Interim Core Map Documentation for the Bog Turtle (Northern Population)

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Species Summary

The bog turtle (*Glyptemys muhlenbergii*; Entity ID 182) is a threatened reptile whose northern population is found in the Eastern United States. The southern population is classified as threatened due to similarity in appearance to the northern population to prevent accidental take from collection, not relevant to pesticides. The U.S. Fish and Wildlife Service (FWS) has not assigned designated critical habitat for the bog turtle. This species inhabits wetlands that include dry pockets, saturated areas, and areas that are periodically flooded. Bog turtles depend upon this diversity of micro-habitats for foraging, nesting, basking, hibernation and shelter. Additional habitat information is provided in **Appendix 1**.

Description of Core Map

The core map for the bog turtle is based on biological information. A description of habitat from the species' Recovery Plan was used to identify usable geospatial data contributing to the core map.

As a wetland species, the bog turtle's habitat was identifiable in spatial data using the National Wetlands Inventory (NWI) dataset (NWI 2023). Water bodies matching species habitat description were clipped to the species range, buffered by 300 feet to account for the species' proximity to those waters, and clipped again to the species range. Following that, the National Land Cover Database (NLCD) was used to isolate only areas of emergent herbaceous wetlands with 50% canopy cover or less, as closed canopy areas and other land cover types including woody wetlands are unsuitable habitat.

The southern portion of the species' range is inhabited by the species' southern population, which is classified as threatened only for similarities in appearance with the northern population to prevent accidental take due to collection and thus was not included in this core map.

The core map developed in this document spans approximately 52,496 acres (Error! Reference source not found.). A summary of Landcover categories within the core map area is included in **Table 1**.

Based on EPA's "best professional judgment classification" system, the developers graded this core map as "moderate" (4) because assumptions were made when connecting species life history and/or biological needs (habitat preferences and water body descriptions) to a GIS dataset, in this case the NWI dataset (NWI 2023) and NLCD. More information about this classification system and its definitions can be found in the core map process document (EPA 2024).

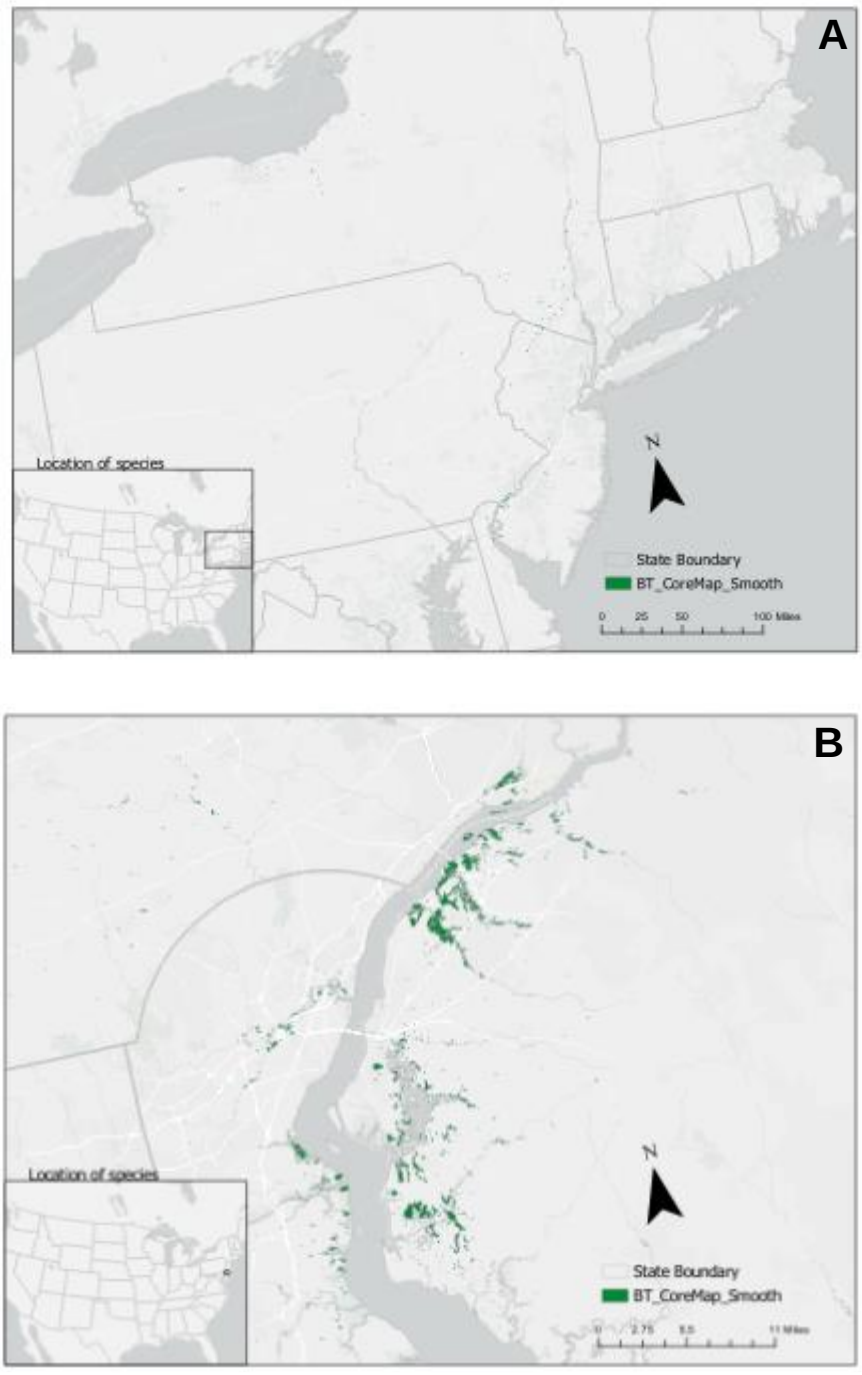

Figure 1. A) Interim core map for the bog turtle. It is fragmented across multiple northeastern states, so it is difficult to see individual patches zoomed out to the full extent like this. B) This is an example of what the core map looks like when zoomed in more closely. It's best to look at the core map GIS file in a dynamic map such as ArcGIS Online to zoom in and out on various areas.

