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**Develop Resources for Natural Resource
Managers to Integrate Downscaled SWAP
Information with INRMPs: Case Study for
Marine Corps Base Quantico**

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1. Identify Installation Landscape

Marine Corps Base (MCB) Quantico is located approximately 35 miles South of Washington DC in the coastal plain of Virginia along the West bank of the Potomac River (Figure 1). It straddles three counties (Prince William, Fauquier, and Stafford) and is approximately 61,000 acres in size.

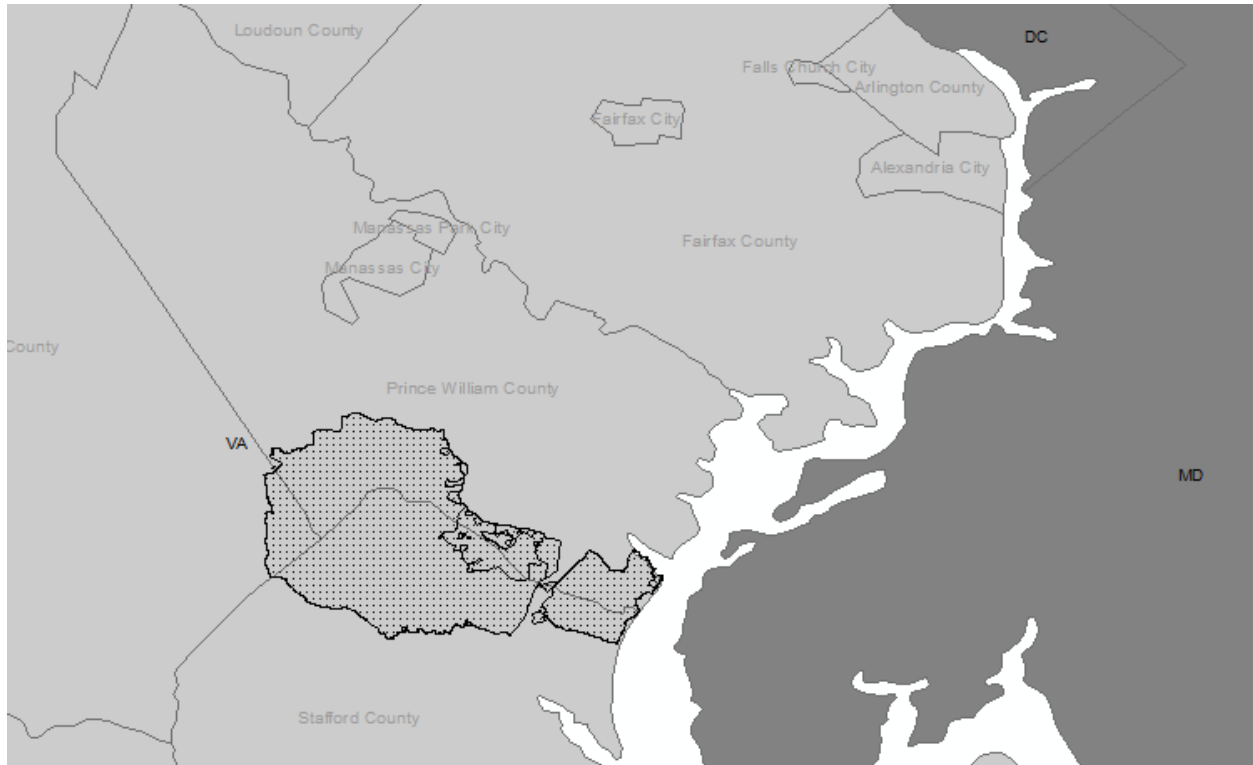


Figure 1. MCB Quantico is located in northern Virginia approximately 35 miles from Washington DC.

1.1 Identify spatial units for the installation landscape

The natural resource managers (NRMs) at Marine Corps Base (MCB) Quantico decided to include the surrounding watersheds (HUC12 level) intersecting the base boundary, which involved eight watersheds (Table 1). These watersheds encompass approximately 677 km² of land area of which MCB Quantico comprises about 37% (Figure 2. Marine Corps Base Quantico (black) with the HUC12 boundaries comprising the installation landscape (gray).Figure 2). This larger watershed area would serve as the reference area.

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

The NRMs at MCB Quantico opted to consider the installation boundary along with the 12-digit hydrologic units that intersect the installation. MCB Quantico is adjacent to Prince William Forest Park; a unit of the National Park Service. This unit is included in the Neabsco Creek 12-digit HUC and is included in the reference area.

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

The spatial information necessary to define the installation landscape is the boundary of MCB Quantico and the 12-digit HUCs for the area. The boundary information was provided by the installation as a geospatial dataset, and the 12-digit HUC layer is a publically available spatial dataset (USGS Watershed Boundary; <https://water.usgs.gov/GIS/huc.html>).

