet	*Tringa semipalmata*	17-18, 35-37, 57	27.5	888.8	3.10%
254	Spotfin killifish	*Fundulus luciae*	34-36	27.5	888.8	3.10%
58	Black skimmer	*Rynchops niger*	17-18, 36-37, 51	160.1	6541.5	2.45%
73	Brown pelican	*Pelecanus occidentalis*	17, 34-37, 51	160.1	6541.5	2.45%
84	Common tern	*Sterna hirundo*	17-18, 36-37, 51	160.1	6541.5	2.45%
91	Forster's tern	*Sterna forsteri*	17-18, 36-37, 46, 51	160.1	6541.5	2.45%
101	Gull-billed tern	*Gelochelidon nilotica*	17-18, 36-37, 51	160.1	6541.5	2.45%
104	Horned grebe	*Podiceps auritus*	35-36, 45-46, 51, 57	160.1	6541.5	2.45%
107	Laughing gull	*Leucophaeuss atricilla*	17-18, 36-37, 46, 51	160.1	6541.5	2.45%
132	Pied-billed grebe	*Podilymbus podiceps*	34-36, 45-46, 51, 57	160.1	6541.5	2.45%
146	Royal tern	*Thalasseus maximus*	17-18, 36-37, 51	160.1	6541.5	2.45%
147	Ruddy duck	*Oxyura jamaicensis*	34-36, 46, 49-51, 57	160.1	6541.5	2.45%
153	Sandwich tern	*Thalasseus sandvicensis*	17-18, 36-37, 51	160.1	6541.5	2.45%
45	American black duck	*Anas rubripes*	19-21, 30, 34-37, 46, 49-50, 57	32.4	1366.2	2.37%
62	Black-crowned night-heron	*Nycticorax nycticorax*	10, 19-20, 30, 34-37, 57	32.4	1366.2	2.37%
100	Greater yellowlegs	*Tringa melanoleuca*	17-20, 34-37, 57	32.4	1366.2	2.37%
112	Lesser yellowlegs	*Tringa flavipes*	17-21, 34-37, 57	32.4	1366.2	2.37%
164	Spotted sandpiper	*Actitis macularius*	17, 19-21, 34-37, 44-46, 57	32.4	1366.2	2.37%
183	Yellow-crowned night-heron	*Nyctanassa violacea*	10, 19, 20, 30, 34-37, 41, 42, 45	32.4	1366.2	2.37%
5	Blue whale	*Balaenoptera musculus*	51	132.6	5652.8	2.35%
7	Bottlenose dolphin	*Tursiops truncatus*	51	132.6	5652.8	2.35%
8	Cuvier's beaked whale	*Ziphius cavirostris*	51	132.6	5652.8	2.35%
15	Fin whale	*Balaenoptera physalus*	51	132.6	5652.8	2.35%
16	Gervais beaked whale	*Mesoplodon europaeus*	51	132.6	5652.8	2.35%
18	Humpback whale	*Megaptera novaeangliae*	51	132.6	5652.8	2.35%
26	Northern right whale	*Eubalaena glacialis*	51	132.6	5652.8	2.35%

Table 12 (continued)

27	Sei whale	*Balaenoptera borealis*	51	132.6	5652.8	2.35%
38	Sperm whale	*Physeter catodon*	51	132.6	5652.8	2.35%
40	True's beaked whale	*Mesoplodon mirus*	51	132.6	5652.8	2.35%
51	Audubon's shearwater	*Puffinus lherminieri*	51	132.6	5652.8	2.35%
63	Black-legged kittiwake	*Rissa tridactyla*	51	132.6	5652.8	2.35%
70	Brant	*Branta bernicla*	17, 37, 49-51	132.6	5652.8	2.35%
85	Cory's shearwater	*Calonectris diomedea*	51	132.6	5652.8	2.35%
108	Leach's storm-petrel	*Oceanodroma leucorhoa*	51	132.6	5652.8	2.35%
124	Northern gannet	*Morus bassanus*	51	132.6	5652.8	2.35%
138	Red phalarope	*Phalaropus fulicarius*	51, 57	132.6	5652.8	2.35%
