

Bog Turtle
(*Glyptemys muhlenbergii*)
5-Year Review:
Summary and Evaluation



Photo Credit: Maryland Dept. of Natural Resources

U.S. Fish and Wildlife Service
New York Field Office
Cortland, New York
August 2022

5-YEAR REVIEW

Species Reviewed: Bog Turtle (*Glyptemys muhlenbergii*) Northern Population

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5-YEAR REVIEW

Bog Turtle [Northern Population] (*Glyptemys muhlenbergii*)

GENERAL INFORMATION

Agencies, Partners, and Experts Consulted

Lead Regional Office: Northeast Region, Martin Miller, 413-253- 8615, martin_miller@fws.gov

Lead Field Office: New York Field Office, Noelle Rayman-Metcalf, 607-753-9334, noelle_rayman@fws.gov; Robyn Niver; Sandra Doran; Ian Drew; Arianna Ramirez

Cooperating Field Offices:

- Asheville Field Office – Sue Cameron
- Chesapeake Bay Field Office – Julie Slacum
- New England Field Office – Eliese Dykstra
- New Jersey Field Office – Alicia Protus
- Pennsylvania Field Office – Pam Shellenberger, Alison Whitlock

Cooperating States:

- Connecticut Department of Energy and Environmental Protection – Michael Ravesi
- Delaware Division of Fish and Wildlife – Nathan Nazdrowicz
- Maryland Department of Natural Resources – Scott Smith, Beth Schlimm
- Massachusetts Division of Fisheries and Wildlife – Michael Jones
- New Jersey Division of Fish and Wildlife – Brian Zarate, Bill Pitts
- New York State Department of Environmental Conservation – Dan Rosenblatt, Kathy O'Brien, Lisa Masi, Lisa Pipino
- Pennsylvania Fish and Boat Commission – Chris Urban, Kathy Gipe, Lori Erb (contractor)

Partners provided data and input into the methodology of the analyses, provided expert opinion when needed, and/or provided comments on this 5-Year Review.

Species: Bog turtle (*Glyptemys muhlenbergii*)

Northern Population (Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania); Distinct Population Segment

Date listed: November 4, 1997

FR citation(s): 62 FR 59605

Classification: Threatened

4(d) rule: Under 50 CFR 17.31, all of the provisions of §17.21, except § 17.21(c)(5), apply to the threatened northern population of the bog turtle.

Critical habitat: The Service found that proposing critical habitat for the bog turtle was not prudent due to ongoing risk of collection.

Similarity of appearance/4(d) rule: The southern population is treated as a threatened species due to similarity of appearance under section 4(e) of the Endangered Species Act (ESA), and there is a 4(d) rule for this population that excepts all incidental take.

Methodology Used to Complete the Review: In accordance with section 4(c)(2) of the ESA, the purpose of a 5-Year Review is to assess each threatened and endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. The U.S. Fish and Wildlife Service (Service) evaluated the biology and status of the northern population of the bog turtle (hereto referred simply as the bog turtle) as part of an interim (or phases 1 and 2) Species Status Assessment (SSA) to inform this 5-Year Review. Phases 1 and 2 cover the biological and threats information, and the historical and current condition of the species. Phase 3, assessing the species' future condition and viability, will be completed in the near future to aid in possible Recovery Plan revisions and will culminate in a final SSA report. The lead biologist (Noelle Rayman-Metcalf, New York Field Office) and endangered species biologist (Robyn Niver, New York Field Office) led a team of biologists from States and Service field offices across the bog turtle's northern range through phases 1 and 2 of the SSA process. We summarized the results of the interim SSA in a Biological Report (Service 2022, entire), which represents our evaluation of the best available scientific and commercial information, including individual, population, and species needs and the current condition of the species. Additional State and Service biologists reviewed sections of the Biological Report and this document. This is the first 5-Year Review for the bog turtle since its listing in 1997.

FR Notice citation announcing the species is under active review: 83 FR 39113 (August 8, 2018)

REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) Policy: The northern population of the bog turtle was listed as a threatened species in accordance with the 1996 DPS Policy (61 FR 4772). A 250-mile gap distinguishes the northern from the southern population and is thought to be a result of Pleistocene and post-Pleistocene climatic changes (FR Vol. 62 No. 213 pp. 59605–59623 in Lee and Norden 1996). There is no new information to suggest that the northern population of the bog turtle is not a DPS.

Recovery Criteria

Recovery Plan: U.S. Fish and Wildlife Service. 2001. Bog Turtle (*Clemmys muhlenbergii*), Northern Population, Recovery Plan. Hadley, Massachusetts. 103 pp. See: <https://www.fws.gov/node/68066>

To assess the current status of the species, it is helpful to describe its biological condition in terms of the conservation principles of resiliency (ability of species/populations to withstand stochastic events, which is measured in metrics such as numbers, growth rates), redundancy (ability of a species to withstand catastrophic events, which is measured in metrics such as number of populations and their distribution), and representation (variation/ability of a species to adapt to changing conditions, which may include behavioral, morphological, genetics, or other variation), collectively known as the three Rs. To address the three Rs, the Service has developed a recovery program that focuses on addressing the primary threats and maintaining healthy populations across five recovery units (RU) – Delaware, Hudson-Housatonic, Outer Coastal Plain, Prairie Peninsula-Lake Plain, and Susquehanna-Potomac.

The Recovery Plan states the following four criteria as targets for delisting:

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*

¹ The term “protection” was not defined in the Service’s 2001 Recovery Plan; however, there are four recovery tasks that help address this criterion using “existing regulations” (Service 2001, p. 45) and are as follows: 1) adequately screen projects/permits that may affect bog turtles and their habitat (sub-tasks: map contiguous habitat; map/identify watersheds or wetland systems of occurrence; include all extant bog turtle sites on state freshwater wetland maps; ensure that adequate screening tools are used so that projects that may affect bog turtles are identified early in the planning process); 2) improve the effectiveness of regulatory reviews in protecting bog turtles and their habitats, specifically to address agencies working at cross purposes when permitting activities in wetlands (sub-tasks: identify project/permit categories that may adversely affect bog turtles and their habitat; train appropriate Federal, state, and local agency staff in the recognition of bog turtle habitat, and threats to the species and its habitat; 3) avoid and minimize direct and indirect adverse effects to bog turtles and their habitat; and 4) consider amending and/or clarifying the scope of state and municipal regulatory protections afforded to bog turtles and their habitat.

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.

Table 1. Recovery targets (PASs per recovery unit; table 5 in Recovery Plan (Service 2001, p. 42).

Recovery Unit	Extant PAS	Recovery Objective	Subunits	Extant Subunit PAS	Subunit Objective
Prairie Peninsula/ Lake Plain	4	10	New York	4	≥2
			Pennsylvania	0	≥2
Outer Coastal Plain	3	5	--	--	--
Hudson/Housatonic	87	40	Hudson	26	≥10
			Housatonic	20	≥10
			Wallkill	41	≥10
Susquehanna/Potomac	92	50	Potomac	5	≥3
			Susquehanna West	69	≥30
			Susquehanna East	28	≥10
Delaware	164	80	Delaware West	48	≥20
			Delaware East	116	≥40
TOTAL	350	185	--	--	--

- Prairie Peninsula-Lake Plain Recovery Unit:** *Conclusively determine the presence of any remnant bog turtle populations at historical sites and in suitable wetland habitats within watersheds of historical occurrence. Based upon these data, restore and maintain the geographic range of the species by protecting no fewer than 10 viable bog turtle populations and sufficient habitat to ensure the sustainability of those populations. If an insufficient number of extant sites is found during surveys, the*

reintroduction of turtles into suitable habitats should be considered to meet these targets. To meet the recovery criterion of 10 protected populations (and sufficient habitat²) for this unit, no fewer than 2 populations should be protected/established in each of the states (New York, Pennsylvania) within the unit.