Table 1. List of 12-digit HUCs intersecting MCB Quantico.

HUC Code	HUC Name
PL39	Town Run
PL40	Slate Run – Cedar Run
PL52	Neabsco Creek
PL53	Chopawamsic Creek
PL54	Tank Creek – Potomac River
PL55	Beaver Dam Run
PL56	Upper Aquila Creek
PL57	Lower Aquia Creek



Figure 2. Marine Corps Base Quantico (black) with the HUC12 boundaries comprising the installation landscape (gray).

2. Identify WAP SGCN and Associated Information

2.1 Retrieve and review relevant SWAP for your state

We worked closely with the Virginia Department of Game and Inland Fisheries (VDGIF) on writing the 2015 Wildlife Action Plan (WAP); thus, we had a copy available to use. The WAP is also available online at www.bewildvirginia.org. We accessed additional information using the 2015 Wildlife Action Plan Interactive Tool (<http://vafwis.dgif.virginia.gov/WAP2>).

2.2 Contact relevant state fish and wildlife office if needed

The WAP Coordinator in Virginia was contacted regarding this project at both the proposal stage as well as throughout this process. The Virginia WAP Coordinator was involved at several stages of the process to solicit input and provide updates to our progress.

2.3 Review list of Action Plan SGCN

We took 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, rankings, various state and federal rankings, etc.). The WAP has 883 species of greatest conservation need (SGCN), including species from all taxa known in Virginia. Over 70% of the SGCN are invertebrates and over 60% depend on the aquatic environment or nearshore environment for all or some of their lifecycles.

2.4 Review habitat classification and descriptions

The Virginia WAP used the Northeast Terrestrial Habitat Model (NETHM) classification system to depict habitats spatially as a first step; however, Virginia's WAP borrows from a variety of habitat conservation models and tools and adapts their habitat data to best suit the needs of land and water managers. The WAP provides a crosswalk between the habitat definitions from the NETHM classification system to ensure this WAP is useful to all conservation practitioners as well as to demonstrate how the model classification can be used by land managers. Eight basic habitat types are described and referenced within the WAP. Within these habitat types, several other habitat subcategories are described. Habitats in the WAP include:

- Beaches, Dunes, and Mudflats
- Tidal wetlands
- Non-tidal wetlands
- Freshwater aquatic and riparian habitats
 - Tidally influenced warm water streams and rivers
 - Coldwater streams and rivers
 - Non-tidal warm water streams and rivers
 - Blackwater streams and rivers
- Open habitats
 - Post-agricultural lands
 - Glades and barrens

- Pine and oak savanna
- Mixed hardwood/ conifer forests
 - Young forests
 - North Atlantic coastal plain maritime forest
 - Central Atlantic coastal plain maritime forest
 - Southern Atlantic coastal plain upland longleaf pine woodland
 - Southern Appalachian low elevation pine forest
- Spruce fir forests
- Karst and subterranean habitats

These habitat types were identified based on the meetings with DGIF staff and conservation partners (see Methods Section). Information about these habitats, threats that affect habitat quality, and actions that can be taken to address these threats at a statewide level are described below.

2.5 Review threat and conservation action information

Virginia’s WAP includes threat and conservation action information at the habitat level in each local planning region summary. Local planning region summaries also include priorities for conservation action where available and relevant.

2.6 Obtain relevant spatial data if available

We helped develop much of the spatial data used in developing the WAP; thus, spatial information was readily available. However, some of the data is not available to the public at this time, such as SGCN distribution by HUC (priority SGCN distribution by HUC is available to view online).

3. Identify Species on Installation

3.1 Retrieve and review INRMPS from installation

The INRMP for MCB Quantico contains information on the species known to occur on the installation as identified in surveys and through direct observation. This list was compared to the SGCN list from the SWAP. Overlapping species were identified and listed (Table 2).

Based on the INRMP, 61 SGCNs occur, or have occurred, at MCB Quantico. The majority of these SGCN are birds (over 40), but also include mammals, fish, mollusks, and other invertebrates. This list represents those species documented to occur within the installation; however, there may be some species present on the installation that were not detected by any survey.

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 be found on the installation.

Table 2. List of species occurring on MCB Quantico identified as SGCN in the Virginia SWAP.