Table 1. Percentage of Interim Core Map Represented by NLCD[1] Land Covers and Associated Example Pesticide Use Sites/Types.

Example pesticide use sites/types	NLCD Class/Value	% Area	Total area for landcover type
Forestry	Deciduous Forest (41)	0%	0%
Forestry	Evergreen Forest (42)	0%	0%
Forestry	Mixed Forest (43)	0%	0%
Agriculture	Pasture/Hay (81)	0%	0%
Agriculture	Cultivated Crops (82)	0%	0%
Mosquito adulticide, residential	Developed Open Space (21)	0%	0%
Mosquito adulticide, residential	Developed Low Intensity (22)	0%	0%
Mosquito adulticide, residential	Developed Medium Intensity (23)	0%	0%
Mosquito adulticide, residential	Developed High Intensity (24)	0%	0%
Invasive species control	Woody Wetlands (90)	0%	100%
Invasive species control	Emergent Herbaceous Wetlands (95)	100%	100%
Invasive species control	Open Water (11)	0%	100%
Invasive species control	Grassland/Herbaceous (71)	0%	100%
Invasive species control	Shrub/Scrub (52)	0%	100%
Invasive species control	Barren Land (31)	0%	100%
Total Acres	Interim Core Map Acres	~52,496	

Evaluation of Known Location Information

There were three evaluated datasets with known location information:

- Occurrence locations in iNaturalist;
- Occurrence locations in the Global Biodiversity Information Facility (GBIF); and
- Occurrence locations in NatureServe.

The developers evaluated these datasets before developing the core map. Overall, there were six usable research-grade observations found in iNaturalist, which also comprised the full dataset of usable GBIF observations (sourced from iNaturalist)[1]. The iNaturalist dataset was not comprehensive enough to contribute to the core map development process.

NatureServe public element occurrence (EO) data were also evaluated and were more numerous than the other public databases. These data were considered for refinement, but given the scale and resolution of the data, these data would not likely have made a meaningful difference.

Approach Used to Create Core Map

[1] According to iNaturalist, an observation is designated as "research grade" if it 1) is verifiable with date, coordinates, photos/sounds, and not captive; 2) achieves community agreement defined as "more than 2/3 of identifiers needs to agree on the species level ID or lower;" and 3) "must pass a data quality assessment, which includes checks for accurate date and location, evidence of a wild organism, and clear evidence of the organism itself" (https://help.inaturalist.org/en/support/solutions/articles/151000169936-what-is-the-data-quality-assessment-and-how-do-observations-qualify-to-become-research-grade-).

The core map was developed using the process implemented by EPA to develop core maps for species listed by the FWS and their designated critical habitats[2] (referred to as "the process"). This core map was developed using the four steps described in the process document:

1. Compile available information for a species;
2. Identify core map type from among the following defined types: Designated Critical Habitat, Range, and Biological Information. From EPA, summaries of each core map type are provided below (EPA 2024).
3. Develop the core map for the species; and
4. Document the core map.

For step 1, the developers compiled available information for the bog turtle from FWS, as well as observation information available from various publicly available sources including iNaturalist, GBIF, and NatureServe. The information compiled for the bog turtle is included in **Appendix 1**. Influential information that impacted the development of the core map includes a description of the species habitat from the FWS ECOS page:

- "Bog turtles usually occur in small, discrete populations, generally occupying open-canopy, herbaceous sedge meadows and fens bordered by wooded areas. These wetlands are a mosaic of micro-habitats that include dry pockets, saturated areas, and areas that are periodically flooded. Bog turtles depend upon this diversity of micro-habitats for foraging, nesting, basking, hibernation and shelter. Unfragmented riparian systems that are sufficiently dynamic to allow the natural creation of open habitat are needed to compensate for ecological succession. Beaver, deer, and cattle may be instrumental in maintaining the open-canopy wetlands essential for this species' survival" (FWS 2001).

For step 2, the developers used the compiled information including the species range, known locations, and habitat location information to determine the core map type. Compliance Services International and EPA compared the known location data to the range and found that known locations from larger databases (iNaturalist and GBIF) were not robust enough for use in core map development. Therefore, these datasets were not used in core map development. Known location information from FWS was not detailed or specific enough to be used as a refinement of core map extent from species range.

Review of the available data also suggested that the core map could be refined using habitat descriptions for the bog turtle. A national wetlands layer was used to represent reasonable potential habitat for this species, along with the NLCD. When weighing this information together, the biological information core map type was chosen, limited to an extent of species range. The developers used a combination of range and habitat information to derive this core map.

For step 3, the developers used the best-available data sources to generate the core map. Data sources are discussed in the EPA's core map process document. For this interim core map, the developers followed EPA's decision framework to arrive at a core map type of biological information. Designated critical habitat was quickly eliminated as a core map type because the bog turtle does not have critical habitat. The range core map type was not used because the range is neither endemic nor refined.