- **Outer Coastal Plain Recovery Unit:** *Protect five viable bog turtle populations and sufficient habitat to ensure the sustainability of these populations.*
 - **Hudson-Housatonic Recovery Unit:** *Protect 40 viable bog turtle populations and sufficient habitat to ensure the sustainability of these populations, including at least 10 populations in each of the following subunits: the Wallkill River watershed, the Hudson River watershed, and the Housatonic River watershed.*
 - **Susquehanna-Potomac Recovery Unit:** *Protect 50 viable bog turtle populations and sufficient habitat to ensure the sustainability of these populations. This recovery unit is divided into the following subunits: (1) Potomac (consisting of the Potomac River watershed), (2) Susquehanna West (consisting of the Susquehanna watershed west of the Susquehanna River), and (3) Susquehanna East (consisting of the Susquehanna watershed east of the Susquehanna River, including sites draining directly to the Chesapeake Bay). To meet the recovery criterion for this recovery unit, at least 3 populations must be protected in the Potomac subunit, at least 30 in the Susquehanna West subunit, and at least 10 in the Susquehanna East subunit.*
 - **Delaware Recovery Unit:** *Protect 80 viable bog turtle populations and sufficient habitat to ensure the sustainability of these populations. This recovery unit is divided into the following subunits: (1) Delaware West (consisting of the Delaware River watershed west of the Delaware River, which occurs in Pennsylvania and Delaware), and (2) Delaware East (consisting of the Delaware, Raritan and Manasquan River watersheds in New Jersey). To meet the recovery criterion for this unit, at least 20 populations must be protected in the Delaware West subunit and at least 40 in the Delaware East subunit.*
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.*

² The wording “and sufficient habitat” was not included for the Lake Plain/Prairie Peninsula Recovery Unit in the Recovery Plan as it was for the other four recovery units. The Service assumes the omission was in error and has added it here parenthetically.

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.*
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.*

Criterion 1 has not been met. The Recovery Plan used a protocol known as the "Standardized Bog Turtle Site-Quality Analysis" to assess the capacity of sites to maintain viable populations of bog turtles (Service 2001, pp. C1–C8). This protocol grouped bog turtle occurrences into PASs based on the likelihood of turtles moving between documented occurrence locations and interbreeding. Under this rubric, each PAS linked individual bog turtle occurrences into larger groupings based upon a number of factors including proximity and lack of impediments to turtle movement. Due to widespread wetland habitat fragmentation, many PASs consisted of only one small extant occurrence, often isolated from other such occurrences. This approach recognized that the ecologically functional unit of the bog turtle is the metapopulation rather than an individual site occurrence.

The PAS methodology for assessing viability was complex and inconsistently applied and has since been replaced with a new population-ranking methodology for planning purposes in the Conservation Plan (Erb 2019, entire). This now allows for clear and consistent application across the northern range. States developed this new ranking methodology for assessing populations and habitat consistently across the northern range using the following updated definitions for population and metapopulation and data collected from a regional monitoring program initiated in 2014:

- a **population** is defined as a functionally reproductive group of individuals (e.g., at least one individual from each sex or evidence of reproduction such as presence of a hatchling or juvenile) using one or more core habitat areas³, which are within 300 m⁴ (984 ft) of each other, with no major barriers between them. Movement between core habitat patches likely occurs every 1 to 10 years.
- a **metapopulation** is defined as a group of populations with genetic exchange feasible through occasional dispersal events. Populations are close enough to each other to allow

³ Core habitat is defined as an area that meets bog turtle suitable habitat requirements where turtles are most frequently found. Multiple core habitat areas may be found within a single delineated wetland but may cross multiple landowner parcels. Additional details on suitable habitat requirements can be found at:

<https://www.fws.gov/media/guidelines-bog-turtle-surveys-phase-1-and-2-surveys>

⁴ The 300 m distance in the definition of "population" is the potential travel distance that bog turtles 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 habitat.

occasional movements within one generation time (10 to 40 years) of an individual: less than 3 km (1.8 mi) of contiguous wetland, less than 2 km (1.2 mi) of intermediate or mosaic upland-wetland habitat, or less than 1.5 km (0.9 mi) undeveloped upland habitat.

In this 5-Year Review, we present information, analyses, and conclusions based on the current definitions of population and metapopulation.

States have been working with conservation partners towards long-term protection of both core habitat and buffers. Erb (2019, pp. A10, B11, C9, D11, E12) estimates that 102 extant populations in the northern range have full and permanent protection of core habitat and 133 have full and permanent protection of both the core habitat and a 300-ft buffer (table 2). Fully protected populations are those where all landowner parcels that fall within the core habitat are protected in perpetuity by an easement or purchase by a conservation organization, as well as full or partial protection through an easement or purchase of a 300-ft buffer (as described in Service 2001, p. A2). Partially protected populations are those where both the core habitat and buffer are not fully protected by an easement or purchase by a conservation organization in perpetuity or where there is full protection in the core habitat and none in the buffer (Erb 2019, p. 11). Full and permanent protection of core habitat and a 300-ft buffer is critical in supporting habitat that may include essential dispersal, aestivation, and hydrological inputs. When buffers contain intact native vegetation, they are especially important to protect as they help preserve groundwater hydrology, and filter out road salt, sediment, pesticides, and nutrients before they enter the wetland.

Table 2. Recovery criteria and protection type by state and by recovery unit (per Erb 2019, pp. A10, B11, C9, D11, E12). Note: Recovery criteria are for PASs as defined in the Recovery Plan. We currently have protection information available for individual populations as described in the Conservation Plan.

	Recovery Criteria (from Recovery Plan)	Type of Protection (from Conservation Plan)				
State	No. of PASs Needed Towards Achieving Criterion 1	Full Permanent Protection⁵: Core Habitat	Full Permanent Protection: 300-ft Buffer	Partial Permanent Protection: Core Habitat	Partial Permanent Protection: 300-ft Buffer	Partial Temporary Protection⁶
DE		2	0	0	2	0
CT		1	0	1	4	0
MA		2	0	0	2	0
MD		15	4	33	62	0
NJ		32	7	32	26	0
NY		15	8	2	11	13
PA		35	12	34	62	2
Total		102	31	102	169	15
Recovery Unit						
Delaware	80	42	11	40	54	1
Hudson-Housatonic	40	28	9	18	28	12
Outer Coastal Plain	5	1	1	1	2	0
Prairie Peninsula-Lake Plain	10	5	3	0	2	1
Susquehanna-Potomac	50	26	7	43	83	1
Total	185	102	31	102	169	15

⁵ Fully protected populations are those where all landowner parcels that fall within the core habitat are protected in perpetuity by an easement(s) or a land purchase by a conservation organization, as well as full or partial protection through an easement(s) or land purchase of the buffer. Partially protected populations are those where both the core habitat and buffer are not fully protected by an easement(s) or land purchase in perpetuity or where there is full protection in the core habitat and none in the buffer, or the core habitat is fully protected and there is no protection in the buffer

⁶ Partial temporary protection is not defined in the Conservation Plan, but it is assumed these refer to agreements or easements where they are time-limited (e.g., the Service’s Partners for Fish and Wildlife Program habitat management 10-year agreements or 30-year Wetland Reserve Easements through the Natural Resources Conservation Service.).