SGCN in Quantico INRMP	VA SWAP Tier	Opportunity Ranking
Alewife	IV	a
American black duck	II	a
American eel	III	a
American shad	IV	a
American woodcock	II	a
Bank swallow	III	c
Barn owl	III	a
Belted kingfisher	III	b
Black-bellied plover (winter)	IV	a
Black-crowned night-heron	III	a
Black-and-white warbler	IV	a
Black-billed cuckoo	II	b
Blueback herring	IV	a
Brook trout	IV	a
Brown thrasher	IV	a
Canada warbler	IV	b
Cerulean warbler	II	a
Chimney swift	IV	b
Dunlin	IV	a
Dwarf wedgemussel	I	a
Eastern box turtle	III	a
Eastern hog-nosed snake	IV	c
Eastern kingbird	IV	a
Eastern meadowlark	IV	a
Eastern mud salamander	IV	a
Eastern spadefoot	IV	c
Eastern towhee	IV	a
Eastern whip-poor-will	III	a
Eastern wood-pewee	IV	b
Field sparrow	IV	a
Forster's tern	III	a
Golden-winged warbler	I	a
Grasshopper sparrow	IV	a
Gray catbird	IV	a
Greater scaup	IV	a
Greater siren	IV	a
Kentucky warbler	III	a

Table 2 continued

King rail	II	b
Lake chubsucker	IV	c
Laughing gull	IV	a
Least bittern	III	a
Least brook lamprey	IV	c
Little blue heron	II	a
Little brown bat	I	a
Loggerhead shrike	I	a
Marsh wren	IV	a
Monarch butterfly	III	a
Northern bobwhite	III	a
Northern diamondback terrapin	II	a
Northern flicker	IV	b
Northern harrier	III	a
Northern pintail	IV	a
Northern saw-whet owl	I	c
Peregrine falcon	I	a
Queen snake	IV	a
Red bat (proposed for inclusion)	IV	a
Red-throated loon	IV	a
Ruffed grouse	III	a
Rusty blackbird	IV	b
Snowy egret	II	a
Spotted turtle	III	a
Timber rattlesnake	IV	a
Virginia rail	IV	a
Wood thrush	IV	b
Yellow-crowned night-heron	II	a
Yellow-billed cuckoo	III	a
Yellow-breasted chat	IV	a
Yellow-breasted chat	IV	a

4. Identify WAP Priority SGCN that Occur on Installation

The Virginia SWAP is somewhat unique compared to other SWAPs in that the document identifies priority species for each of the planning district commission regions in the state. In addition, the VDGIF has developed an online tool for identifying priority SGCNs at the watershed scale (tool may be accessed via the Virginia State Wildlife Action Plan website at <http://www.bewildvirginia.org>).

We used the WAP online tool to identify priority SGCN for each of these eight HUC12 watersheds. The SWAP identifies 12 SGCN within the eight HUCs comprising the installation landscape as priorities for this area (Table 3). Of these 12, only three SGCNs (American shad, dwarf wedgemussel, and least brook lamprey) also appear on the list of SGCNs derived from the INRMP.

Table 3. List of priority SGCN for HUCs comprising the installation landscape at MCB Quantico.

SGCN Common Name	Scientific Name	Tier	Conservation Ranking
American brook lamprey	<i>Lampetra appendix</i>	IV	c
American shad	<i>Alosa sapidissima</i>	IV	a
Atlantic spike	<i>Elliptio producta</i>	IV	c
Brook floater	<i>Alasmidonta varicosa</i>	I	b
Carolina lance mussel	<i>Elliptio angustata</i>	IV	c
Creeper	<i>Strophitus undulatus</i>	IV	a
Dwarf wedgemussel	<i>Alasmidonta heterodon</i>	I	a
Least brook lamprey	<i>Lampetra aepyptera</i>	IV	c
Northern lance mussel	<i>Elliptio fisheriana</i>	IV	b
Regal fritillary	<i>Speyeria idalia idalia</i>	I	a
Tidewater mucket	<i>Leptodea ochracea</i>	IV	a
Triangle floater	<i>Alasmidonta undulata</i>	IV	a

The remaining SGCN, with the exception of the regal fritillary, are all freshwater mussels, which have not been surveyed extensively at MCB Quantico according to the INRMP. All of these species (again, with the exception of the regal fritillary) are aquatic.

4.1 Represent SGCN spatially on the landscape

While the species surveys used in the development of the INRMP provide critical information on SGCNs known to occur on the installation, we want to consider whether other species may be present.

We can use the information from the SWAP to compile a list of all SGCN expected to occur within the installation landscape either directly by accessing species distribution models, or indirectly by using species-habitat relationships, along with available habitat maps, to create potential distributions for the area.

Virginia’s WAP includes priority SGCN distribution maps at both the planning region and HUC12 watershed scales. To produce these maps, Virginia completed a SGCN downscaling process as a part of developing the WAP. Users, therefore, have distribution data readily available to identify SGCN that occur within an installation landscape. However, it is important to note that the SGCN information

summarized to the HUC12 level, so finer detailed distributions are not available. Using the all SGCN HUC12 watershed data, we determined that within the eight watersheds that make up MCB Quantico, there are 57 SGCN predicted to occur (Table 4).