Species habitat was represented by water body types in the NWI dataset matching species habitat description and NLCD, according to methods discussed in **Appendix 1** and **Appendix 2** (FWS 2013).

Discussion of Approaches and Data that were Considered but Not Included in Core Map

Known Observation Datasets

The iNaturalist, GBIF, and NatureServe datasets all had a considerable number of observations that could be spatially rendered. The developers determined that after accounting for coordinate uncertainty, this would not provide a significant refinement. Therefore, known observation datasets were not used in core map development.

EPA Cultivated Lands > 25 Acres

EPA has developed and published a cultivated layer for use in core map development as a potential refinement of extent. EPA's modified cultivated layer was considered for removal since this species is confirmed off-field, but it proved unnecessary once the NLCD refinement to emergent herbaceous wetlands was completed as that refinement already removed cultivated lands.

New York Natural Heritage Program

The New York Natural Heritage Program (NYNHP) has developed species-specific habitat models for several listed species, including the bog turtle. Compliance Services International attempted to find the model, but could only obtain related/derivative products, such as a layer of "rare species" that includes the bog turtle. Because the bog turtle model was not readily available and its extent would likely have been limited to New York anyway, developers decided not to pursue this dataset.

Appendix 1. Information compiled for the bog turtle (northern population)

1. **Recent FWS documents**
   - 5-Year Review (2022a) https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/3947.pdf.
   - Interim Species Status Assessment/Biological Report (2022b) https://iris.fws.gov/APPS/ServCat/DownloadFile/220862.
   - Recovery Plan (2001) https://ecos.fws.gov/docs/recovery_plan/010515.pdf.

2. **Background information**

- Status: Federally listed as threatened in 1997.
- Resiliency, redundancy, and representation (the 3Rs) (FWS 2022b)
  - Resiliency
    - "Rangewide 6–30% of metapopulations have "good" resiliency
    - 26–50% have "fair" resiliency
    - 20–67% have "poor" resiliency
    - 37 historical (individual populations)
    - 40 extirpated (individual populations)."
  - Redundancy
    - "Bog turtles continue to have a large distribution with extant metapopulations known throughout the range and within each [recovery unit (RU)]. However, most are in poor to fair condition. In addition, there was an historical range contraction with most losses at the northern extent of the range (primarily in New York)."
  - Representation
    - "Metapopulations occur throughout the range. However, most are in poor to fair condition within each recovery unit (RU).
    - **Delaware RU**
      162 metapopulations
      poor (20–71%)
      fair (24–49%)
      good (5–31%)
    - **Hudson-Housatonic RU**
      66 metapopulations
      poor (17–65%)
      fair (23–47%)
      good (12–36%)
    - **Outer Coastal Plain RU**
      1 metapopulation=fair
      2 metapopulations=poor or good (too many unknowns)
    - **Prairie Peninsula-Lake Plain RU**
      1 metapopulation=poor
      2 metapopulations=fair

1 metapopulation=good
1 metapopulation=poor or fair (too many unknowns)

- **Susquehanna-Potomac RU**
  94 metapopulations"
  poor (23–64%)
  fair (32–55%)
  good (4–21%)

- Habitat, Life History, and Ecology
  - Habitat: "Bog turtles usually occur in small, discrete populations, generally occupying open-canopy, herbaceous sedge meadows and fens bordered by wooded areas. These wetlands are a mosaic of micro-habitats that include dry pockets, saturated areas, and areas that are periodically flooded. Bog turtles depend upon this diversity of micro-habitats for foraging, nesting, basking, hibernation and shelter. Unfragmented riparian systems that are sufficiently dynamic to allow the natural creation of open habitat are needed to compensate for ecological succession. Beaver, deer, and cattle may be instrumental in maintaining the open-canopy wetlands essential for this species' survival" (FWS 2001).
  - "Mating in bog turtles occurs in spring from March to June (Ernst and Lovich 2009, p. 268). Males locate females via visual and olfactory cues and may pursue females in a short chase. Courtship lasts about 35 minutes and may occur in or out of water (Ernst and Lovich 2009, p. 268). Nesting occurs from June to early July, with most eggs laid in June. In New England, eggs became calcified in early June and egg-laying was documented approximately 10 days later from the second to fourth week in June (Whitlock 2002, pp. 52, 72). In Maryland, Byer et al. (2018, p. 230) documented nesting occurred June 8 to 22. Similarly, Zappalorti et al. (2015, p. 575) found most nests occurred between June 8 to 29 in New Jersey and Pennsylvania.
    Bog turtles rarely leave their wetland habitat to nest; females typically seek out elevated areas within the wetland such as sedge tussocks or root hummocks in open-canopy areas (Zappalorti et al. 2015, pp. 576–577), although nests have also been documented in rotting wood and stumps (Zappalorti et al. 2015, p. 576), and in adjacent pastures and railroad embankments (Ernst and Lovich 2009, p. 268). Eggs are typically concealed with vegetative material, such as blades of sedge or grass, sphagnum moss, or humus, but some eggs may be left partially or fully exposed" (FWS 2022b).
  - Diet: "The first report of, presumably wild, bog turtle stomach content includes both plants and insects (Surface 1908, p. 158). Later a wild turtle was observed to have the capacity to feed both terrestrially and aquatically (Barton and Price 1955, p. 162). Food items include a wide diversity of animals, primarily invertebrates, but also include dead animals (Campbell 1960, p. 16), root material and moss (Klemens 1993, p. 182). More comprehensive lists of animal prey items and consumed plants are detailed in Ernst and Lovich (2009, p. 270) and Melendez et al. (2017, entire). Two of the broader studies of bog turtle feeding ecology and diet were conducted in New Jersey (Gemmell 1994 entire; Melendez et al. 2017, entire) and study populations are representative of habitats within the Atlantic Highlands and Coastal Plain physiographic provinces and Delaware and Hudson-Housatonic bog turtle recovery units. While Gemmell employed stomach pumping, or flushing, in his study to analyze stomach content, Melendez et al. followed a