Criterion 2 has not been met. The 25-year monitoring period has not been triggered for any bog turtle wetland at the time of this review. As stated previously, a population and habitat monitoring program was initiated in 2014, where States developed protocols for consistency in collecting data, to track population and habitat trends, and to work towards meeting this criterion over time. Coinciding with the protocols was the development of a regional database, maintained by the Service, to house the data being collected. Monitoring surveys can consist of rapid assessments where three visual or tactile surveys are conducted within a survey year or intensive sampling can be done consisting of additional visual or tactile surveys, live trapping, nest surveys, or radio telemetry. Approximately 60 populations are targeted for rapid assessments for this criterion, spanning the 3 major recovery units (Delaware, Hudson-Housatonic and Susquehanna-Potomac), totaling 20 per recovery unit. Two or more populations in each of the three recovery units are targeted for intensive sampling. States are encouraged to add additional populations to the monitoring rotation if staff, funding, and time allows. States began surveying these populations in 2014, and a subset of the 60 populations is scheduled for monitoring over the next few years.

Criterion 3 has not been met. The threat of collection at bog turtle wetlands has been a concern since the development of the Recovery Plan (Service 2001, p. 44) and remains a concern. The most recent known case occurred in August 2018 in the Village of Allegany, Cattaraugus County, New York, involving a private citizen that was in possession of over 300 northeast native turtles of multiple species, including 17 bog turtles. It is unknown at this time where the bog turtles were originally collected from. Additional cases of purported poaching have anecdotally been reported over the last 40 years⁷ by Erb (2019, pp. A7, B8, C7, D8, E8) in five different RU's. Refer to Chapter 3 of the Biological Report (Service 2022, pp. 43–67) for more information.

Criterion 4 has not been met. Since the development of the Recovery Plan, States and other conservation partners have made significant strides to better understand the habitat needs of bog turtles and how to manage habitat and other threats. However, populations are still facing many threats (see Chapter 3 in Service 2022, pp. 43–58) that make it difficult to successfully manage populations and habitat.

Habitat loss or alteration is the primary current threat to bog turtle populations (Service 2022, p. 46). We have a good understanding of how to set back plant succession, control native and invasive plant species that create monocultures, and utilize livestock grazing to promote open canopy core habitats (Service 2019, entire). In addition, there are some hydrology studies by Feaga (2010, entire) and Feaga *et al.* (2012, entire; 2013, entire) in the southern population, and the Natural Resources Conservation Service (NRCS) is conducting additional hydrology monitoring at northern population sites that started in spring 2021. However, we lack scientific knowledge and clear guidance on how to restore and protect existing hydrology effectively at sites or to evaluate potential effects to bog turtles and their habitat from upland activities that may alter hydrology.

⁷ In most cases, the exact date of a purported poaching event could not be determined as the majority of bog turtle field surveys are not conducted on an annual basis. Dates that are stated in the reference are estimates of when state biologists thought a poaching event occurred based on the last date a field survey was completed. In other cases, no estimated date could be given due to lack of information in field records.

While addressing this criterion has been underway for many years now, it will take significantly more resources to achieve the goal of better understanding long-term habitat dynamics and getting threats under control.

The recovery criteria require revision. The current recovery criteria address primary threats, which are still relevant. However, we have modified our definition of “population” and “metapopulation” to have greater consistency with data collection, which will ultimately help states better track the condition and viability of bog turtles over time. More importantly, the current criteria do not explain when a population or metapopulation is considered healthy or what constitutes species viability rangewide, and so criteria are not objective and measurable.

Updated Information and Current Species Status

Biology and Habitat

Since the bog turtle was listed, research and field observations have yielded new information regarding its biology and life history and points relevant to the species status are highlighted below. Refer to the Recovery Plan (Service 2001, pp. 1–39) and Chapter 2 in the Biological Report (Service 2022, pp. 16–42) for more information.

Taxonomic classification or changes in nomenclature

Since the bog turtle was listed as a threatened species, there has been a change in taxonomy. Originally under the genus *Clemmys*, the bog turtle was placed under a new genus, *Glyptemys*, after advances in genetic sequencing revealed it is more closely related to the wood turtle (*Glyptemis insculpta*) than to the spotted turtle (*Clemmys guttata*) (Crother *et al.* 2003, p. 203). This change in taxonomy has been accepted by professional herpetological organizations and was recognized and changed by the Service in the Code of Federal Regulations on October 15, 2021 (86 FR 57373). Refer to section 2.2 in the Biological Report for more information (Service 2022, p. 16).

Genetics, genetic variation, or trends in genetic variation

There is limited genetic variability in bog turtle populations. Amato *et al.* (1997, entire) evaluated mitochondrial DNA (mtDNA) variation in 20 individuals from northern and southern populations. While they found almost no mtDNA variability in a gene that was found to be phylogenetically informative for wood and spotted turtles, they acknowledged that these preliminary data using a small sample size should not be used in any conservation decisions for the species range-wide. Alternatively, Rosenbaum *et al.* (2007, entire) found that although there is low rangewide and regional genetic diversity overall, there are distinct differences between northern and southern populations within mtDNA. Using 15 microsatellite loci, Shoemaker and Gibbs (2013, pp. 326–327) found that among 234 bog turtles from 2 sites in New York and 8 sites in Massachusetts, there was no evidence of previous bottleneck events. Refer to section 2.3 in the Biological Report for more information (Service 2022, pp. 17–18).

Habitat

Throughout their life cycle, bog turtles occupy wetlands, including shallow, spring-fed fens; sphagnum bogs; swamps; marshy meadows and pastures that have soft, muddy bottoms; and clear, cool, slow-flowing water, often forming a network of rivulets and open canopies. Bog turtles use wetlands with low-growing vegetation such as native sedges, grasses, forbs, scattered shrubs on perennially saturated mucky, and lower-strength soils (Carter *et al.* 1999, p. 858; Feaga *et al.* 2013, p. 410). Bog turtles rely on grazers, beavers, fire, and periodic wet years to maintain a dynamic system that allows for the natural or managed creation of open habitat and microhabitats (Service 2001, pp. 12–13).

Core habitat is generally found within a portion of a wetland and is typically small, with a range of less than 0.81 ha (2 ac) to over 3.24 ha (8 ac) (Erb 2019, unpublished data). Although information on the relationship between core habitat size and bog turtle population size is lacking rangewide, one study found that bog turtle abundance estimates are positively correlated with estimated core fen area (Shoemaker *et al.* 2013, p. 5).

Bog turtles have also been documented in atypical habitat, such as in ponds, lakes, or man-made structures like pipes or ditches (Miller 2019, p. 31; Brookens 2020, pers. comm.; Torocco 2020, pers. comm.). Occasionally, bog turtles are found hibernating in roadside or agricultural ditches that lack root structures or other covering vegetation but provide the flowing water necessary to avoid freezing (Torocco 2020, pers. comm.). Upland habitat may be used by bog turtles for hibernation, transportation between core wetlands, or refuge from high temperatures. Roos and Maret (2018, p. 36) found that bog turtles were more abundant in upland areas closer to core wetland habitat than in farther upland areas.

Geography, elevation, and weather influence the incubation period and affect hatching success of bog turtle eggs (Tryon 2009, p. 4). Egg position in nests and the surrounding environment can also affect development rate and duration, hatchling turtle sex ratios, phenotype, and growth rate (Zappalorti *et al.* 2015, p. 573). Bog turtles typically nest on elevated sites, such as tussocks, clumps of grasses or sedges, moss-covered stumps, in *Sphagnum* moss; nesting near jewelweed (*Impatiens* sp.), sensitive fern (*Onoclea sensibilis*), or narrow-leaved cattail (*Typha angustifolia* L.) has also been observed (Zappalorti *et al.* 2015, p. 576). High nest elevation prevents flooding mortality, although nests have been observed near the water's surface (Whitlock 2002, p. 54). Female bog turtles have been documented returning to their prior nesting sites, suggesting high nesting fidelity (Macey 2015, p. 30). Refer to section 2.7.1 in the Biological Report for more information (Service 2022, pp. 24–29).

