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NRCS contributions to the conservation of the northern lineage of bog turtle (*Glyptemys muhlenbergii*), with recommendations for future programmatic improvements

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Project Information:

This project was funded by NRCS to conduct an outcomes assessment for the WLFW-Bog turtle initiative. This initiative was initiated in 2012 to assist in the recovery of bog turtles (*Glyptemys muhlenbergii*), which are federally listed as Endangered in the northern lineage and as a species of greatest conservation need (SGCN) in every state where they occur. The WLFW-Bog turtle initiative is implemented primarily through ACEP-WRE but some EQIP funds have also been committed to conservation practices.

Findings: Northern Lineage

Easements:

In total, there are 82 recorded NRCS easements that directly protect an extant bog turtle population (at least one documented turtle in the last 20 years). These 82 easements covered 80 unique locations and totaled over 29,000 acres (Fig. 1). For the purposes of this exercise, I defined direct protection of a bog to include any easement within 300 meters of a known population. This was based on conversations with several state biologists that work with the species. The 2001 bog turtle recovery plan identifies a recovery target of at least 185 of the 350 known extant bogs. Thus, to date, NRCS has accomplished (on its own) roughly 42% of this goal. The USFWS and other partners are currently assessing non-USDA easements, as well as other recovery actions. At this time, it's unclear as to what the total impact of conservation actions has been.

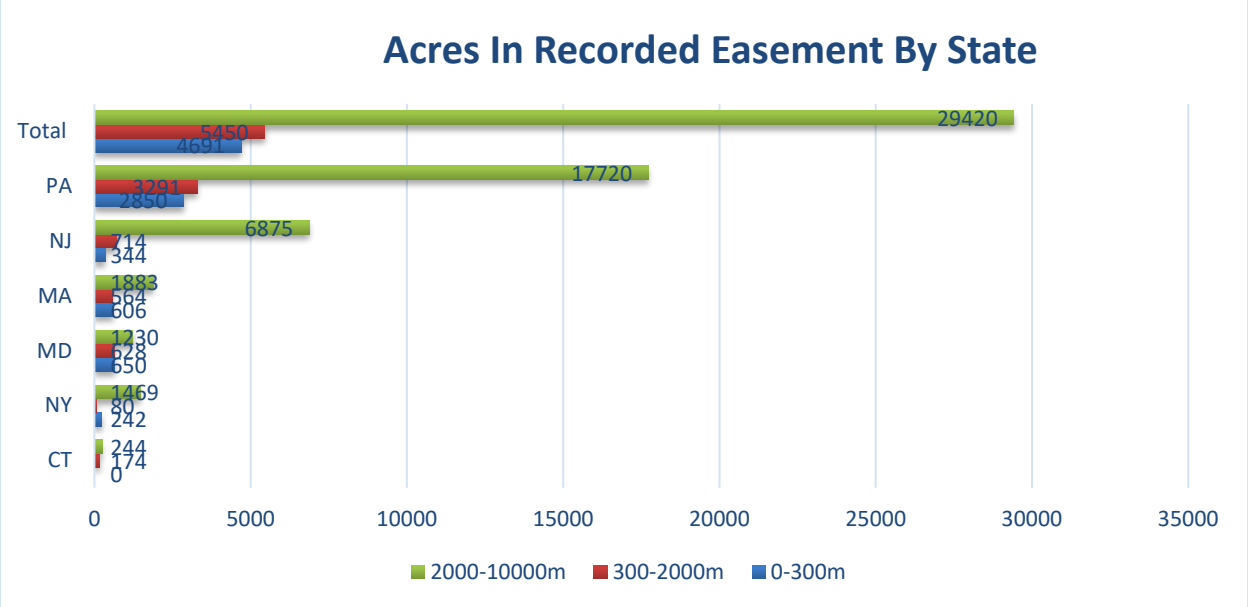

Figure 1. Acreage of NRCS easements near bog turtle sites by state.

In addition to those extant bogs that have been directly protected, 70 easements are found within a distance of 300 to 2000m from a population. At this distance, it is highly possible that the easements are having a direct positive benefit on the populations. Further, these easements are likely important to re-establishing functioning meta-populations and encouraging gene flow and migration, not to mention the benefit to the watershed health and hydrology.

There have been 307 easements found between 2 and 10 kilometers, covering 240 populations. It is less clear what contributions these easements are making to current bog turtle conservation. However, they likely also have a positive impact on meta-population function, watershed health, and hydrology. They are also very likely to play an important role when the targets of the recovery plan shift in 2023 (more on this later).

The easements are not distributed equally across the landscape. In fact, 2 of the recovery units (Outer Coastal Plain and Lake Plain) do not have any easements near bog turtle sites (Fig. 2). However, this is somewhat deceiving considering those units have very few sites to begin with (3 and 4 respectively according to the 2001 Recovery Plan). The distribution of bog turtle easement sites is also skewed by state (Fig. 3) but tends to mirror the actual distribution of the species.