less invasive approach of examining fecal samples, and this difference in methodology may have contributed to significant differences in their respective findings. In Gemmell's three-year study of 92 flushed stomachs, slugs (*Arion* sp.) made up nearly 70% of the turtle's diet. Similarly, Surface (1908, p. 158) found the stomach contents of one turtle to be 80% insects. In contrast, Melendez et al. (2017, p. 275) found 90% plant material in his 60 samples, primarily consisting of seeds. Melendez et al. (2017, p. 275) also found no significant differences between the diets of males and females or between his study areas. Bog turtles appear to be opportunistic foragers and feeding preference is likely based on food availability" (FWS 2022b).

- Taxonomy

  The currently accepted classification is:
  Kingdom: Animalia
  Phylum: Chordata
  Class: Reptilia
  Order: Testudines
  Family: Emydidae
  Species: *Glyptemys muhlenbergii*

- Delisting Criteria
  - 5-Year Review (2022a) Recovery Criteria

    Criterion 1**. Long-term protection is secured for no fewer than 185 viable** (see Service 2001, Recovery Task 7. 1. 1) **populations** (= population analysis sites, PAS; see p. 7 "Criterion 1 has not been met" for details) **distributed among the 5 recovery units**. Protection1 of 185 of the 350 extant bog turtle sites and their populations (refer to table 4 of Recovery Plan) has been determined to be appropriate to meet the recovery goal, since protection of this many sites across the species' range will significantly reduce the species' risk of extinction due to anthropogenic and non-anthropogenic threats and allow its eventual delisting. It should also be noted that some of the existing sites may not be capable of sustaining viable bog turtle populations due to small population size, and/or habitat loss, degradation, and fragmentation.

    Some of the recovery units have been partitioned into subunits for the purpose of ensuring that an adequate number of PAS populations are protected across the species' range. The specific recovery criteria for each unit and subunit are summarized in Table 5 of the Recovery Plan (see table 1), followed by more detailed descriptions of the criteria for each unit."

    Criterion 2. **Monitoring at 5-year intervals over a 25-year period shows that these 185 populations are stable or increasing.** This 25-year monitoring period will be triggered when populations and their habitat are considered secure from external threats such as habitat loss and destruction, collection of turtles, or elevated levels of predation. Therefore, monitoring at some sites could be initiated immediately, whereas other sites may require considerable protection and management efforts prior to the initiation of the 25-year monitoring period. Monitoring will track general population health, reproduction, age structure, and habitat trends. These parameters should indicate that the population and its habitat have the capacity for being self-sustaining

in the wild over the long term, with regular monitoring (and where necessary management) regimes in place.

Criterion 3. **Illicit collection and trade in this species have been eliminated or reduced to a minimal level** (i.e., a level that no longer constitutes a threat to the survival of this species). Indications that this criterion has been attained would include: (a) implementation of an effective law enforcement program that reduces illicit take of this species, (b) a demonstrated success rate associated with the law enforcement program, and (c) consensus among federal and state enforcement agencies, state non-game programs, and the research community that illicit trade has been brought under control.

Criterion 4. long-term habitat dynamics, at all relevant scales, are sufficiently understood to monitor and manage threats to both habitats and turtles, including succession, invasive wetland plants, hydrology, and predation that are sustained by human activities.