Additional life history information can be found in Chapter 2 of the Biological Report (Service 2022, pp. 16–42).

Abundance, Population Trends, Demographic Features and/or Trends

At the time of listing, the bog turtle was thought to be extant in 191 individual populations in 7 states (Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, and Pennsylvania) in the northern range of the species. Since the species was listed, progress has been made in finding new bog turtle wetlands (primarily in Pennsylvania) and managing the

primary threat of habitat loss or alteration from altered hydrology and changes to vegetation (succession and invasive plants). We are now aware of 330 extant bog turtle metapopulations (table 3; using the new definition of population and metapopulation from the Conservation Plan [Erb 2019, pp. xi, xii]), which includes both connected populations, as well as isolated individual populations (no connectivity to other populations currently, but likely were once part of a metapopulation). In other words, there are 330 bog turtle metapopulations across the 5 recovery units; 106 of these are metapopulations comprising multiple populations, and 224 of these are single isolated populations (table 3). Thirty-seven additional individual populations are considered historical as bog turtles have not been found in these populations for at least 30 years; however, state biologists consider these as likely to be extirpated. Finally, 40 additional individual populations are considered extirpated (suitable habitat is no longer present) across the range. Pennsylvania is the only state in the northern range where new populations are regularly being discovered, while the distribution in the rest of the northern range is stable.

Although there is a positive trend in the discovery of new extant individual populations, the number of these populations is not directly comparable from the 1997 listing decision (considered wetlands) or the 2001 Recovery Plan definition of PAS.

Table 3. The number of populations and metapopulations in each state and recovery unit using the current definitions of population and metapopulation (Erb 2019, pp. xi, xii).

Recovery Unit	State	Number of Individual Populations	Number of “Metapopulations” (whether made up of single population or multiple populations)
Delaware	DE	3	2
Delaware	NJ	95	59
Delaware	PA	130	101
Subtotal		228	162
Hudson-Housatonic	CT	3	3
Hudson-Housatonic	CT/NY	2	1
Hudson-Housatonic	MA	2	2
Hudson-Housatonic	NJ	62	28
Hudson-Housatonic	NY	55	32
Subtotal		124	66
Outer Coastal Plain	NJ	3	3
Subtotal		3	3
Prairie Peninsula-Lake Plain	NY	5	5
Subtotal		5	5
Susquehanna-Potomac	MD	92	50
Susquehanna-Potomac	PA	56	44
Subtotal		148	94
Total		508	330

To assess resiliency, we identified 6 metrics (see section 4.3 Current Condition of the Biological Report and table A2 [Service 2022, pp. 70–76, 96]):

Demographic needs included 3 condition metrics:

1. sufficient number of adults (population size),
2. sufficient recruitment and age structure (recruitment), and
3. interconnectedness (part of a metapopulation with other populations of large size).

Habitat needs included 3 condition metrics:

1. suitable soils and associated vegetation for all life stages (lack of succession),
2. suitable soils and associated hydrology for all life stages (hydrology), and
3. intact upland buffer (lack of development).

Of the known extant metapopulations across recovery units, a range of 21–98 metapopulations have good resiliency (6–30 percent) and should be able to continue to respond to environmental stochasticity. The remaining metapopulations are considered to have fair to poor resiliency due to their small population size or degradation of habitat and/or isolation; 87–166 metapopulations have fair resiliency (26–50 percent), and 66–222 metapopulations have poor resiliency (20–67 percent; see figure 4.4 [table A27] in the Biological Report [Service 2022, pp. 75, 127]). Many of these populations (not considered metapopulations if no connectivity) have the potential for higher resiliency in the future if habitat was restored and managed. Overall, we are aware of 127 habitat management projects conducted within the northern range as of 2019, but many are reported at the landowner parcel-level and may not include the entire individual population or metapopulation.

One conservation partner, the NRCS, has contributed significant resources since 2012 through their Working Lands for Wildlife (WLFW) Initiative to restore and protect wetland habitat to assist with bog turtle recovery in the northern range (Apodaca 2021). To date, the NRCS has approximately 100 habitat restoration projects and land protection easements where their biologists work directly with private landowners to protect parcels containing wetlands within an extant bog turtle population and adjacent uplands. Temporary easements can be for as great as 30 years and many other easements receive permanent protection, within the Service’s three Conservation Zones⁸ (Service 2001, pp. A1–A3). The NRCS has made protecting as much land as possible within each of these zones a high priority, especially within Zone 1.

See Appendix A in the Biological Report (Service 2022, pp. 123–140) for results by recovery unit and (pp. 94–123) for more information regarding the methodology used to assess resiliency.

⁸ The Service (2001, pp. A1–A3) developed three Conservation Zones for the bog turtle which includes the concept of upland buffers. Zone 1 is the entire wetland and not just the core bog turtle habitat. Zone 2 extends 300 feet from the entire wetland edge and Zone 3 includes the area up to a wetland drainage basin boundary or at least a half mile beyond Zone 2.

Spatial Distribution, Trends in Spatial Distribution, and/or Historic Range

Erb (2019, pp. 3–4) estimated a range reduction of 39 percent of the northern population within the past 30 years, with no discernable reduction since the time of listing. Figure 1 shows the historical/extirpated range of bog turtles in the northern population. Populations once occurred in a small portion of western Pennsylvania (Mercer and Crawford Counties) and in Philadelphia County. Within New York, isolated individual populations were once found in additional counties bordering Lake Ontario (Monroe and Wayne Counties), as well as in central New York (Onondaga, Otsego, and Tompkins Counties) and in eastern New York (Albany, Rensselaer and Warren Counties). Additional range contractions have occurred in Connecticut (Fairfield County), Delaware (New Castle), and New Jersey (Atlantic, Bergen, Camden, Cape May, Middlesex, and Passaic Counties).

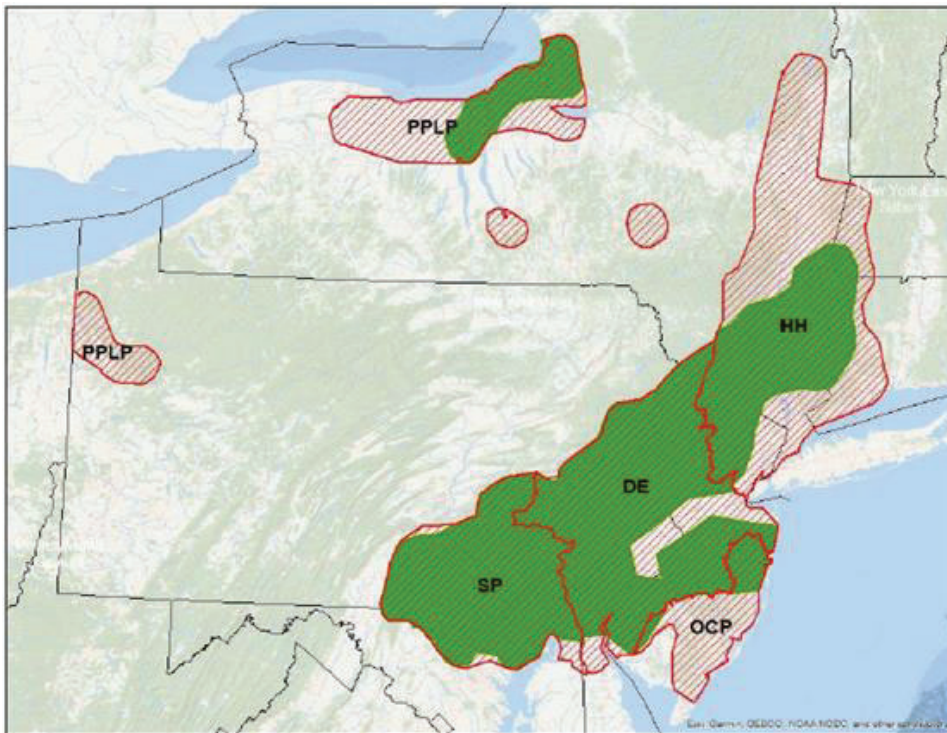


Figure 1. The historical (red hatch) and current (green) bog turtle northern population range including the Delaware (DE), Hudson-Housatonic (HH), Outer Coastal Plain (OCP), Prairie Peninsula-Lake Plain (PPLP), and Susquehanna-Potomac (SP) Recovery Units (from Erb 2019, p. 4).