141	Redhead	*Aythya americana*	46, 49-51, 57	132.6	5652.8	2.35%
143	Red-necked phalarope	*Phalaropus lobatus*	51, 57	132.6	5652.8	2.35%
144	Red-throated loon	*Gavia stellata*	46, 51	132.6	5652.8	2.35%
145	Roseate tern	*Sterna dougallii*	17-18, 37, 51	132.6	5652.8	2.35%
193	Green seaturtle	*Chelonia mydas*	49-51	132.6	5652.8	2.35%
195	Leatherback seaturtle	*Dermochelys coriacea*	51	132.6	5652.8	2.35%
231	American shad	*Alosa sapidissima*	42, 45, 46, 51	132.6	5652.8	2.35%
244	Hickory shad	*Alosa mediocris*	42, 45, 46, 51	132.6	5652.8	2.35%
82	Common merganser	*Mergus merganser*	19, 44-46, 51	137.5	6130.2	2.24%
33	Southeastern star-nosed mole	*Condylura cristata parva*	20, 26-31, 33, 42-43, 46	37.3	1703.1	2.19%
204	Plain-bellied watersnake	*Nerodia erythrogaster*	20, 26, 30, 33-35, 42, 43, 46, 54	37.3	1703.1	2.19%
205	Rainbow snake	*Farancia erytrogramma*	20, 26-28, 31, 33, 34, 42, 46	37.3	1703.1	2.19%
191	Eastern six-lined racerunner	*Aspidoscelis sexlineata*	4, 8, 9, 12, 15, 17	31.6	1580.5	2.00%
117	Louisiana waterthrush	*Parkesia motacilla*	19-23, 25-27, 33, 38-46	42.2	2198.8	1.92%
136	Prothonotary warbler	*Protonotaria citrea*	19-20, 22-23, 25-28, 33	42.2	2198.8	1.92%
111	Least tern	*Sternula antillarum*	17-18, 34-37, 46, 51, 58	182.5	9801.9	1.86%
200	Northern diamond-backed terrapin	*Malaclemys terrapin terrapin*	17, 18, 34-37, 46-51, 57, 58	182.5	9801.9	1.86%
57	Black scoter	*Melanitta americana*	46-48, 51, 57-58	155.0	8913.1	1.74%
75	Canvasback	*Aythya valisineria*	46-51, 57-58	155.0	8913.1	1.74%

Table 12 (continued)

81	Common loon	*Gavia immer*	46-48, 51, 57-58	155.0	8913.1	1.74%
116	Long-tailed duck	*Clangula hyemalis*	46-48, 51, 57-58	155.0	8913.1	1.74%
165	Surf scoter	*Melanitta perspicillata*	46-48, 51, 57-58	155.0	8913.1	1.74%
174	White-winged scoter	*Melanitta fusca*	46-48, 51, 57-58	155.0	8913.1	1.74%
194	Kemp's ridley seaturtle	*Lepidochelys kempii*	47-51, 58	155.0	8913.1	1.74%
196	Loggerhead seaturtle	*Caretta caretta*	17, 47-51, 58	155.0	8913.1	1.74%
232	Atlantic sturgeon	*Acipenser oxyrinchus*	46-48, 51, 58	155.0	8913.1	1.74%
234	Barndoor skate	*Dipturus laevis*	47, 48, 51, 57, 58	155.0	8913.1	1.74%
252	Shortnose sturgeon	*Acipenser brevirostrum*	46-48, 51, 58	155.0	8913.1	1.74%
253	Smooth skate	*Malacoraja senta*	47, 48, 51, 58	155.0	8913.1	1.74%
259	Thorny skate	*Amblyraja radiata*	47, 48, 51, 58	155.0	8913.1	1.74%
98	Great blue heron	*Ardea herodias*	7, 10, 19-20, 26, 30, 33-37, 42-46, 57	83.1	5371.1	1.55%
99	Great egret	*Ardea alba*	7, 10, 19-20, 26, 30, 33-37, 45-46, 57	83.1	5371.1	1.55%
55	Bicknell's thrush	*Catharus bicknellii*	6-9, 20, 26	80.2	5294.3	1.51%