3. Species Range (From the 2022 5-Year Review)

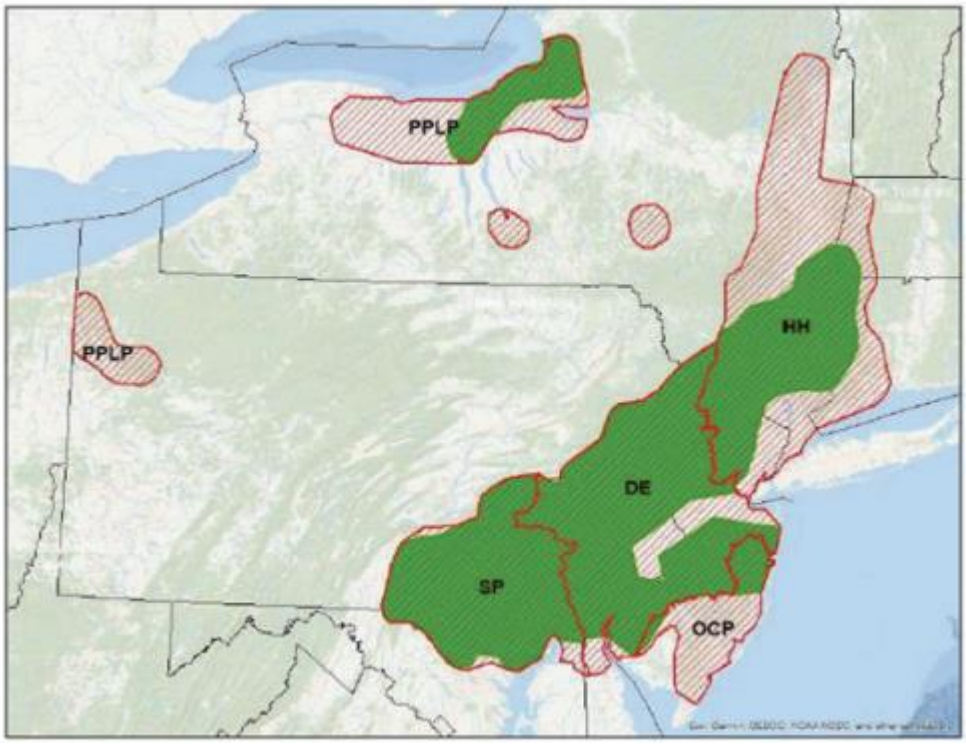

Figure 1. The historical (red hatch) and current (green) bog turtle northern population range including the Delaware (DE), Hudson-Housatonic (HH), Outer Coastal Plain (OCP), Prairie Peninsula-Lake Plain (PPLP), and Susquehanna-Potomac (SP) Recovery Units. Copied from Figure 1 of the 5-Year Review (FWS 2022a).

4. Critical Habitat

The bog turtle (northern population) does not have designated critical habitat.

5. Known Locations

FWS

- 350 Extant Populations.

State	Prairie Peninsula/ Lake Plain	Outer Coastal Plain	Hudson/ Housatonic	Susquehanna/ Potomac	Delaware	Total PAS
Connecticut			5			5
Delaware					4	4
Maryland				61		61
Massachusetts			3			3
New Jersey		3	46		116	165
New York	4		33			37
Pennsylvania	0			31	44	75
TOTAL	**4**	**3**	**87**	**92**	**164**	**350**

Table 1. Extant bog turtle PAS by State and Recovery Unit (FWS 2001).

- iNaturalist: https://www.inaturalist.org/observations?taxon_id=39864
  - 32 verifiable observations; six of which are research-grade and meet the following criteria:
    - U.S. only (excludes Canada)
    - Latitude and longitude precision were both 3+ decimal places
    - Relative recency (2010-present)
    - Observation description did not include the text “intentionally incorrect”
    - Public positional accuracy values no greater than 30 kilometers
  - These locations include areas that extend beyond just the northern population of the bog turtle with a status of “threatened” (**Figure 1** and **Figure 2**).

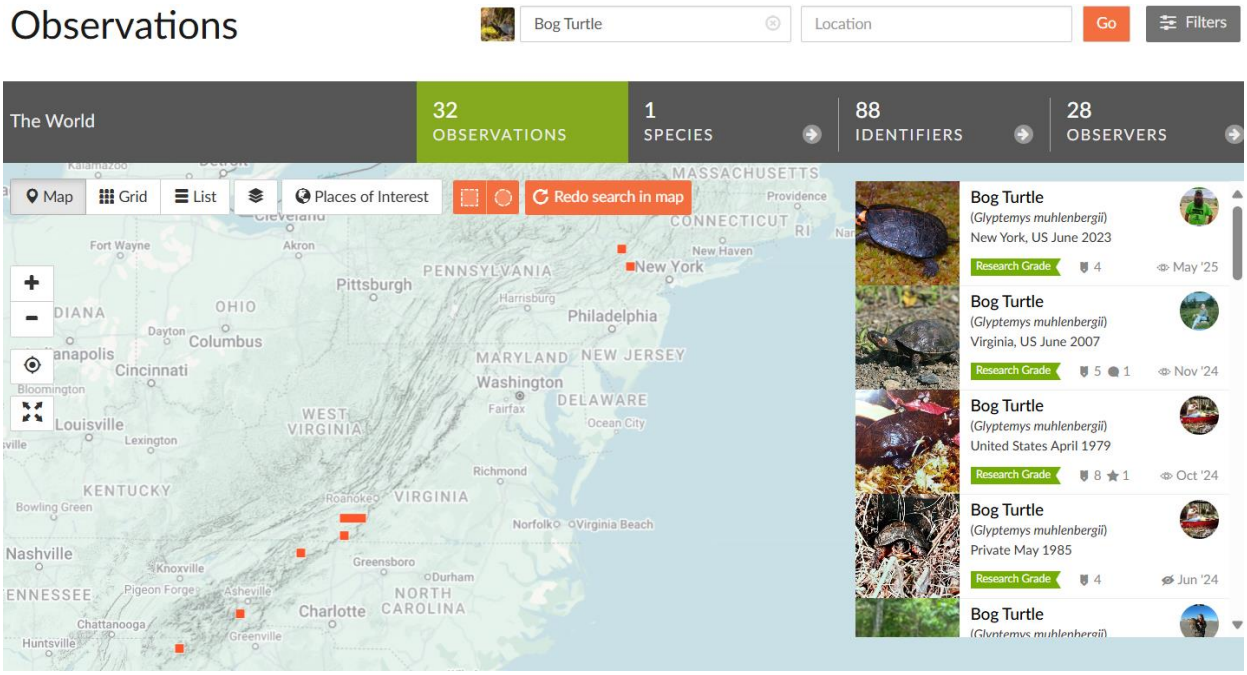

Figure 1. iNaturalist occurrences for the bog turtle.