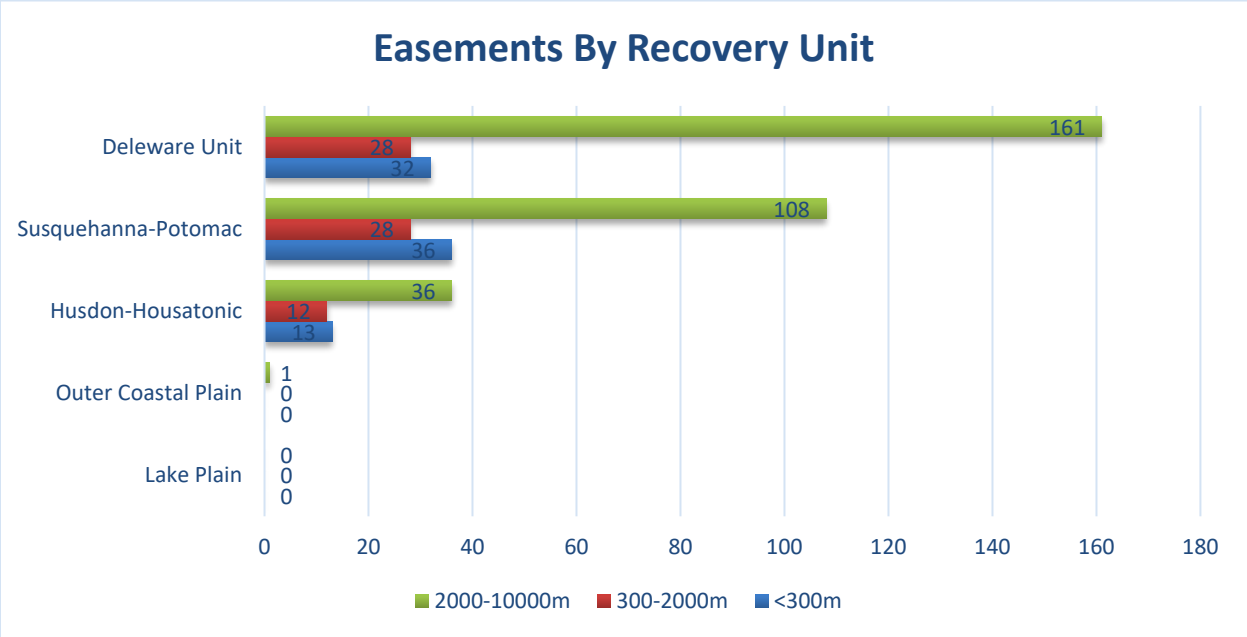

Figure 2. NRCS easements near extant bog turtle populations by recovery unit.