Table 4. List of all SGCN predicted to occur in the HUCs comprising MCB Quantico.

Predicted SGCN from SWAP	Documented at MCB Quantico
Alewife	X
American black duck	X
American brook lamprey	
American eel	X
American shad	X
American woodcock	X
Atlantic spike	X
Barn owl	X
Black-and-white warbler	
Brook floater	X
Brown thrasher	X
Canada warbler	X
Carolina lance mussel	
Carolina slabshell mussel	
Cerulean warbler	
Chimney swift	X
Common tern	
Creeper	
Dwarf wedgemussel	
Eastern box turtle	X
Eastern hog-nosed snake	X
Eastern kingbird	
Eastern meadowlark	X
Eastern mud salamander	X
Eastern spadefoot	X
Eastern towhee	
Eastern whip-poor-will	X
Eastern wood-pewee	X
Field sparrow	X
Forster's tern	X
Grasshopper sparrow	X
Gravel elimia	
Gray catbird	X
Greater scaup (winter)	X

Table 4 continued

Green heron	X
Kentucky warbler	X
King rail	X
Least bittern	X
Least brook lamprey	X
Marsh wren	
Northern bobwhite	X
Northern harrier	X
Northern lance mussel	
Northern rough-winged swallow	
Northern saw-whet owl	X
Peregrine falcon	X
Queen snake	X
Regal Fritillary	
Rusty blackbird (migrant)	X
Short-billed dowitcher (migrant)	
Spotted turtle	
Tidewater mucket	
Timber rattlesnake	X
Triangle floater	X
Wood thrush	X
Yellow-billed cuckoo	X
Yellow-breasted chat	X

Of these, 42 are also found in the SGCN list derived from the INRMP (42/57 = 74%); however 25 species from the INRMP list are not included in the SWAP list of SGCN (25/61 = 41%). The SWAP list includes 15 species not previously documented at MCB Quantico.

This demonstrates the importance of including both analyses in the downscaling process. We cannot know whether some of the species that have not been documented are, in fact, present. Nor can we expect that the modeled species distributions will capture all of the species that are present.

Table 5. Comparison of species identified in the SWAP and INRMP for MCB Quantico. This illustrates the need for evaluating both resources in order to plan for species-at-risk.

		INRMP		Total
		Present	Absent	
SWAP	Present	42	15	57
	Absent	25	---	25
	Total	67	15	82

4.2 Downscale priority SGCN to installation landscape

The Virginia WAP does not provide direct information on how each species utilizes the habitat classes used, nor does it supply species distribution information in a format that can be readily included in the MCB Quantico analysis. Therefore, our best approach for downscaling would be to identify a surrogate habitat layer that can be used for both the installation landscape and the reference landscape for comparison.

We chose to use the Terrestrial Habitat Map (THM) for the Northeast US and Atlantic Canada (Ferree and Anderson 2013) because it utilizes the NETHM and provides a consistent representation of habitat classes across both the installation and reference landscape. For the purpose of this investigation, we elected to compare the distribution of the habitat classes found on the installation to the entire area encompassed by the eight HUCs intersecting MCB Quantico (Figure 3). The resulting data are used to create downscaled metrics that provide the relative importance of the MCB Quantico-managed habitat to the surrounding area.