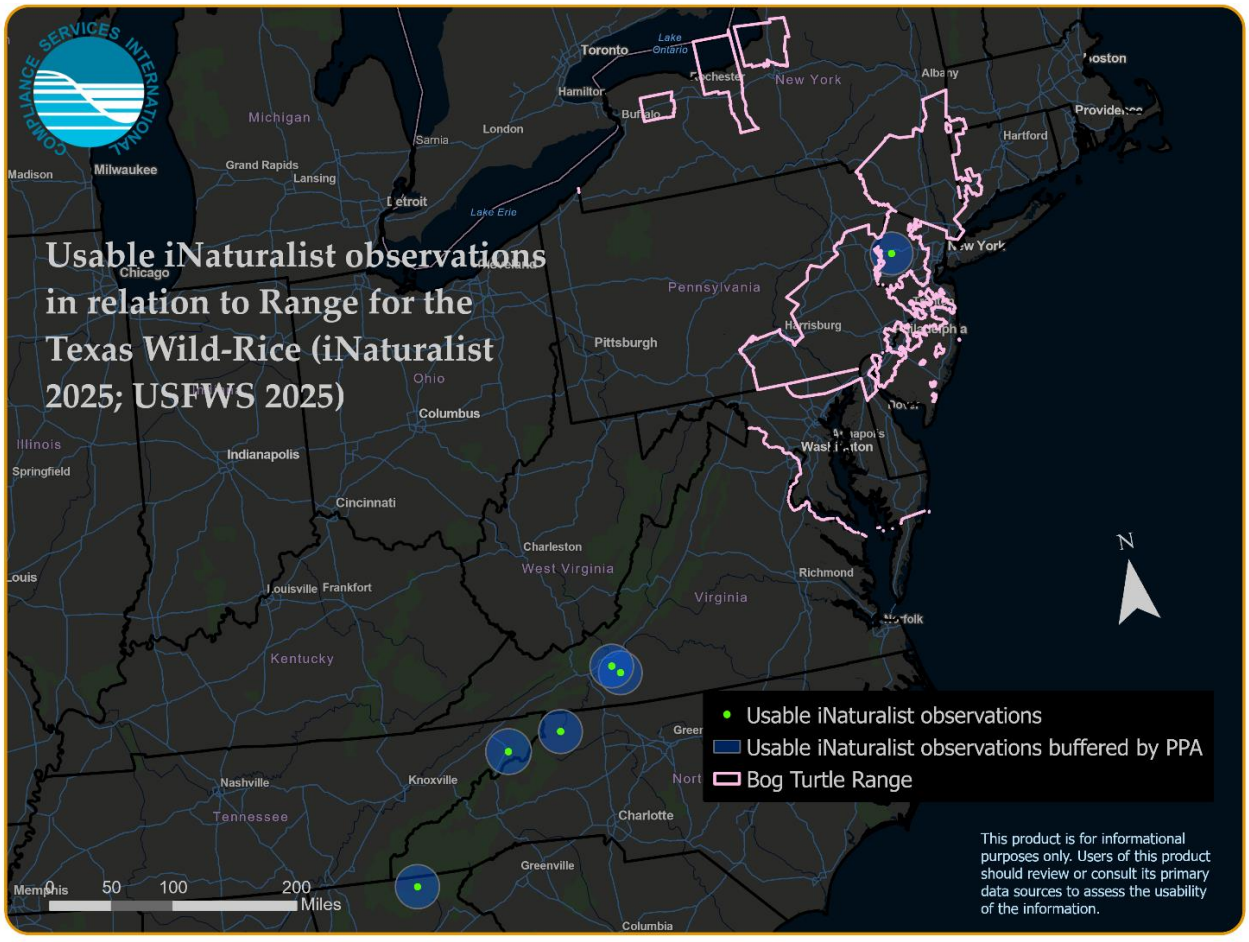

Figure 2. Usable iNaturalist observations in relation to range for the bog turtle. Observations are buffered by public positional accuracy (iNaturalist 2025; FWS 2025).

- GBIF: https://www.gbif.org/species/2443122
    - The GBIF database was queried for the bog turtle using the same criteria as was used for iNaturalist and found to be the same six observations. Therefore, the GBIF database was not treated as a distinct dataset and did not contribute to the core map for this species (**Figure 3).**