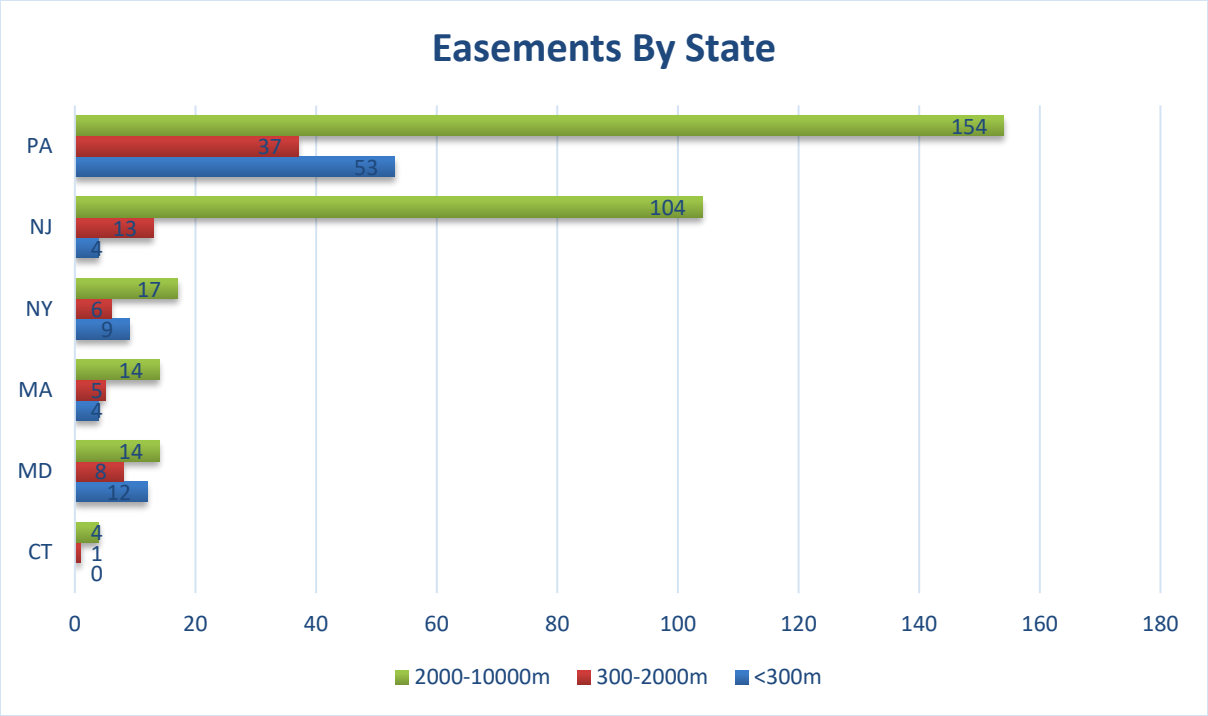

Figure 3. NRCS easements near extant bog turtle populations by state.

Practices:

56 extant bog turtle sites have benefited from NRCS practices (within 300 meters). Table 1 shows the breakdown of the practices employed in extant bogs. Clearly, many of these bogs have had practices employed several times at the same site. In these systems, it is vitally important to maintain proper habitat for bog turtles. Naturally, the habitat shifts rapidly, which is accelerated with the increased nutrient loads. Historically, this would have meant that the turtles had a shifting mosaic of potential habitat, but with the current anthropogenic footprint across the landscape that is no longer a reality. Thus, a central goal for NRCS and partners should be to have regular maintenance at each site. Table 3 shows the time since the last practice. This demonstrates that since the start of the WLFW bog turtle initiative, NRCS has done a good job of maintaining regular practices at most sites. The average time since last practice is 6.13 years, which is likely sufficient and should be a regular target. The one caveat to this data is that more than half of the data for time since last practice is missing (251 sites). In these cases, there was a practice recorded but no date in the database. Keeping better track of such data will be important in the future to track impact.

Table 1. Management practices employed in bogs with extant populations.

Practice	# of sites
Access Control	1
Conservation Cover	4
Brush Management	30
Critical Area Planting	1
Early Successional Habitat Development/Management	10
Herbaceous Weed Treatment	18

Riparian Forest Buffer	2
Riparian Herbaceous Cover	1
Prescribed Grazing	2
Upland Wildlife Habitat Management	14
Restoration of Rare or Declining Natural Communities	21
Wetland Enhancement	18
Wetland Restoration	6
Wetland Wildlife Habitat Management	5
Grand Total	**129**

79 sites within 300m to 2,000m of an extant bog have benefited from NRCS practices that targeted bog turtles (Table 2). As above, many of these practices have been carried out several times at the same bog.

Table 2. Management practices employed within 300-2,000 meters of an extant bog.

Practice	**# of sites**
Access Control	2
Brush Management	51
Critical Area Planting	3
Conservation Cover	24
Early Successional Habitat Development/Management	8
Heavy Use Area Protection	7
Herbaceous Weed Treatment	30
Prescribed Grazing	8
Restoration of Rare or Declining Natural Communities	45
Riparian Forest Buffer	1
Riparian Herbaceous Cover	3
Stream Habitat Improvement and Management	2
Upland Wildlife Habitat and Management	18
Wetland Restoration	22
Wetland Enhancement	27
Grand Total	**251**

Table 3. The number of years since a practice has occurred at a specific

Years Since Last Practice	**Count of Time since last practice**
4	33
5	50
6	54
7	39
8	23
9	1
10	3

11	3
12	1
13	1
14	2
Grand Total	**210**

Findings: Southern Lineage

Easements:

The WLFW-Bog turtle program has not been focused on the southern lineage. Yet, there was still a possibility that the NRCS was making an impact on the conservation of the Southern lineage. The population data for the Southern lineage are not as refined, likely given the scarcity of funding due to it only having a Similarity of Appearance listing. In practice, this means that we know a lot less about the viability of potential bogs and populations. Nevertheless, we reviewed 256 historically known populations for this analysis. The results were strikingly less impressive than the effort in the north. There are only 2 recorded easements within 300 meters of a known population (less than 200 acres). There are 4 recorded easements between 300-2,000 m, and 13 between 2,000 and 10,000 m (1038 acres).

Priority Analysis

Priority analysis was conducted for each county throughout the species' extant range using 3 variables: density of easements, populations, and management practices. Variables were calculated per county range-wide, then, per county, each variable was assigned a value between 1-4 using the natural breaks (Jenks) method. Figures 4-6 below show the 4 natural breaks that were used to categorize the 1-4 values per variable. The lowest-value group per variable was assigned a value of 1, second-lowest a value of 2, etc.