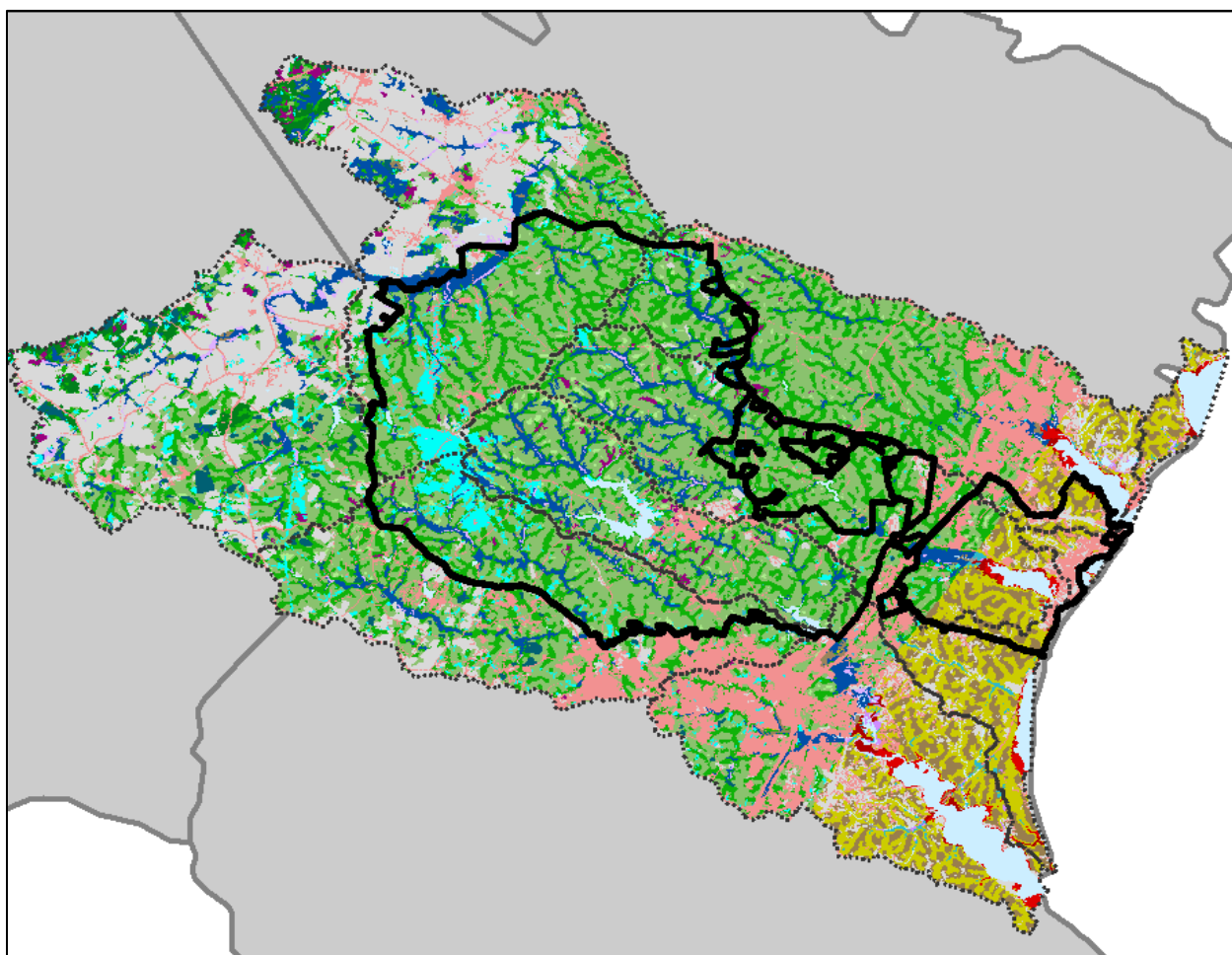


Figure 3. Terrestrial habitats of MCB Quantico and the installation landscape defined as the eight HUCs intersecting the base (see Table 6 for a summary of habitats present).

Using both the boundary of MCB Quantico and the eight HUCs, we extracted the habitat data from the THM and summarized the area in each habitat class present (Table 6). Then we calculated the

proportion of each class by both HUC and MCB Quantico. The installation comprises approximately 37% of the entire reference (i.e., surrounding HUC) area.

We can better-understand the importance of habitat within the MCB Quantico 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 HUC, and represents the proportion of that SGCN's total distribution in that can be found within the installation landscape.

$$\frac{\text{Area (installation)}}{\text{Area (HUC)}}$$

The maximum score would be 1.0 that occurs when the entire 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.

When we examine the calculated importance score, we see that MCB Quantico contains a significant amount of the Appalachian (Hemlock)-Northern Hardwood Forest and Southern Piedmont Lake Floodplain Forest found in the surrounding region. Other types such as Dry Oak-Pine Forest, Shrubland/grassland, and Northeastern Interior Dry-Mesic Oak Forest are also found in greater amounts on MCB Quantico relative to the surrounding landscape. This suggests that these types, and any SGCNs that utilize them, might also be a priority for installation managers since options to conserve these types outside of the installation are more limited.

5. Determine Installation Priority SGCN

Installation NRMs may consider a variety of factors to consider when evaluating which SGCN identified during the process described above should be considered as installation priorities. They include the following:

- 1) Are there endemic SGCN to the installation?
- 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 WAP provide a prioritization process based on distribution within the state?
- 5) Does the WAP 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?

5.1 Consider all WAP priority SGCN occurring on installation

All 12 of the SGCN identified as priorities for the region in the SWAP depend on the aquatic environment and are fish or mussels except for regal fritillary. This butterfly depends on specific plants growing in open habitats.

Table 6. Summary of the area (acres) in each habitat type for the installation landscape (MCB Quantico) and surrounding reference area (HUC) along with the proportions of each. The importance score is the area on MCB Quantico divided by the area in the HUC and represents the total amount of that habitat type within the installation landscape. The higher the score, the more important the installation is to that type in the reference area.