203	Northern scarletsnake	*Cemophora coccinea*	6-9, 26, 54	80.2	5294.3	1.51%
218	Eastern tiger salamander	*Ambystoma tigrinum*	6-8, 26, 29, 31, 57	80.2	5294.3	1.51%
9	Delmarva fox squirrel	*Sciurus niger cinereus*	6-8, 10, 20, 26, 33	82.4	5585.5	1.47%
78	Chuck-will's-widow	*Antrostomus carolinensis*	7-10, 20, 26, 33	82.4	5585.5	1.47%
187	Coastal Plain milksnake	*Lampropeltis triangulum elapsoides X triangulum*	6-9, 20, 26, 33	82.4	5585.5	1.47%
197	Mole kingsnake	*Lampropeltis calligaster rhombomaculata*	6-9, 20, 26, 33	82.4	5585.5	1.47%
213	Carpenter frog	*Lithobates virgatipes*	7, 8, 26-31, 33	82.4	5585.5	1.47%
217	Eastern narrow-mouthed toad	*Gastrophryne carolinensis*	6-8, 20, 26, 31, 33, 56, 57	82.4	5585.5	1.47%
52	Bald eagle	*Haliaeetus leucocephalus*	2, 4-7, 10, 19-20, 33-37, 44-46, 51, 57	181.3	13560.6	1.34%
212	Barking treefrog	*Hyla gratiosa*	6, 7, 26, 29, 57	48.6	3713.8	1.31%
190	Eastern ribbonsnake	*Thamnophis sauritus*	6, 7, 19, 20, 22-30, 33, 38-43	56.1	4587.7	1.22%
48	American peregrine falcon	*Falco peregrinus anatum*	15, 35-37, 58	49.9	4149.1	1.20%
202	Northern pinesnake	*Pituophis melanoleucus*	6-9, 54, 56	45.0	3882.3	1.16%

Table 12 (continued)						
2	American mink	*Neovison vison*	2-8,19-31,34-36,38-46,57	113.9	10714.5	1.06%
4	Big brown bat	*Eptesicus fuscus*	1-15, 18-31, 33-36, 38-46, 52, 54, 58, 59	116.0	11005.7	1.05%
43	Alder flycatcher	*Empidonax alnorum*	19, 21	4.8	477.4	1.01%
53	Bank swallow	*Riparia riparia*	16, 19-20, 46	4.8	477.4	1.01%
192	Eastern spiny softshell	*Apalone spinifera*	19, 44, 57	4.8	477.4	1.01%
129	Northern waterthrush	*Parkesia noveboracensis*	19, 21-23	4.9	495.6	0.99%
182	Yellow-breasted chat	*Icteria virens*	4-10, 19, 20, 25, 26, 33	87.4	8862.8	0.99%
189	Eastern kingsnake	*Lampropeltis getula*	5-9, 20, 26-29, 31-35	82.6	8385.3	0.98%
176	Willow flycatcher	*Empidonax traillii*	19-25, 54, 56	5.4	582.8	0.92%
150	Rusty blackbird	*Euphagus carolinus*	19-21, 33-34	7.0	768.6	0.91%
201	Northern map turtle	*Graptemys geographica*	19, 20, 33, 45, 46	7.0	768.6	0.91%
71	Broad-winged hawk	*Buteo platypterus*	1-9, 19-20, 26	85.8	9720.4	0.88%
180	Worm-eating warbler	*Helmitheros vermivorus*	1-10, 19-21, 25, 26, 33	88.0	10011.6	0.88%
59	Black-and-white warbler	*Mniotilta varia*	1-9, 19-23, 25-27, 33	88.0	10029.8	0.88%
131	Ovenbird	*Seiurus aurocapillus*	1-14, 19-23, 25-27, 33	88.0	10029.8	0.88%
155	Scarlet tanager	*Piranga olivacea*	1-9, 19-23, 25-27, 33	88.0	10029.8	0.88%
179	Wood thrush	*Hylocichla mustelina*	1-9, 19-23, 25-27, 33	88.0	10029.8	0.88%
90	Eastern whip-poor-will	*Antrostomus vociferus*	1-9, 11-14, 26	81.0	9243.0	0.88%