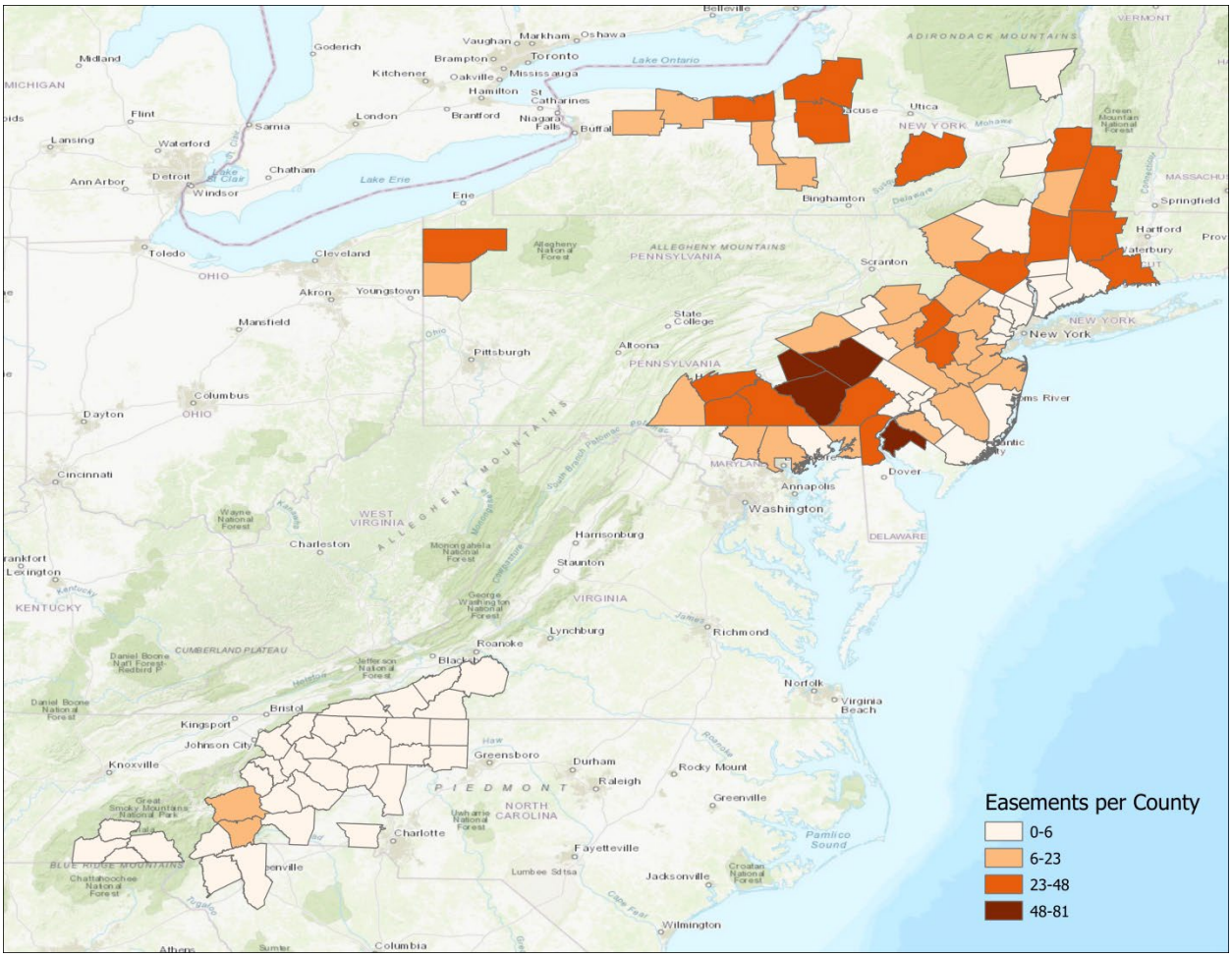

Figure 4. Density of NRCS easements per county throughout the extant range of bog turtles.