Habitat Class	MCB Quantico Area	HUC Area	Prop MCB Quantico	Prop HUC	Imp. Score
Appalachian (Hemlock)-Northern Hardwood Forest	34.0	35.6	0.1%	0.0%	0.956
Southern Piedmont Lake Floodplain Forest	103.0	126.3	0.2%	0.1%	0.815
Dry Oak-Pine Forest, Central Apps and Southern Piedmont	790.6	1,146.9	1.3%	0.7%	0.689
Shrubland/grassland	2,997.0	5,195.6	4.9%	3.2%	0.577
Northeastern Interior Dry-Mesic Oak Forest	26,198.3	47,540.8	42.9%	29.0%	0.551
Riparian Forest, southeast Virginia	5,063.7	9,685.5	8.3%	5.9%	0.523
Southern Piedmont Mesic Forest	14,201.9	29,232.2	23.2%	17.8%	0.486
Piedmont Upland Depression Swamp	542.6	1,344.6	0.9%	0.8%	0.404
Laurentian-Acadian Wet Meadow-Shrub Swamp	8.5	21.8	0.0%	0.0%	0.388
Piedmont-Coastal Plain Freshwater Marsh	363.8	1,003.7	0.6%	0.6%	0.363
Piedmont-Coastal Plain Shrub Swamp	157.5	497.7	0.3%	0.3%	0.316
North Atlantic Coastal Plain Hardwood Forest	1,456.7	6,020.9	2.4%	3.7%	0.242
Southern Atlantic Coastal Plain Mesic Hardwood Forest	2,042.5	8,944.3	3.3%	5.5%	0.228
Coastal Plain Tidal Swamp	100.7	457.5	0.2%	0.3%	0.220
Open water	1,205.2	5,690.6	2.0%	3.5%	0.212
Developed	4,266.4	21,539.1	7.0%	13.1%	0.198
Tidal Salt Marsh, Estuarine Marsh	139.7	719.0	0.2%	0.4%	0.194
North Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest	85.6	491.5	0.1%	0.3%	0.174
Laurentian-Acadian Freshwater Marsh	7.8	121.0	0.0%	0.1%	0.064
Agriculture	1,369.3	24,162.5	2.2%	14.7%	0.057
Totals	61,134.7	163,977.0			

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

The Virginia WAP used a similar downscaling process to assess the amount of a species' habitat found within a particular Planning District Commission area or HUC unit relative to the entire state distribution. This information was not provided in a quantitative format, but the process was replicated similarly through our habitat analysis in section 4.2.

By completing a species/ habitat association analysis, we can quantify the relative importance of these habitats on the installation as compared to other reference areas such as the installation landscape or even the rest of the state. These values could be incorporated into a ranking system as well.

Any ranking system should include information on the status of the SGCN (e.g., severity of threat, population levels, etc.), likelihood of management success (e.g., known occurrence on installation, compatibility with training mission, etc.), and the relative weights between these factors.

There are no “correct answers”. What is important is that, in any ranking process, the methods used to complete the rankings are transparent and repeatable, and that the ranks could be adjusted as information or weighting criteria change. For example, the little brown bat was common in the MCB Quantico landscape in 2005, so this species was not a listed SGCN. Due to catastrophic population declines caused by white nosed syndrome, this species has been identified as a Tier I a in the recent SWAP. Any ranking system should be able to respond to this change, and might include information on the current status of this species on the installation, the likelihood that this species could be effectively managed at MCB Quantico, and/or how known conservation actions align with installation training goals.

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

When considering the priority SGCN located within the installation landscape based on the HUC distribution analysis, three of those SGCN also occurs in the INRMP. They are the American shad, least brook lamprey, and dwarf wedgemussel. However, because the other SGCN are primarily invertebrates and fish species as well, it is likely that no recent surveys have been conducted that could detect these species. An installation that has little overlap with the priority SGCN and the INRMP may wish to consider all SGCN that occur within the landscape. As noted previously, if we look at the entire list of SGCN present on the installation landscape, there are 57 SGCN. Of these, Quantico’s INRMP includes 42 (Table 4).

Using this method helps an installation narrow a longer list of potential installation priority SGCN to a manageable and defensible number. 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 tier ones that overlap with the INRMP.

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

On MCB Quantico, the terrestrial habitat with the highest importance score Appalachian (Hemlock)-Northern Hardwood Forest. There are approximately eight SGCN associated with this habitat type that are also listed in the INRMP. Because nearly all of this habitat type in the region is found on the installation, NRMs may also want to include them as installation priority SGCN. By focusing on this habitat, various other freshwater marsh species may also be protected. This process can be repeated for each type with an importance value above a predetermined threshold importance score to encompass those species whose regional distribution is likely greatly dependent on habitats on the installation.