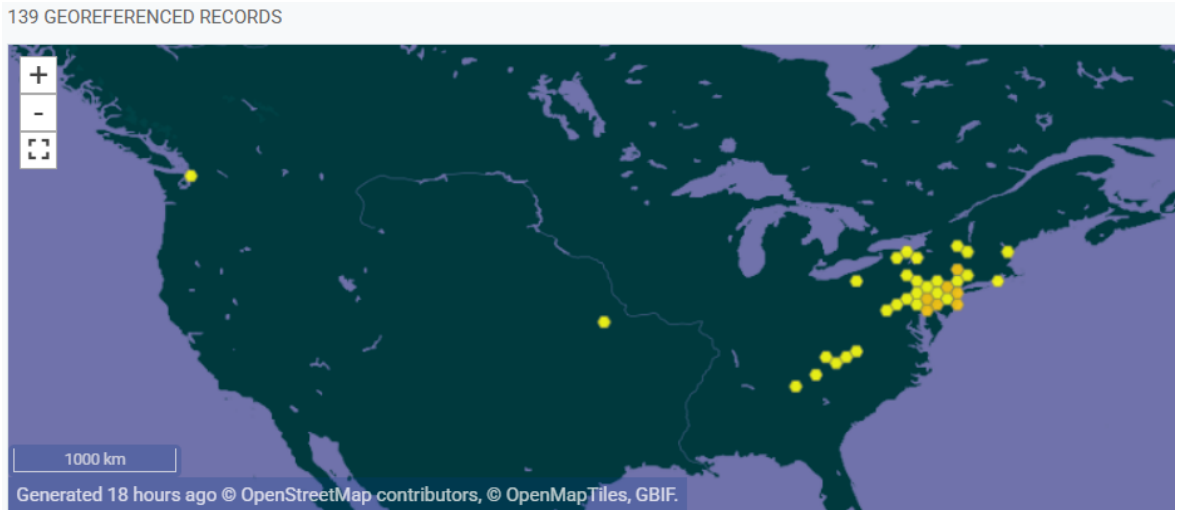

Figure 3. GBIF occurrences of the bog turtle.

- NatureServe Explorer: https://explorer.natureserve.org/
    - Available public EO information from NatureServe Explorer is consistent with the areas identified in GBIF. Compliance Services International considered the use of public EOs for core map development but ultimately decided that range would better represent an outer extent for the core map.

Appendix 2. GIS Data Review and Method to Develop Core Map

The core map for this species is based on biological information, which includes the habitat used by this species found within a spatial extent of range. The core map identifies all areas within the range matching its habitat description provided in **Appendix 1** (FWS 2025b). The NWI dataset is regarded as a high quality national-level dataset that is appropriate to identify aquatic habitat for reptile species such as the bog turtle. Relevant water body type selections were limited to waters within the range of the species. A 300-ft buffer was added to the selected water bodies, based on biological information. Following this, NLCD emergent herbaceous wetlands with less than 50% canopy cover were isolated and comprised the interim core map shown in **Figure 1** of the main document.

1. References and Software

- National Wetlands Inventory: https://www.fws.gov/program/national-wetlands-inventory.
- USA NLCD Land Cover: https://www.arcgis.com/home/item.html?id=3ccf118ed80748909eb85c6d262b426f
- USA NLCD Tree Canopy Cover: https://epa.maps.arcgis.com/home/item.html?id=f2d114f071904e1fa11b4bb215dc08f3
- Software used: ArcGIS Pro version 3.2 (for NWI refinement) and version 3.5 (for NLCD refinement).
- EPA Modified Cultivated Layer: https://cdn.arcgis.com/home/item.html?id=159e70ce4c284f5b972c687037f8a668.
- FWS Species Range: https://ecos.fws.gov/ecp/species/6962.

2. Datasets Used in Core Map Development

2.1. Range

The range for this species was last updated on July 1, 2024. A shapefile including species range for all listed species was downloaded from the FWS ECOS website on Jan. 24, 2025. The shapefile was converted to a feature class stored in a file geodatabase and reprojected to WKID #4269 (“North America Albers Equal Area Conic”).

1. Using an ArcGIS Web Map the species was queried based on the ECOS listed “Entity ID” of 182 and exported as a feature class to a temporary file geodatabase as a standalone Entity ID-specific layer.
2. The area of the range was calculated automatically by loading it into the software (ArcGIS Pro version 3.2) and reading its area from the attribute table (“Shape_Area”), then converting its units (square meters) into acres with a conversion rate of 0.000247105.
3. This shapefile was added to an ArcGIS Pro map and compared against the available known locations from the GBIF, iNaturalist, and NatureServe databases.

2.2. National Wetlands Inventory

The NWI dataset was preliminarily vetted to determine its appropriateness in representing aquatic areas matching descriptions of the bog turtle habitat. The bog turtle inhabits palustrine waters that are not forested; these were selected in the NWI dataset using a SQL query: ATTRIBUTE LIKE 'P%' And ATTRIBUTE NOT LIKE '%FO%' (FWS 2013).

The NWI is publicly available as state-level downloads. The state-level NWI datasets were downloaded for each state intersecting the species range (MA, MD, NJ, NY, PA, VA, and VT), merged into a single layer, and

clipped to species range. The resulting attribute table was examined for different wetland types relevant to the bog turtle. Additionally, a 300 ft buffer was added to the selected water bodies, based on species-specific habitat information provided in the Species Status Assessment (FWS 2022b):

> "The 300 m distance in the definition of "population" is the potential travel distance that bog turtle may take to seek other wetlands with core habitat. This should not be confused with the 300-foot buffer described in the Service's 2001 (pp. A1-A3) Conservation Zones guidance that is a protective upland vegetative area surrounding an individual wetland containing core bog turtle's habitat."

While individuals can travel distances up to 300 m, most individuals remain within the same wetland for nesting (FWS 2022b):

> "Unlike most other semi-aquatic turtles, the bog turtle does not leave its wetland habitat and travel to dry, upland areas to lay eggs…Bog turtles in southeastern New York and western Massachusetts displayed fidelity to nest-site areas (coarse-scale nest-site fidelity) as 100% of females returned to the same nest-site area the second year they were observed nesting (Macey 2015, p. 30). Zappalorti et al. (2015, p. 578) also observed nest fidelity in females at wetlands in Pennsylvania and New Jersey and Byer et al. (2018, p. 231) observed this at two individual populations in Maryland."