Prior to listing, there were range reductions, with at least 40 individual populations extirpated (bog turtle wetlands no longer contain suitable habitat) and an additional 37 individual populations considered historical (no bog turtle observations within the last 30 or more years; of which the majority are likely extirpated) in the northern range (table 4). Most extirpations resulted from development that eliminated core habitat.

These range reductions resulted in a decline in the redundancy of populations across the northern range, also potentially reducing representation and reducing genetic variation. As stated previously, Pennsylvania is the only State in the northern range where new populations are regularly being discovered, while the distribution in other states in the northern range is stable. Within the last few years, 7 new sites have been found in new WBDHU12-level watersheds⁹ in Pennsylvania. Refer to sections 2.4 and 4.1 in the Biological Report for more information (Service 2022, pp. 18, 68–69).

Table 4. Historical and extirpated populations by state and recovery unit in the bog turtle northern population range.

State	Historical (Likely Extirpated) Populations	Extirpated Populations
CT	1	9
DE	4	1
MA	0	2
MD	4	10
NJ	2	0
NY	23	10
PA	3	8
Total	37	40
Recovery Unit		
Delaware	5	6
Hudson-Housatonic	24	18
Outer Coastal Plain	2	0
Prairie Peninsula-Lake Plain	0	3
Susquehanna-Potomac	6	13
Total	37	40

Threats Analysis (Threats, Conservation Measures, and Regulatory Mechanisms)

The purpose of a 5-Year Review is to recommend whether a listed taxon continues to warrant protection under the ESA and, if so, whether it should be reclassified (from threatened to endangered or from endangered to threatened). This task requires that the analysis of the threats to the species be performed while assuming that the species is not receiving the regulatory protections, funding, recognition, and other benefits of ESA listing. Summaries of ongoing applications of ESA protections may shed light on some future activities that constitute threats to the species. However, the analysis under Factor D (Inadequacy of Existing Regulatory Mechanisms) focuses on the adequacy of existing alternative (*i.e.*, non-ESA) mechanisms to address the continuing and foreseeable threats.

⁹ See the following link for Watershed Boundary Data for Hydrologic Units (WBDHU): <https://www.usgs.gov/national-hydrography/watershed-boundary-dataset>

Current threats to the bog turtle include: habitat loss or alteration from altered hydrology (*i.e.*, due to development, roads, beavers, agriculture) and changes in vegetation (*e.g.*, invasive species encroachment, vegetation succession, incompatible or lack of management) (Factor A); collection (Factor B); predation (Factor C); and inherent factors (*e.g.*, specialized habitat requirements, limited dispersal ability, small population sizes, delayed sexual maturity, road mortality, contaminants) (Factor E) (table 5). It is unclear if disease is a threat to the species at this time. Details regarding each threat can be found in the Biological Report (Service 2022, pp. 43–58).

Table 5. The factors currently influencing bog turtle viability at the individual- and metapopulation-levels.

Factor (A, B, C, D*, or E)	Factors affecting individual animals	Factors affecting multiple individuals - metapopulation level impacts
Habitat loss or alteration from (A): -altered hydrology (filling, draining, conversion of wetlands by humans or beaver, effects from development, roads, agriculture, precipitation changes) -vegetation changes (invasive species encroachment and vegetation succession)	X	X
Inappropriate habitat management (A) (direct impacts to individuals)	X	X
Collection/Poaching (B)	X	X
Predation (C)	X	X
Inherent factors (E)	X	X
Roads (E) (mortality and reduced dispersal)	X	?
Flooding (E) (direct impacts to individuals)	X	X
Disease (E)	?	?
Pollution/Contaminants (E)	X	X
Effects from climate change (E): -temperature extremes -changes in snowpack -changes in precipitation -saltwater intrusion	?	?
Conservation actions	X	X

*See *Future Threats if Not Listed under the ESA* section for more information.

Using the methodology adapted from Master *et al.* (2012, pp. 28–35) (table 6), we determined the current scope, severity, and impact level of the threats acting upon the bog turtle in table 6. Habitat loss or alteration (comprising both altered hydrology and changes to vegetation) is the greatest current threat to the bog turtle. This threat has a “high” impact level, as we estimate it is occurring throughout a “large” portion of its range and where it does occur, results in altered hydrology at sites that leads to negative changes in vegetation type (introduction of invasive plant species) and abundance (creation of native and invasive plant species monocultures), and increased succession. The interim SSA analyses indicate that 15 percent of metapopulations in the northern range have a high degree of woody vegetation and 46 percent have a moderate degree of woody vegetation; totaling 61 percent of metapopulations (Service 2022, p. 103). Likewise, 36 percent of metapopulations have a high level of hydrology disturbance and 34 percent have a moderate level of hydrology disturbance; totaling 70 percent (Service 2022, p. 105). These two threats may do irreversible damage, if not managed, as bog turtles can lose habitat used for feeding, breeding, and sheltering. The majority of these degraded metapopulations had poor to fair resiliency scores, and even some metapopulations with good resiliency scores had a moderate to high level of impact from succession and hydrology

disturbance indicating a serious magnitude of severity. See sections 3.2 in the Biological Report for more detail (Service 2022, pp. 46–51).

Table 6. Comparative threat assessment criteria and definitions (adapted from Master *et al.* 2012).

SCOPE (% OF RANGE)	Severity (Population Decline)			
	Slight (1–10%)	Moderate (11–30%)	Serious (31–70%)	Extreme (71–100%)
SMALL (1-10%)	Low	Low	Low	Low
RESTRICTED (11-30%)	Low	Medium	Medium	Medium
LARGE (31- 70%)	Low	Medium	High	High
PERVASIVE (71-100%)	Low	Medium	High	Very High

Roads can result in direct mortality of vehicle-struck individuals and create barriers that affect dispersal of individuals to other nearby wetlands. However, Myers and Gibbs (2013, p. 262) noted that road density in New York did not influence bog turtle persistence or distribution, and that they may experience less mortality than other congeners. Bog turtles nest directly in wetlands; and thus, are less likely to cross roads than congeners that use upland habitats to nest (Myers and Gibbs 2013, p. 262). We have records of 19 bog turtles killed on roads in New York since 1978. In Connecticut, years of monitoring individual populations have resulted in no road mortality observations (Ravesi 2021, pers. comm.). No other information was available from the rest of the northern range to compare. Many metapopulations throughout the northern range are in close proximity to roads and may potentially experience higher mortality or reduced dispersal ability at the local level if roads have higher traffic volumes. Currently, while the existence of roads is “pervasive” across the range, the magnitude of impact to each metapopulation appears “slight.”