5.6 Consider SGCN in habitats where some level of efficiency exists

In addition to looking at habitats that occur across a significant portion of an installation, you can also consider where there are habitats that include many SGCN’s or more habitat exists on the installation

than expected. By focusing on these areas, you may get the most efficiency for available resources, and be more effective.

Focusing on aquatic environments at MCB Quantico would be very beneficial as the majority of both the WAP priority SGCN and all SGCN occurring on the installation are aquatic; thus, focusing on riparian buffers or reducing erosion and sedimentation in other ways would likely benefit multiple species.

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

Virginia’s WAP uses a tiered system to rank its SGCN based on imperilment ranging from I being the most impaired to IV being moderately impaired. For its 2015 WAP update, the state developed an additional ranking system based on conservation opportunity. The rankings are as follows:

- a – Managers have identified “on the ground” species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species’ conservation status.
- b – Managers have only identified research needs for the species or managers have only identified “on the ground” conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.
- c – Managers have failed to identify “on the ground” actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Of the 12 priority SGCN occurring on MCB Quantico’s installation landscape, there are three in the top two Tiers (Table 7). Overall, six of the 12 have a conservation opportunity ranking “a”, meaning that there are clear management actions identified at management program or planning level.

Table 7. List of Tier I and II SGCNs known to occur on MCB Quantico.

SGCN Common Name	Scientific Name	Tier	Conservation Ranking
Dwarf wedgemussel	<i>Alasmidonta heterodon</i>	I	a
Regal fritillary	<i>Speyeria idalia idalia</i>	I	a
Brook floater	<i>Alasmidonta varicosa</i>	I	b

We can also examine the rankings for those species identified in the INRMP (Table 8). Virginia used a 4-tier system for categorizing SGCNs with the Tier I constituting the highest level of imperilment. 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 tier ones that overlap with the INRMP. Additionally, you can see which ones of these overlap with the species identified in Step 5.4. For the three listed above, the INRMP also includes the dwarf wedgemussel.

Table 8. Summary of MCB Quantico priority species by Virginia SWAP Tier and conservation ranking.

Conservation Ranking					
Tier Ranking	a	b	c	d	Total
I	5	0	0	1	6
II	7	0	2	0	9
III	14	0	1	1	16
IV	24	2	6	4	36
Total	50	2	9	6	67

5.8 Use legal status or another designation such as NatureServe’s G and S ranks to help determine installation priority SGCN

Because Virginia’s Tier system incorporates legal status and other designations related to imperilment, using the Tier and Conservation Opportunity Ranking system is the best mechanism to use to help identify which SGCN you may wish to consider as priorities SGCN for the installation.

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

With all of this information assembled, the NRMs, along with their designated partners, can complete a list of priority SGCN for the installation landscape. This list will enable NRMs to be efficient in their application of available resources, and more effective in achieving their objectives. This information will also enable state wildlife management agencies to understand how other organizations are working to conserve SGCNs and their habitats, and to value the contributions of installation lands toward SWAP goals.

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 it (conservation actions).

The state 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 an Excel worksheet. Along the top row, column headers include Common Name, Scientific Name, Habitat number, Threats, and Conservation Actions.

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

We used threat and conservation information included in the relevant Local Planning Region Summaries' habitat sections of the Virginia SWAP. The three planning regions intersecting MCB Quantico are Northern Virginia, Rappahannock Rapidan, and George Washington. We used the narrative information for each habitat type corresponding to our installation priority SGCN. We compared habitat threats and actions across the three planning region chapters and removed any repetitive threats and actions. An example of how the information appears for one of the priority SGCN identified through the priority SGCN HUC analysis appears in the Excel spreadsheet is below (Table 9).

Table 9. Example of how the Virginia SWAP provides information on the threats and conservation actions identified for each SGCN.

Common Name	Scientific Name	Habitat	Threats	Conservation Actions	
American brook lamprey	Lampetra appendix	Aquatic	Degradation of water quality in aquatic and riparian habitats from nutrients, sediments, human and animal waste, storm water runoff, and failing septic systems.	Establish retention ponds, impoundments, or other features to manage and slow urban storm water runoff into rivers and streams.	
				Repair or replace failing septic systems and eliminating "straight pipes" that deposits unprocessed residential waste water directly into the environment.	
				Establish vegetated or forested riparian vegetative buffers along rivers and streams, especially in agricultural, urban, and residential areas to prevent erosion and limit the flow of sediment and nutrients.	
				Restore and enhance vegetation within wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels).	
				Impervious surface cover that leads to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity.	Establish vegetated or forested riparian vegetative buffers along rivers and streams, especially in agricultural, urban, and residential areas to prevent erosion and limit the flow of sediment and nutrients.
				Table 9. continued	Degradation of aquatic habitats from invasive plant and animal species.