While individuals can disperse for hibernation, most individuals hibernate within the upland habitat directly adjacent to the wetland (FWS 2022b):

> "Small clumps of woody vegetation within an open emergent wetland may be preferred as hibernating spots, potentially because these locations have several desirable features, including root structures, spring flow, and solar exposure. Eichelberger (2005, p. 24) found that all of 10 tracked turtles hibernated in a swamp forest in the root balls of large white pines. Ernst et al. (1989, p. 762) found five juvenile bog turtles hibernating at the base of a cedar stump while the adults hibernated in a different location approximately 40 m (131 ft) away. Bog turtles have also been found hibernating in the root networks of reed canary grass (Gress 2008, unpublished data; Brookens 2020b, pers. comm.). Bog turtles are often found partially to completely buried in mud and water (Ernst et al. 1989, p. 761)."

Given the high fidelity to individual wetlands for nesting and limited dispersal to hibernation sites within the upland habitat adjacent to the wetlands, 300 ft. was deemed protective of "core bog turtle's habitat" and was therefore added to the selected water bodies.

3. Creating the Core Map

3.1. Defining Extent

The core map for the bog turtle was developed using the species range as the basis for the species extent as follows:

1. Load a layer of all FWS species ranges in the preferred projection (WKID #4269). Subsequent layers should also be outputted to this projection.
2. Use the Select by Attributes tool to select just the population of interest using this SQL query: ENTITY_ID IN (870).
3. Export the selected feature from the species ranges as a standalone layer representing the bog turtle northern population range, saved as "BT_range". This represents the core map extent.

3.2. Refinement based on Biological Information

The total extent of the bog turtle range includes a significant area and number of different land cover types

that do not align with descriptions of bog turtle habitat. To improve confidence in the core map, a refinement based on biological information was applied to the extent.

National Wetlands Inventory Steps

The NWI spatial layer was used as a refinement of the core map area as follows:

1. Download the state-level dataset of the NWI dataset for each of these states: DE, MA, MD, NJ, NY, PA, VA, and VT.
2. Use the Merge tool to merge the state-level layers from the previous step into a single layer, "NWI_merge".
3. Use the Pairwise Clip tool to clip the previous layer "NWI_merge" by the species range ("BT_range") and save as a new layer, "NWI_merge_pcRange".
4. (Optional) Delete the "NWI_merge" layer from the geodatabase. This was done to reduce file size and facilitate geoprocessing and file transfer and is not necessary to develop the core map.
5. Use the Select by Attributes tool to select the wetland types relevant to the bog turtle (palustrine waters that are not forested) from the previous layer ("NWI_merge_pcRange") using the following SQL query: ATTRIBUTE LIKE 'P%' And ATTRIBUTE NOT LIKE '%FO%'. Export as a standalone layer, "NWI_merge_pcRange_selnoFO".
6. Use the Pairwise Dissolve tool to dissolve selections from the previous layer ("NWI_merge_pcRange_selnoFO") into a single feature, named "NWI_merge_pcRange_selnoFO_pd".
7. Use the Pairwise Buffer tool to buffer the previous layer by 300 ft. Select the option to dissolve output features into a single shape. Save output layer as "NWI_merge_pcRange_selnoFO_pd_pb300ft".
8. Use the Pairwise Clip tool to clip the previous layer ("NWI_merge_pcRange_selnoFO_pd_pb300ft") by the species range ("BT_range") and save as a new layer "NWI_merge_pcRange_selnoFO_pd_pb300ft_pcRange".

National Land Cover Database (NLCD) Steps

9. Add the NLCD (link cited under Section 1 of this appendix) to the map project
10. Right click on the NLCD layer in the "Contents" pane of ArcGIS Pro, and use the dropdown menu to "Export Raster," setting the clip area as the output of step 8.
11. Once the extent of the NLCD has been limited to the extent of the NWI-refined species area, run the tool "Raster to Polygon," ensuring that ClassName is indicated as the field of interest in the tool.
12. Once the data have been vectorized, complete the following "Select by Attribute" query to isolate only the habitat areas used by the bog turtle, the expression should be: Where ClassName is equal to Emergent Herbaceous Wetlands.
13. Export the selected data as its own layer, named BT_NLCDtype.
14. From there, determine if additional areas of unsuitable canopy cover can be removed by using the NLCD Tree Canopy Cover layer to the map project, linked under section 1 of this appendix.
15. Limit the NLCD Tree Canopy Cover layer to the extent of the output from step 13 (export raster or clip raster may be used), and run the "Raster to Polygon" tool with ClassName as the field of interest.
16. Select by less than 50% canopy cover using "Select by Attributes" in order to capture the open canopy habitat the bog turtle prefers, just in case the NLCD removal of forests from step 12 did not remove all the areas with dense vegetation. The expression should be: Where ClassName is equal to 0-1% Or Where ClassName is equal to 1-25% Or Where ClassName is equal to 25-50%.
17. Simplify the layer using the "Dissolve" tool (otherwise, there will be thousands of unnecessary

objects that may take forever to draw. Dissolving brings it down to one object).

18. EPA has developed and published its own cultivated layer for use in core map development as a potential refinement of extent. For the bog turtle, the species' distribution is widespread and it can be found near agriculture, but it's not found on-field. Consequently, EPA's cultivated layer was considered to be erased from the interim core map following the smoothing process described in Appendix 4 page 72 of the core map process documentation, but it proved unnecessary in this case since the NLCD habitat refinement already removed cultivated lands.
19. Export the previous layer from step 18 as a new layer with a file name recognizable as the core map of the bog turtle, "Bog Turtle Core Map.gdb" and "Interim_Core_Map." This new layer is featured in Figure 1 of the main document.

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