42	Acadian flycatcher	*Empidonax virescens*	1-9, 19-28, 33	88.5	10116.9	0.87%
184	Yellow-throated vireo	*Vireo flavifrons*	3-7, 19, 20, 25, 26, 33	55.8	7282.2	0.77%
32	Southeastern shrew	*Sorex longirostris*	5-7, 19-20, 24-28, 54	54.1	7078.2	0.76%
167	Swainson's warbler	*Limnothlypis swainsonii*	20, 33	2.2	291.1	0.74%
172	Wayne's black-throated green warbler	*Setophaga virens waynei*	20, 33	2.2	291.1	0.74%
211	Atlantic Coast leopard frog	*Lithobates kauffeldi*	33-35	2.2	291.1	0.74%
216	Eastern mud salamander	*Pseudotriton montanus*	20, 27, 28, 33	2.2	291.1	0.74%
206	Red cornsnake	*Pantherophis guttatus*	4, 5, 8, 9, 12, 15	31.8	4380.4	0.73%
142	Red-headed woodpecker	*Melanerpes erythrocephalus*	4-9, 19-20, 25, 33, 54	52.2	7450.8	0.70%
208	Spotted turtle	*Clemmys guttata*	5-8, 19-25, 27-31, 33, 34, 41-47, 57	52.8	7556.1	0.70%

Table 12 (continued)

77	Chimney swift	*Chaetura pelagica*	58	22.4	3260.3	0.69%
135	Prairie warbler	*Setophaga discolor*	3-14, 33, 54, 56	47.4	6973.3	0.68%
31	Southeastern myotis	*Myotis austroriparius*	6-10, 20, 26-31, 33-35, 42-43, 46, 54-58	127.2	18955.4	0.67%
103	Hooded warbler	*Setophaga citrina*	2-3, 5-7, 19-23, 25-27, 33	56.4	8449.3	0.67%
105	Kentucky warbler	*Geothlypis formosa*	2-3, 5-7, 19-23, 25-28, 33	56.4	8449.3	0.67%
127	Northern parula	*Setophaga americana*	2-3, 5-7, 19-23, 25-27, 33	56.4	8449.3	0.67%
49	American redstart	*Setophaga ruticilla*	2-3, 5-7, 19-28, 33	56.9	8536.4	0.67%
35	Southern pygmy shrew	*Sorex hoyi winnemana*	2-3,5-7, 19-21, 24-28	54.7	8227.0	0.66%
34	Southern bog lemming	*Synaptomys cooperi*	2-3,5-7, 19-29, 54	54.7	8245.3	0.66%
20	Least shrew	*Cryptotis parva*	8-14, 19, 21-25, 34-36, 54-55	87.0	13161.7	0.66%
29	Silver-haired bat	*Lasionycteris noctivagans*	1-15, 18-31, 33-36, 38-46, 52, 54-59	160.9	24375.6	0.66%
39	Tricolored bat	*Perimyotis subflavus*	1-15, 18-31, 33-36, 38-46, 52, 54-59	160.9	24375.6	0.66%
83	Common nighthawk	*Chordeiles minor*	8, 10, 18, 35-36, 54-55, 58	104.0	15839.2	0.66%
6	Bobcat	*Lynx rufus*	1-9, 11-15, 19-30, 33-36, 54-55	138.5	21115.3	0.66%
11	Eastern red bat	*Lasiurus borealis*	1-14, 18-31, 33-36, 38-46, 54-57	138.5	21115.3	0.66%
17	Hoary bat	*Lasiurus cinereus*	1-14, 18-31, 33-36, 38-46, 54-57	138.5	21115.3	0.66%
28	Seminole bat	*Lasiurus seminolus*	4-11, 18-20, 22-31, 33-36, 41-43, 45-46, 54-57	138.5	21115.3	0.66%
14	Evening bat	*Nycticeius humeralis*	4-9, 19-20, 22-27, 31, 38-39, 41, 45, 54-58	130.6	22046.9	0.59%
123	Northern bobwhite	*Colinus virginianus*	4-10, 18, 26, 30, 54-55	102.9	18203.8	0.57%
222	Northern red salamander	*Pseudotriton ruber*	23, 24, 27, 28, 32, 38-42	0.5	87.1	0.55%