Loss of stream/ river connectivity from dams, culverts, and other impediments.	Restore aquatic connectivity where feasible.
Aquatic habitat degradation from channelization and/ or shoreline hardening.	Restore natural stream channels.
Catastrophic spills or other events can result in extensive loss of species and habitat in a short time period.	As needed, assist with restoration of aquatic environments after catastrophic spills.
Increasing water temperatures due to climate change.	Establish vegetated or forested riparian vegetative buffers along rivers and streams, especially in agricultural, urban, and residential areas to prevent erosion and limit the flow of sediment and nutrients.
	Consider how conditions may change when reforesting or restoring riparian buffers and work with appropriate vegetation (e.g., native tree and shrub species that have a broader salinity and temperature tolerances).
Increasing storm water run off and other pollutants due to more intense storm events.	Ensure storm water control methods account for predicted changes in precipitation and flow.

6.3 Add any additional threats and actions specific to the installation

Once we organized threat and conservation action data from Virginia’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 MCB Quantico. 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 Excel spreadsheet.

For example, all aquatic/ riparian threats were relevant to the least brook lamprey; however, several conservation actions were not. These include those to mining and pet waste.

During this step, 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 consider other installation sources/ documents/ plans for this step. For example, vehicle stream crossings have the potential to introduce sediment to streams. An effective action would be to routinely inspect and maintain crossings to ensure erosion is managed appropriately.

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

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

MCB Quantico mentions the Virginia WAP, but the primary reference is to the 2005 version of the Plan which is now outdated. Within its Natural Resources Management chapter, however, various sections

include management actions that are in line with the WAP. An example for a specific suite of species includes:

Songbirds:

- *50% forest reserved from cutting and other 50% cut even-aged on 80-year rotation. Retain at least 8 dead trees (snags) per acre for nest cavities. Leave mature, big trees > 20" dbh in riparian zones. Allow fallen logs to remain on forest floor.*
- *Use pesticides judiciously to avoid elimination of food supply for insectivores.*
- *Eliminate tall fescue from semi-improved grounds. Emphasize use of native bunchgrasses and forbs.*
- *Develop backyard habitat programs for edge management at schools and public areas.*

The INRMP includes specific management recommendations for specific species that include actions that would benefit habitats and additional related species such as those in open habitats. For example:

MCB Quantico wildlife managers consider the bobwhite to be among the most threatened species at MCB Quantico although it has no formal protection status. The primary management objective for the bobwhite is to halt the downward population trend and restore the health of this species. In accordance with NBCI's strategic plan, management efforts at MCB Quantico will be directed towards the creation of new quail habitat and connection of existing habitat via the fire-ecosystem management effort described in Chapter 6, Section 2. 6-85-6-87 (several specific actions aligned with the WAP).

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 at the habitat level that are realistic for the installation to implement. 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 MCB Quantico, freshwater marshes and hardwood forests are the top value habitats. However, many of the priority SGCN by HUC distribution analysis include aquatic species. Thus, it is important to consider the health and conservation of these systems as well. Many actions that benefit one of these habitat types will also help the other species.

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

If a base has only a small percent of a specific habitat type, but is rare within the state, then this is a habitat to analyze further in terms of both conservation opportunities and challenges. It is important to determine what threats training may pose or if training is already limited in the areas, then perhaps little will need to take place to provide conservation benefit. Alternatively, management actions may require minimal effort to protect a high value area. The Appalachian (Hemlock)-Northern Hardwood Forest type

is an example of this case where the type is clearly unique in this landscape and almost entirely limited to MCB Quantico.

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 documented. 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 training lands at MCB Quantico has created unique habitats that result in valuable lands for SGCN. Prescribed fire, used to maintain training areas, has resulted in many species of SGCN persisting within the installation that have all but disappeared from the surrounding landscape. It is important for NRM 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 those 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 process and are included in the overall plan.

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

While much of our downscaling efforts have focused on identifying priority SGCN for the installation, we should understand that any conservation actions implemented would likely benefit other SGCN. For example, we have demonstrated how protecting water quality 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 119 species of SGCN identified for the three planning districts around MCB Quantico, and many more species of aquatic and terrestrial species will benefit. Quantifying that number by reviewing the habitat information provided by the DGIF SWAP tool will further support the conservation actions taken in this habitat.

8. Conclusion

The SWAP is a powerful tool for identifying species at risk of endangerment in Virginia. The process we have outlined for MCB Quantico demonstrates how information to identify how readily available information from the SWAP can inform conservation on the installation, and vice-versa. MCB Quantico 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.

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