Inappropriate site management has the next highest level of impact in the northern range. This threat is estimated to occur over a “restricted” portion of the northern range and where it occurs, impacts are likely “moderate.” Because bog turtles are present year-round in their wetlands and management activities can result in impacts to individual turtles, the Service developed best management practices and a programmatic consultation (Service 2019, entire) for actions that the Service funds, conducts, or authorizes to reduce adverse impacts while restoring and managing bog turtle habitat for the overall benefit of the species. The Biological Opinion details the types of impacts (positive and negative) anticipated from various management actions. Conducting vegetation management activities in bog turtle wetlands without employing the best management practices is likely to result in increased risk of death or injury to bog turtles or their nests and may result in damage to the habitat. Several conservation actions include obtaining Service-funded Competitive State Wildlife Grant Projects to fund broad scale strategies for recovery and

habitat protection using conservation easements, land purchases, mitigation banking (both of which may not be available options if bog turtles were not federally listed), etc.; habitat management and restoration; wetland and endangered and threatened species laws and regulations; and population management. Impacts to core wetland habitat is regulated under Federal and state wetland laws; however, not all states have laws that include regulation of upland buffers adjacent to bog turtle wetlands, and by obtaining permits, negative impacts can still occur. In addition, activities in adjacent uplands are often not regulated and may impact core habitat over time. Additional information regarding inappropriate site management and conservation actions can be found in sections 3.3 and 3.10 of the Biological Report, respectively (Service 2022, pp. 51, 58–67).

Illegal collection, predation, pollutants/contaminants and climate change have the lowest overall current threat level to bog turtles. While few individual bog turtle populations have been purportedly impacted by illegal collection to date (scope is “small”), the risk of illegal collection is high for populations in the northern range. The overall impact to the species is “low”, but should it occur within a given population the impacts could be “extreme.” Most individual populations have a small number of individuals (less than 30 adults) and poachers often collect as many turtles out of a wetland as possible which could quickly lead to population extirpation. More information can be found in section 3.5 in the Biological Report (Service 2022, pp. 53–54).

Although predation is not being proactively monitored at all individual populations, predation is known to be impacting resiliency through reduction of recruitment to at least 23 of 508 individual populations (Whitlock 2002, pp. 55–56; Sirois 2011, p. 22; Zappalorti *et al.* 2017, p. 199; Byer *et al.* 2018, p. 231). If not managed, this could result in extirpation of small, isolated populations over time. These populations have the greatest risk of extirpation from predation (Shoemaker and Gibbs 2013; Sirois *et al.* 2014, p. 259). While few predation events have been documented, the scope is likely “pervasive.” To date, known predation events have not significantly reduced individual population numbers at any bog turtle wetland; therefore, the estimated impacts are “slight.” More information can be found in section 3.6 of the Biological Report (Service 2022, pp. 54–55).

While there are likely many sources of pollution/contaminants, our most reliable information is related to the impacts from oil and gas pipeline projects. Increased oil and gas pipeline building and repair activities in Pennsylvania in recent years has led to more than 6 State take permits and 5 Biological Opinions for the bog turtle, and depending on the pipeline installation demand, inadvertent returns¹⁰ can be expected to occur within the range of this species in the future. While no known turtle mortality has occurred, overwintering individuals have been abruptly disturbed, and for at least one site, core habitat has been impacted by an inadvertent return. Project applicants work with state and Federal biologists to implement measures to minimize

¹⁰ Horizontal directional drilling (HDD) is a pipeline installation method commonly used to cross underneath wetlands and waterways to minimize direct impacts to these systems. However, there is a risk of an inadvertent return of drilling fluids used during the pipeline installation, most commonly bentonite. Bentonite is a clay-like material that is inert and nontoxic but can bury wetland soils and plants in thick clay, alter hydrology, fill habitat crevasses, and disrupt foraging behavior of bog turtles.

inadvertent returns from occurring; however, not all impacts are preventable or predictable, as many factors such as the local geology (including hard to detect subsurface cracks and fissures) and the pressure of the drilling fluid may lead to an inadvertent return (Shellenberger 2021, pers. comm.). We can reasonably assume that if an inadvertent return occurs near a hibernaculum and it fills in with bentonite, that the clay material will harden and render the hibernaculum unusable. If an inadvertent return occurs within a nesting area, depending on the size of the area impacted, the amount of the fluid released and how high nests are off the ground, nests or nesting areas could be covered (Shellenberger 2021, pers. comm.). Bentonite material can also smother seeds, berries, insects, slugs, worms, etc., that bog turtles feed on, which can temporarily affect feeding. Few pollution/contaminant events from oil and gas pipeline projects have been documented in other states. However, due to the extraction of shale gas in Pennsylvania and its associated pipeline crossings (including horizontal directional drilling), most documented inadvertent returns have occurred in this state. As such, the rangewide scope of pollution/contaminant events is “restricted.” To date, horizontal directional drilling (HDD) and inadvertent returns have not been documented to result in reduced population numbers at a bog turtle wetland; and thus, the severity is “slight.”

Changes in temperature and precipitation are occurring throughout the range of the bog turtle (“pervasive”); however, we lack a clear understanding of the degree of effects to individuals or populations and find the current severity to be “slight.” Additional information on climate change can be found in section 3.9 and Appendix B in the Biological Report (Service 2022, pp. 57–58, 141–146).

Health screenings of bog turtles have become standard practice over the past 10 years since being identified as a need in the Recovery Plan (Service 2001, p. 23). Through these screenings, we have learned that different diseases are present within bog turtle populations (Service 2022, pp. 141–142). Some of these diseases are novel to bog turtles, others are shared with other northeast native turtle species. While mortality events periodically occur at known populations, disease outbreaks have not been specifically linked to these events. This is largely due to the vast majority of test results being inconclusive due to predation on or extreme decay of deceased individuals found. Disease within bog turtle populations is “pervasive”; however, because no mortality has been linked to deaths, the current severity is “slight.”

Table 7 summarizes the assessment we made of the current impact of threats on the bog turtle.

Table 7. An assessment of current impact of threats to the bog turtle (adapted from Master *et al.* 2012, entire).

	Threat								
	Altered Hydrology	Changes to Vegetation	Inappropriate Site Management	Roads (Mortality and Reduced Dispersal)	Illegal Collection	Predation	Pollutants/Contaminants (Inadvertent Returns)	Disease	Climate Change
Scope	Large	Large	Restricted	Pervasive	Small	Pervasive	Restricted	Pervasive	Pervasive
Severity	Serious	Serious	Moderate	Slight	Slight	Slight	Slight	Slight	Slight
Impact	High	High	Medium	Low	Low	Low	Low	Low	Low
Confidence Level	High	High	Moderate	Low	Moderate	Moderate	High	Moderate	Low

In summary, bog turtle populations are facing many threats throughout the range that may be affecting resiliency of the species (figure 2). In particular, changes to core habitat characteristics (hydrology and/or vegetation) are impacting a high number of metapopulations across each of the 5 recovery units (figure 3) from a variety of sources (*e.g.*, development, roads, lack of habitat management). The remaining threats have some uncertainty in terms of whether population-level effects are occurring. However, the potential high impact of illegal collection within populations across the northern range cannot be overstated despite the lack of evidence. Poaching events have likely occurred in four states within the Delaware, Hudson-Housatonic, Outer Coastal Plain, Prairie Peninsula-Lake Plain, and the Susquehanna-Potomac Recovery Units. One poaching event may remove nearly all adults from an individual population and thus, could render the population functionally extinct. In addition, impacts to core habitat are regulated under Federal and state wetland laws; however, Connecticut, Delaware, Maryland and Pennsylvania do not have laws that include regulation of upland buffers adjacent to bog turtle wetlands. These States combined contain 56 percent of the northern population, of which the vast majority between these four States are in Maryland and Pennsylvania (55 percent). Section 404 of the Federal Clean Water Act also does not protect upland buffers. In states that have buffer protection included in their laws (Massachusetts, New Jersey and New York; between 50–150 ft buffer protection depending on state), impacts can still occur via permitting processes. Also, activities in adjacent uplands are often not regulated and may impact core habitat over time.