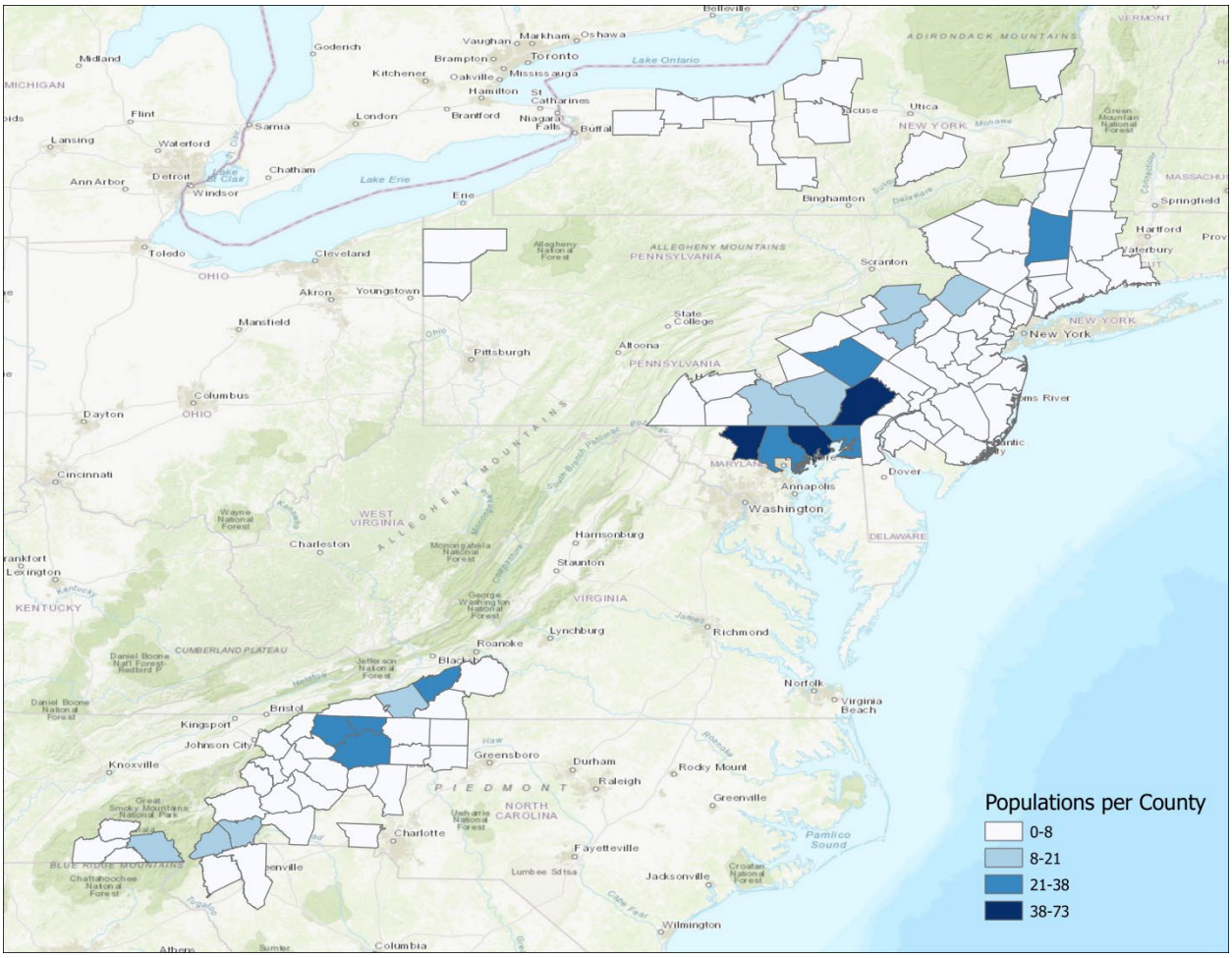

Figure 5. Density of populations per county throughout the extant range of bog turtles.