50	American woodcock	*Scolopax minor*	2-10, 19-30, 33, 54-55	111.0	20226.5	0.55%
188	Eastern box turtle	*Terrapene carolina*	1-9, 19-24, 26-31, 33, 54, 55, 57	111.0	20226.5	0.55%
22	Little brown myotis	*Myotis lucifugus*	1-8, 11-15, 19, 21-25, 31, 36-42, 44-46, 52, 54-59	123.5	22672.5	0.54%
54	Barn owl	*Tyto alba*	34-36, 55, 58	72.4	14258.7	0.51%
10	Eastern harvest mouse	*Reithrodontomys humulis*	8-9, 54-55	54.1	11690.1	0.46%
89	Eastern meadowlark	*Sturnella magna*	35-36, 55	50.0	10998.4	0.45%

Table 12 (continued)

126	Northern harrier	*Circus cyaneus*	18, 21, 34-36, 55	50.0	10998.4	0.45%
157	Sedge wren	*Cistothorus platensis*	20, 34-36, 55	50.0	10998.4	0.45%
161	Short-eared owl	*Asio flammeus*	18, 34-36, 55	50.0	10998.4	0.45%
25	Northern myotis	*Myotis septentrionalis*	1-7, 12-15, 19, 21-25, 31, 38-41, 44-45, 52, 54, 56-59	41.9	10093.6	0.42%
94	Golden eagle	*Aquila chrysaetos*	1-5, 15, 35-36, 55, 57	50.8	14947.1	0.34%
37	Southern water shrew	*Sorex palustris punctulatus*	2-3, 19,21, 38	5.4	1626.2	0.33%
95	Golden-crowned kinglet	*Regulus satrapa*	2, 19, 21, 53	5.4	1626.2	0.33%
76	Cerulean warbler	*Setophaga cerulea*	3, 5-7, 19	18.5	5579.1	0.33%
118	Magnolia warbler	*Setophaga magnolia*	1-2, 19, 21-22, 53	5.4	1644.4	0.33%
178	Winter wren	*Troglodytes troglodytes*	1-3, 15, 19, 20-23	5.4	1644.4	0.33%
19	Indiana myotis	*Myotis sodalis*	1-7, 12-15, 19, 21-25, 31, 38-41, 44-45, 52, 54-59	64.4	20203.2	0.32%
72	Brown creeper	*Certhia americana*	1-7, 19-21	19.0	6727.9	0.28%
209	Timber rattlesnake	*Crotalus horridus*	1-7, 12-15, 19, 21, 54	19.0	6727.9	0.28%
210	Wood turtle	*Glyptemys insculpta*	2-7, 19, 38-41, 44, 45	19.0	6727.9	0.28%
220	Jefferson salamander	*Ambystoma jeffersonianum*	1-7, 19, 31	19.0	6727.9	0.28%
170	Veery	*Catharus fuscescens*	2-3, 5-7, 19-23, 25	19.1	6746.1	0.28%
67	Blue-winged warbler	*Vermivora pinus*	3, 5-7, 19-25, 54, 56	14.2	5207.0	0.27%
227	Upland chorus frog	*Pseudacris feriarum*	3-7, 22-25, 31, 32, 56	14.2	5207.0	0.27%
1	Allegheny woodrat	*Neotoma magister*	1-7,12-15,52,59	14.2	6250.5	0.23%
30	Smoky shrew	*Sorex fumeus*	1-3, 5-7, 15, 21	14.2	6250.5	0.23%
159	Sharp-shinned hawk	*Accipiter striatus*	2-7, 9, 53	14.2	6250.5	0.23%
46	American kestrel	*Falco sparverius*	55	22.5	10109.6	0.22%
69	Bobolink	*Dolichonyx oryzivorus*	55	22.5	10109.6	0.22%
87	Dickcissel	*Spiza americana*	55	22.5	10109.6	0.22%
97	Grasshopper sparrow	*Ammodramus savannarum*	55	22.5	10109.6	0.22%
102	Henslow's sparrow	*Ammodramus henslowii*	55	22.5	10109.6	0.22%
114	Loggerhead shrike	*Lanius ludovicianus*	55	22.5	10109.6	0.22%