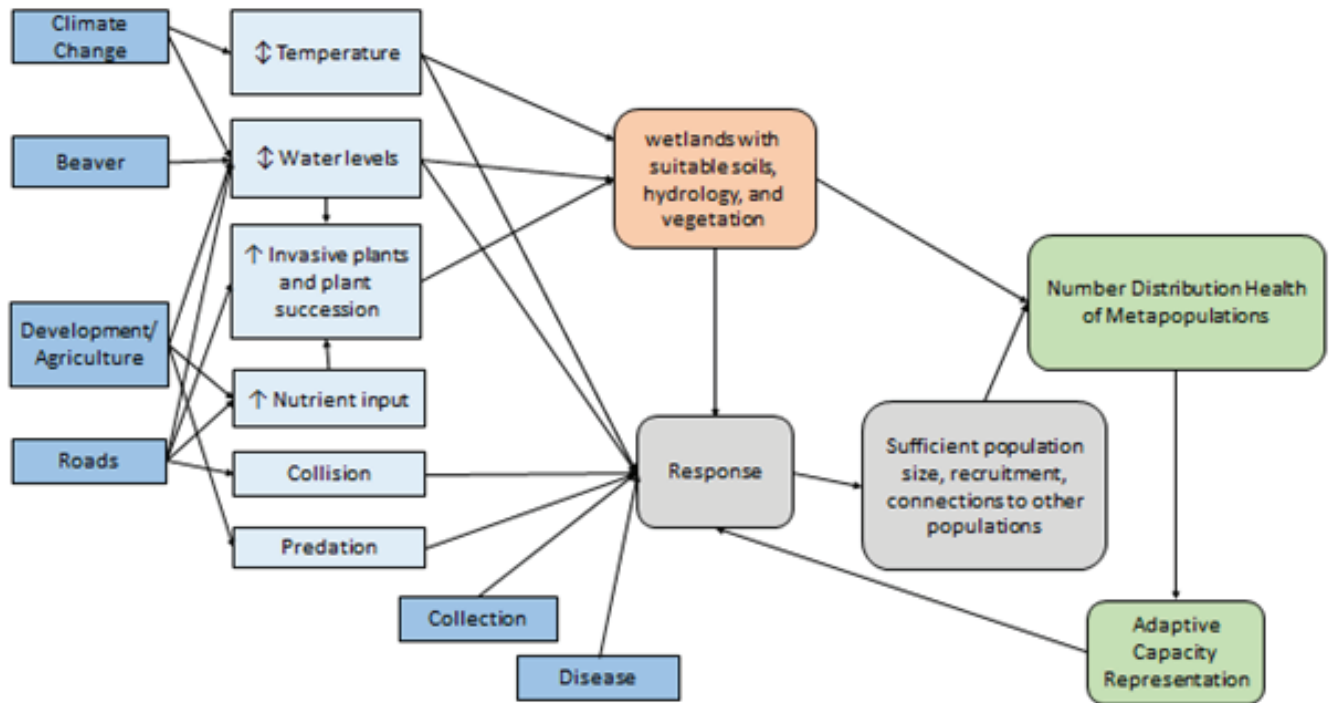


Figure 2. The primary extrinsic factors influencing bog turtle population health (resiliency) in the northern range.

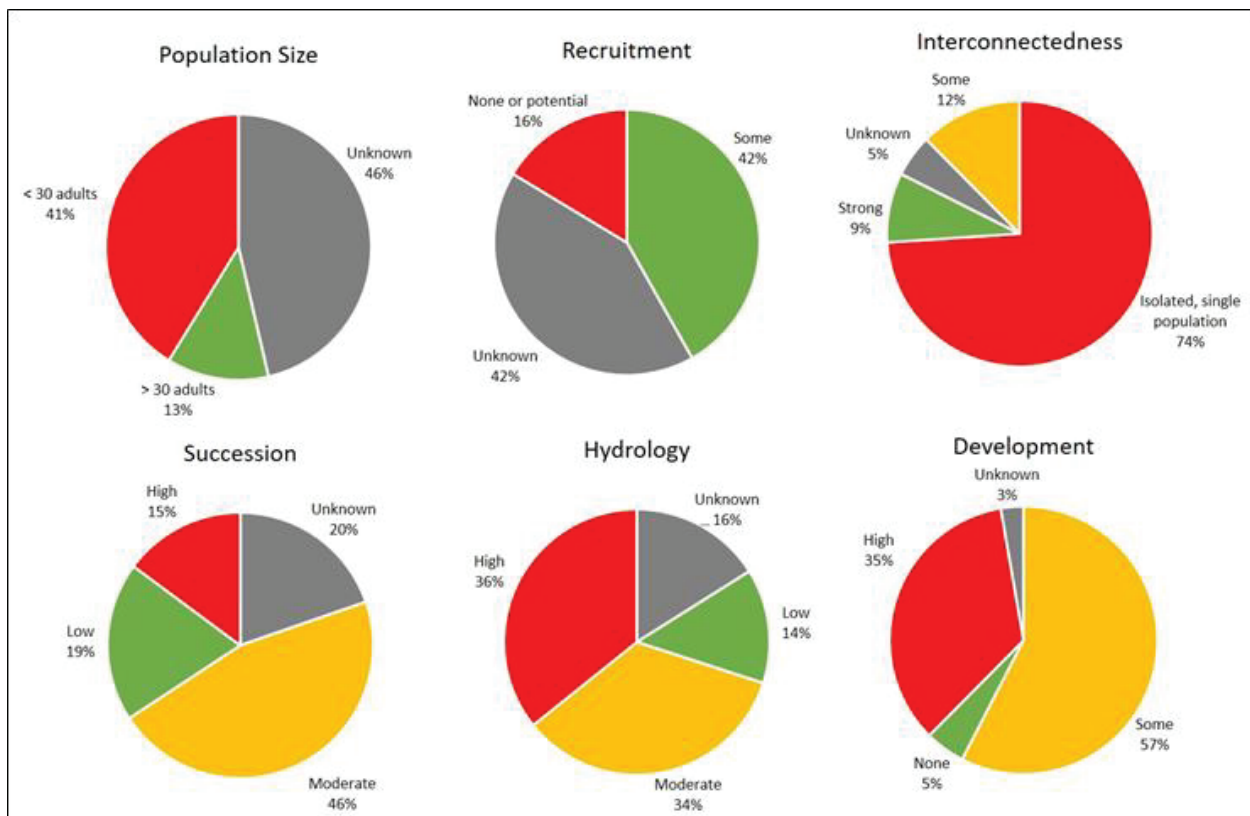


Figure 3. The proportion of metapopulations (N = 330) assigned to each condition metric (demographic metrics: population size, recruitment, and interconnectedness; habitat metrics: succession, hydrology, and development) across all recovery units. Red represents the poor condition, yellow represents the moderate condition (if applicable), green represents the good condition, and grey represents unknown condition. Definitions for each condition can be found in the “Metapopulation Condition Metrics” section A1.4 in the Biological Report (Service 2022, pp. 95–112). Figures pertaining to each recovery unit can be found in the Biological Report (Service 2022, pp. 113–128).

Threats into the Future

We have no information to suggest that ongoing threats from habitat loss or alteration from altered hydrology and changes in vegetation (succession and/or invasive plants) (Factor A), collection (Factor B), and road mortality, pollution/contaminants (Factor E) will not continue into the future. While the benefits of temporary and permanent habitat protections to date would continue to benefit the species into the near future (*i.e.*, NRCS wetland easements), assuming the species is no longer listed, future habitat projects and cooperation with private landowners would be expected to be lower. In the event of a lack of ESA protections, threats evaluated would result in greater negative impacts to the species.