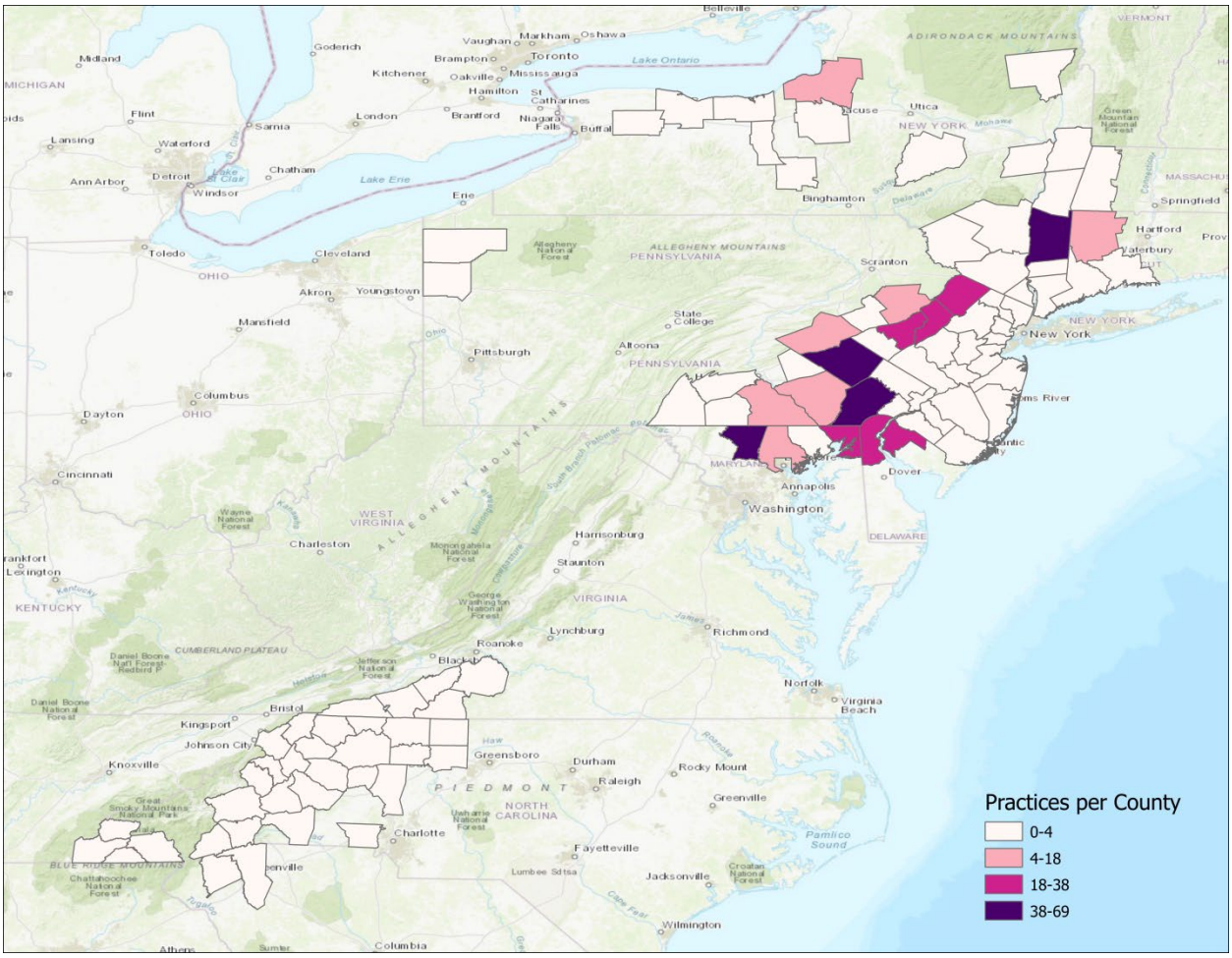

Figure 6. Density of NRCS conservation (management) practices per county throughout the extant range of bog turtles.

4 comparison analyses were conducted per county. Each of these analyses compared a set of 2 variables per county, using the assigned 1-4 values. The difference between these 2 values generated a comparison value. The 2 comparison analyses were: (1) difference between population density and easement density (PEValue), (2) difference between population density and practices (PPrValue). Comparison values farther from 0 indicate a greater disparity between either population number or habitat quality and current management (easement density or practices density). For example, Chester County in Pennsylvania has a population density value of 4 and an easement density value of 3, and 4-3= 1, so the PEValue for Chester County is 1. Figures 7 and 8 show the comparison values for each of the comparison analyses.