115	Long-eared owl	*Asio otus*	10, 53, 55	22.5	10109.6	0.22%

Table 12 (continued)						
154	Savannah sparrow	*Passerculus sandwichensis*	55	22.5	10109.6	0.22%
169	Upland sandpiper	*Bartramia longicauda*	55	22.5	10109.6	0.22%
171	Vesper sparrow	*Pooecetes gramineus*	55	22.5	10109.6	0.22%
207	Smooth greensnake	*Opheodrys vernalis*	2, 4, 5, 13-15, 19, 21-23, 54-56	28.1	14553.9	0.19%
21	Least weasel	*Mustela nivalis*	1-5, 15, 19, 54-55	28.1	14535.7	0.19%
61	Blackburnian warbler	*Setophaga fusca*	2-3, 5, 19, 21-22, 53	5.6	4444.3	0.13%
64	Black-throated blue warbler	*Setophaga caerulescens*	1-3, 5, 19, 21-23	5.6	4444.3	0.13%
65	Black-throated green warbler	*Setophaga virens*	1-3, 5, 19, 21-23, 53	5.6	4444.3	0.13%
74	Canada warbler	*Cardellina canadensis*	1-3, 5, 19, 21-23	5.6	4444.3	0.13%
96	Golden-winged warbler	*Vermivora chrysoptera*	1-5, 19, 21-23, 54, 56	5.6	4444.3	0.13%
149	Ruffed grouse	*Bonasa umbellus*	1-5, 12-13, 19, 21-23	5.6	4444.3	0.13%
228	Valley and Ridge salamander	*Plethodon hoffmani*	2-5, 12, 19	5.6	4426.1	0.13%
36	Southern rock vole	*Microtus chrotorrhinus carolinensis*	2, 22-23	0.6	1167.0	0.05%
3	Appalachian cottontail	*Sylvilagus obscurus*	1-4,12,13,15	0.5	1148.8	0.05%
23	Long-tailed shrew	*Sorex dispar*	1-3, 15,	0.5	1148.8	0.05%
41	Virginia northern flying squirrel	*Glaucomys sabrinus fuscus*	2, 21	0.5	1148.8	0.05%
125	Northern goshawk	*Accipiter gentilis*	2, 53	0.5	1148.8	0.05%
128	Northern saw-whet owl	*Aegolius acadicus*	2-4, 10, 21	0.5	1148.8	0.05%
133	Pine siskin	*Spinus pinus*	2, 21, 53	0.5	1148.8	0.05%
139	Red-breasted nuthatch	*Sitta canadensis*	2, 21, 53	0.5	1148.8	0.05%
166	Swainson's thrush	*Catharus ustulatus*	2, 21	0.5	1148.8	0.05%
229	Wehrle's salamander	*Plethodon wehrlei*	1-3, 15	0.5	1148.8	0.05%
86	Dark-eyed junco	*Junco hyemalis*	1-3, 5, 15, 21-23	0.8	3966.9	0.02%
221	Mountain chorus frog	*Pseudacris brachyphona*	2-5, 21-23, 31, 32	0.8	3966.9	0.02%
12	Eastern small-footed myotis	*Myotis leibii*	1-6, 12-15, 31, 38-40, 44, 52, 59	0.8	3948.7	0.02%
13	Eastern spotted skunk	*Spilogale putorius*	1-5, 13, 15	0.8	3948.7	0.02%
24	North American porcupine	*Erethizon dorsatum*	1-5, 15, 21, 54	0.8	3948.7	0.02%
110	Least flycatcher	*Empidonax minimus*	2-3, 5, 54	0.8	3948.7	0.02%
120	Mourning warbler	*Geothlypis philadelphia*	1-2, 5, 54	0.8	3948.7	0.02%

Table 12 (continued)						
181	Yellow-bellied sapsucker	*Sphyrapicus varius*	1-3, 5, 21	0.8	3948.7	0.02%
219	Green salamander	*Aneides aeneus*	2, 3, 5, 15	0.8	3948.7	0.02%
60	Black-bellied plover	*Pluvialis squatarola*	17, 37, 57	0.0	0.0	0.00%
79	Coastal Plain swamp sparrow	*Melospiza georgiana nigrescens*	34-35	0.0	0.0	0.00%