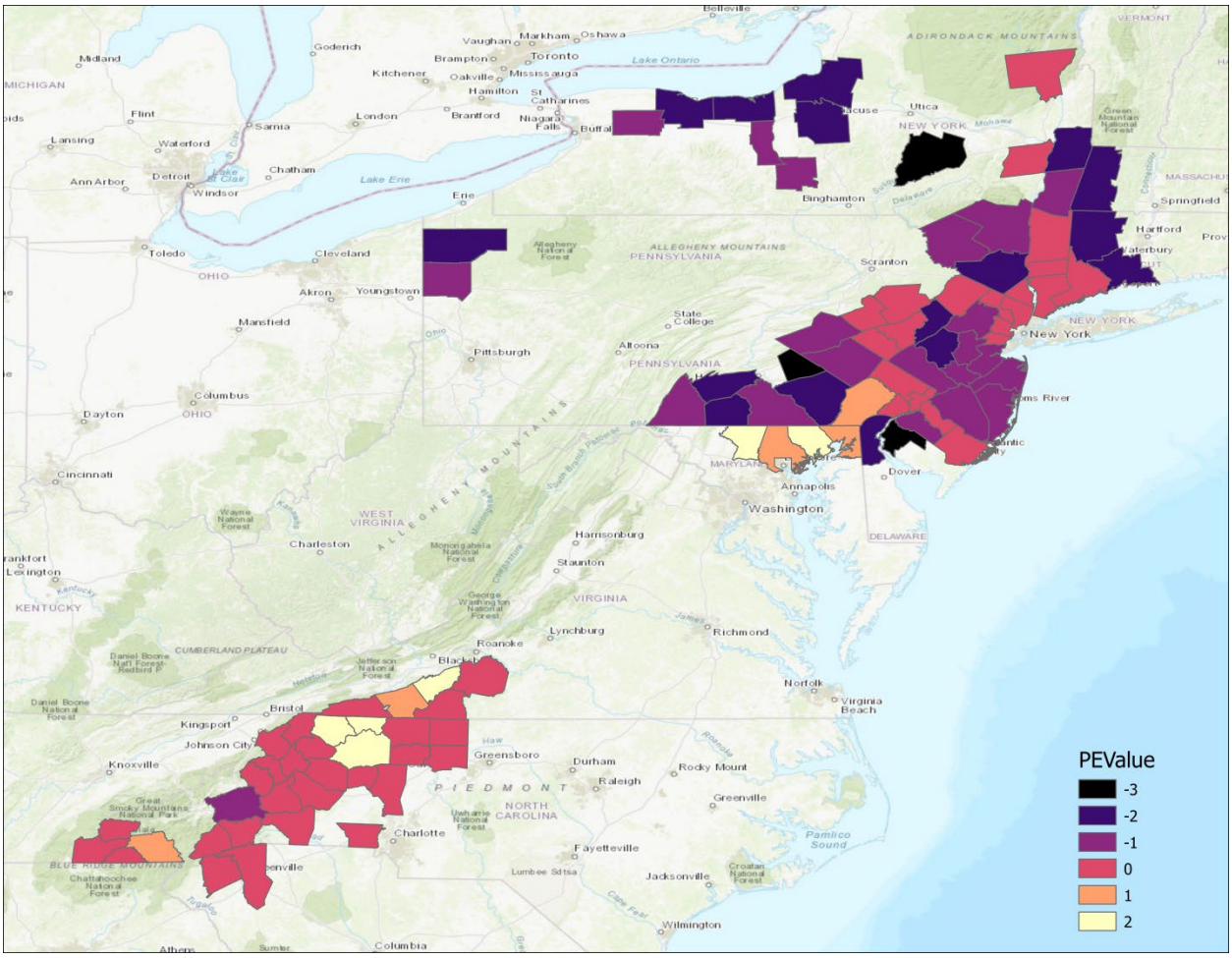

Figure 7. Comparison values between population density and NRCS easement density per county (PEValue) throughout the extant range of bog turtles.

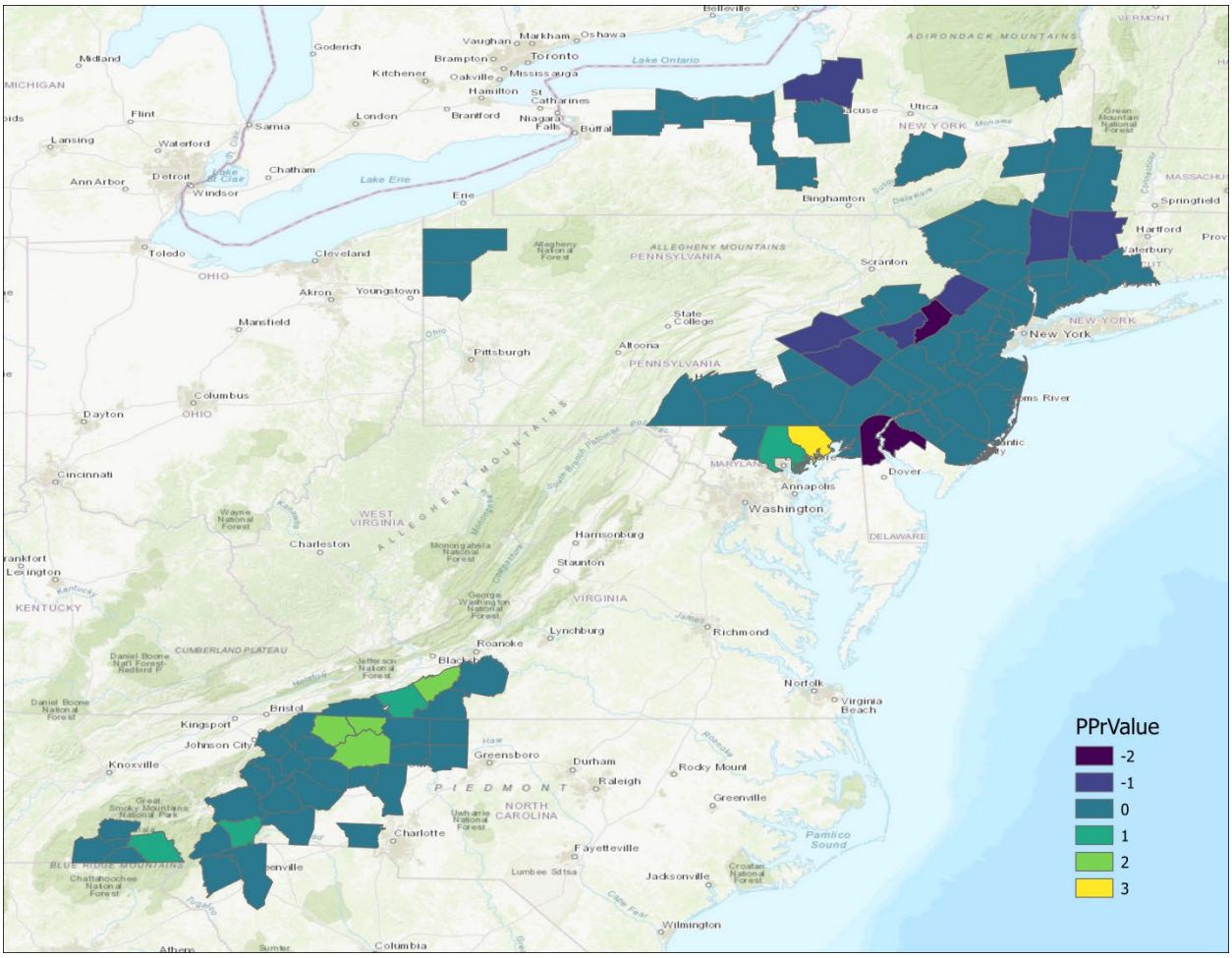

Figure 8. Comparison values between population density and NRCS conservation practices density on easement sites per county (PPrValue) throughout the extant range of bog turtles.

Recommendations:

The NRCS WLFW-Bog turtle initiative has clearly made highly significant contributions to bog turtle recovery. There is also huge potential to continue positive impacts. There are several ways in which the NRCS could target the current recovery plan. These include:

1. Easements to protect extant bog turtle sites. The recovery plan targets 185 sites. The NRCS has already recorded easements on 82 of these sites. The number of acres needed to cover this target is almost laughably small. If all easements aimed at bog turtles that fell within 10km of an extant bog were included, this would already cover over 39,585 acres. The acreage already in place to cover the 82 currently protected bogs is 4,691 (Fig. 1). That means that if all of those easements had been targeted for extant bogs, then the recovery plan goal for wetlands protection would be complete. Of course, this would require coordination with states and an on the ground campaign targeting landowners, made difficult by the high risk of illegal collection and trade of this species. One way to achieve this could be through a 3rd party or by the development of a

database that guides NRCS but does not reveal specific bog turtle data guiding future conservation efforts under the Farm Bill. Figure 6 shows that there is currently a mismatch in some areas between bog turtle population density and number of easements.

Clearly, an RCPP would be appropriate and likely successful for the northern lineage.

2. Secondly NRCS could contribute in a major way by maintaining habitat suitability. This can be accomplished by ensuring that extant suitable wetlands do not succumb to succession or other mechanisms that might eliminate habitat. Many of the practices already employed by NRCS would be effective for this need. In fact, many of the practices that have been employed in occupied bogs are aimed at impeding succession or dealing with invasive plants.

   For the most part, practice effort has coincided with population density (Fig. 8), but there are mismatches across the landscape. Most notably, in northeastern MD, southern PA, VA, and northern NC. Of course, other priorities may be in play in these areas, but this is worth assessing at the state level.

3. Finally, the NRCS can aid the recovery of bog turtles by ensuring watershed health, mainly by limiting/buffering runoff and by maintaining/restoring natural hydrologic patterns.

Of course, a huge caveat in all of this is that the recovery plan for bog turtles is set to be rewritten in 2023. There is virtually no chance that it will be left in the current state of relatively crude recovery targets (e.g. 185 bogs). Rather, a new plan will rely on the framework of the 3 Rs (Representation, Resilience, and Redundancy). This will likely take the form of shifting the boundaries of the recovery units to better match genetic patterns and restoring meta-population function among a handful of the best areas (likely 8-15 meta-populations). Again, the key for NRCS here is to be able to target these prioritized areas. The recently finished Competitive State Wildlife Grant (C-SWG) and a follow up C-SWG just awarded will provide all of the necessary data to identify these areas and metrics. The likely outcomes will be an enhanced appreciation for what has already been accomplished by NRCS in these target areas, as resilience will be of major importance. In other words, easements won't need to be 100% targeted at currently occupied bogs, but rather can aid in corridors and watershed health. The same is true for conservation practices. Resilience will also be reliant on habitat management, and, as stated above, the NRCS is perfectly set up to handle this task. In fact, this is a continuous issue in bog turtle conseravation that could be effectively dealt with by NRCS .

Redundancy will likely be a numbers game, but again, the number of acres to cover the required number of extant bogs per unit is likely to be extremely small. Representation will almost naturally be covered by all state NRCS offices being engaged. However, it would

certainly be helped by a prioritization strategy for NRCS future activities that is closely aligned with the recovery plan.

In conclusion, the road to recovery for bog turtles is clear and simple, though is likely to shift. The NRCS already possesses the tools and resources to make the bog turtle the poster child of NRCS aided recovery in the east. The missing piece appears to be a prioritization strategy.

NRCS can play an important role in the larger community of agencies and non-profits working to recover the species. No other entity has the resources to help maintain populations of bog turtles across the landscape that NRCS does. Especially given the amount of private land that falls within the historic range of bog turtles. There is a dynamic community of partners working in coordination to recover this species, but they lack the resources to secure habitat in a meaningful way. Thus, there is not only a niche for robust NRCS involvement, but a demonstrated need.