106	King rail	*Rallus elegans*	34-35	0.0	0.0	0.00%
121	Nashville warbler	*Oreothlypis ruficapilla*	20	0.0	0.0	0.00%
130	Olive-sided flycatcher	*Contopus cooperi*	21	0.0	0.0	0.00%
134	Piping plover	*Charadrius melodus*	17-18, 37	0.0	0.0	0.00%
140	Red-cockaded woodpecker	*Picoides borealis*	10, 25	0.0	0.0	0.00%
177	Wilson's plover	*Charadrius wilsonia*	17-18, 37	0.0	0.0	0.00%
185	Atlantic hawksbill seaturtle	*Eretmochelys imbricata*	48, 51, 58	0.0	0.0	0.00%
186	Bog turtle	*Glyptemys muhlenbergii*	5-7, 19, 24, 41, 55	0.0	0.0	0.00%
198	Mountain earthsnake	*Virginia valeriae pulchra*	21, 56	0.0	0.0	0.00%
199	Northern coal skink	*Plestiodon anthracinus*	4, 12, 21	0.0	0.0	0.00%
214	Common mudpuppy	*Necturus maculosus*	40, 44	0.0	0.0	0.00%
215	Eastern hellbender	*Cryptobranchus alleganiensis*	38, 40, 44, 45	0.0	0.0	0.00%
223	Northern spring salamander	*Gyrinophilus porphyriticus*	32, 38	0.0	0.0	0.00%
224	Seal salamander	*Desmognathus monticola*	32, 38	0.0	0.0	0.00%
225	Southern two-lined salamander	*Eurycea cirrigera*	42, 43	0.0	0.0	#DIV/0!
226	Undetermined siren	*Siren sp. 1*	57	0.0	0.0	#DIV/0!
230	American brook lamprey	*Lethenteron appendix*	42	0.0	0.0	#DIV/0!
233	Banded sunfish	*Enneacanthus obesus*	42, 43	0.0	0.0	#DIV/0!
235	Blackbanded sunfish	*Enneacanthus chaetodon*	42, 43, 57	0.0	0.0	#DIV/0!
236	Bowfin	*Amia calva*	46	0.0	0.0	#DIV/0!
237	Bridle shiner	*Notropis bifrenatus*	41-43, 45, 46	0.0	0.0	#DIV/0!
238	Brook trout	*Salvelinus fontinalis*	38-41	0.0	0.0	#DIV/0!
239	Checkered sculpin	*Cottus sp 7*	39	0.0	0.0	#DIV/0!
240	Chesapeake logperch	*Percina bimaculata*	41, 42, 45, 46	0.0	0.0	#DIV/0!
241	Comely shiner	*Notropis amoenus*	40, 41, 44-46	0.0	0.0	#DIV/0!

Table 12 (continued)						
242	Flier	*Centrarchus macropterus*	42, 43	0.0	0.0	#DIV/0!
243	Glassy darter	*Etheostoma vitreum*	41-43	0.0	0.0	#DIV/0!
245	Ironcolor shiner	*Notropis chalybaeus*	42, 43	0.0	0.0	#DIV/0!
246	Johnny darter	*Etheostoma nigrum*	40, 44	0.0	0.0	#DIV/0!
247	Longnose sucker	*Catostomus catostomus*	40, 44	0.0	0.0	#DIV/0!
248	Maryland darter	*Etheostoma sellare*	41, 42	0.0	0.0	#DIV/0!
249	Mottled sculpin	*Cottus bairdi*	38, 40	0.0	0.0	#DIV/0!
250	Mud sunfish	*Acantharchus pomotis*	42, 43	0.0	0.0	#DIV/0!
251	Pearl dace	*Margariscus margarita*	39	0.0	0.0	#DIV/0!
255	Stonecat	*Noturus flavus*	40, 44	0.0	0.0	#DIV/0!
256	Stripeback darter	*Percina notogramma*	42, 46	0.0	0.0	#DIV/0!
257	Striped shiner	*Luxilus chrysocephalus*	40, 44	0.0	0.0	#DIV/0!
258	Swamp darter	*Etheostoma fusiforme*	42, 43, 57	0.0	0.0	#DIV/0!
260	White catfish	*Ameiurus catus*	45, 46	0.0	0.0	#DIV/0!