Many of these threats are associated with bog turtles occurring near existing residential and commercial development and roads. Additional development is likely and existing roads will continue to have vehicle traffic (collision risk) and impacts (contaminants, changes in hydrology from stormwater runoff). Nowak and Walton (2005, p. 385) projected that urban land cover in

the continental U.S. will nearly triple over the next several decades, increasing from 3.1 percent in 2000 to 8.1 percent in 2050, with significant expansion predicted in the eastern states. Four of the states in the northern population range are projected to be more than half urban by 2050 (New Jersey, Massachusetts, Connecticut, and Delaware; Nowak and Walton 2005, p. 385). Even when bog turtle habitats are protected during the development process, indirect impacts can be seen to alter the wetland hydrology and vegetation over time. Alteration of the land condition at developed sites can begin years before the building is complete, through the changes in landownership and management (*e.g.*, from farm to fallow) that then lead to vegetative succession and increases in invasive species as well as long drawn-out building processes that may cause temporary increases in sedimentation and runoff (Gipe 2020, pers. comm.). Additionally, access to these development sites to manage bog turtle habitats and populations can be difficult during these years of flux (Gipe 2020, pers. comm.).

In addition to the ongoing threats discussed above, effects from climate change (*e.g.*, increase in flooding and/or drought events) may result in changes to bog turtle metapopulations and habitat in the future (Service 2022, pp. 57–58). Over the next few decades, annual average temperature over the contiguous U.S. is projected to increase by about 2.2 degrees Fahrenheit (F) (1.2 degrees Celsius (C)), relative to 1985 to 2015 regardless of any currently used representative concentration pathway projection (RCP 2.6 to RCP 8.5) (Hayhoe *et al.*, 2018, p. 86). Larger increases are projected by late century of 2.3 to 6.7 degrees F (1.3 to 3.7 degrees C) under RCP 4.5 and 5.4 to 11.0 degrees F (3.0 to 6.1 degrees C) under RCP 8.5, relative to 1986 to 2015 (Hayhoe *et al.*, 2018, p. 86). Annual average temperature has increased in the northeast between 1986–2016 by 1.43 degrees F (0.8 degrees C) (Vose *et al.* 2017, pp. 186–187; Hayhoe *et al.* 2018, p. 86).

Annual average precipitation has increased by 4 percent since 1901 across the entire U.S. including increases over the northeast (Hayhoe *et al.* 2018, p. 88). The frequency and intensity of heavy precipitation events are expected to continue to increase across the U.S. (Hayhoe *et al.*, 2018, p. 88). Projections show shifts of snow to rain in many parts of the eastern U.S. (Hayhoe *et al.*, 2018, p. 91).

While we have confidence that changes in these climate variables will occur, we do not have a quantitative assessment of their effects on bog turtles or their habitat and will be looking more closely during the final phase of the bog turtle SSA.

Future Threats if Not Listed under the ESA

The Clean Water Act and the Federal listing of the bog turtle in 1997 are likely the most important conservation measures that helped to reduce the decline of this species by providing protections (regulating the discharge of dredged or fill material into waters of the U.S., including wetlands) to the species and its habitat. Additional protections for bog turtles are afforded under state endangered species laws, amphibian and reptile laws that regulate the possession, import/export, sale, propagation, and release of species, and wetland laws that regulate direct disturbance to wetlands and their adjacent buffers. However, even with these regulations and protections, adverse impacts to the species may be permitted. As a result, development and associated impervious surface, even within an upland landscape surrounding a bog turtle

wetland, can negatively impact hydrology over time. Absent ESA protections, there are several other laws/regulations that provide benefits to the bog turtle and are summarized below:

Federal: Section 404 of the Clean Water Act only provides protection to wetlands from the placement of fill material. In 2020, the U.S. Army Corps of Engineers' jurisdiction under section 404 of the Clean Water Act was significantly reduced under the Navigable Waters Protection Rule. Wetlands that do not directly abut or have a regular surface connection to a larger, protected water body are no longer regulated. This includes groundwater fed wetlands. Consequently, many bog turtle wetlands may no longer be subject to the Clean Water Act regulation. The Corps is currently reviewing the Navigable Waters Protection Rule in accordance with E.O. 13990 to determine if it conflicts with national objectives.

The bog turtle was given protection in 1973 by the Convention on International Trade in Endangered Species of Wild Flora and Fauna. It is the only global treaty to ensure that international trade in plants and animals does not threaten their survival in the wild. It provides a framework for cooperation and collaboration among nations to prevent decline in wild populations of animals and plants. Because bog turtles are federally listed, they are an Appendix I species, which includes species threatened with extinction and provides the greatest level of protection, including restrictions on commercial trade. If the species was not federally listed, it is likely that it would be covered as an Appendix II species, which includes species that although currently not threatened with extinction, may become so without trade controls. It also includes species that resemble other listed species and need to be regulated in order to effectively control the trade in those other listed species.

Connecticut: The state relies almost completely on the federal government to protect federally listed species since there is no habitat protection in their state law. It is illegal to remove any bog turtle, including eggs, from the wild.

Delaware: This State relies almost completely on the federal government to protect federally listed species. The only endangered species-related regulations are at Delaware Code, Title 7, Chapter 6, which states that it is unlawful to transport, import, possess, or sell endangered species or hides, parts or articles made thereof (without a permit). Delaware Division of Fish and Wildlife regulations include similar wording for native herptiles. New Castle County has a Unified Development Code that restricts what developers can do on "Critical Natural Areas." If there are bog turtles (or any state-listed species) confirmed on a site, their primary habitat cannot be developed. There is no added protection of upland buffers.

Maryland: Under the State's Wetland Protection Act, there is a category of listed wetlands that are afforded legal protection. These are called Wetlands of Special State Concern (WSSC), and about 200 are currently identified. If state or federally listed species are present, a wetland must be designated a WSSC. All WSSC are regulated by Maryland's Department of the Environment and are protected by a 100-ft buffer. However, over 6 years ago State biologists submitted all bog turtle wetlands to receive WSSC designation, but no action has been taken with this information and no bog turtle wetlands have received WSSC designation to date. Therefore, many of the Maryland bog turtle wetlands only receive a 25-ft protection zone. Regardless, State biologists have been able to effectively use the Conservation Zones from the Recovery Plan

(Service 2001, pp. A1–A3) in most cases to establish a 300-ft, no-development buffer between bog turtle wetlands and proposed projects. Maryland’s Nongame and Endangered Species regulations do not allow take of species listed as endangered; however, species listed as threatened may be taken under a special permit (although none have ever been issued). The regulations do provide some protection from take.

Massachusetts: Take is prohibited unless a permit has been issued by the Director of Fisheries and Wildlife. The Massachusetts Endangered Species Act offers protection to all state-listed Endangered, Threatened and Special Concern Species, whether they occur on public or private lands. Wetland buffer zones are defined as 100 ft, and projects proposed within this area must be reviewed. However, this does not mean that work cannot occur, since individual town bylaws vary with regard to the limits of "do not disturb" restrictions within the 100-ft buffer area. A "Species Regulatory Polygon" is used to trigger environmental review under current regulations. Most agricultural practices, including crop production and mowing, are not reviewed by regulatory agencies. Other exemptions that may impact bog turtle habitat also exist.

New Jersey: This State is unique among the northern range states for its State-assumed wetland permitting program and its regulation of floodplains and stormwater. Wetlands are further protected by regional land-use regulations (*e.g.*, Highlands, Pinelands, Coastal Zone), which protect bog turtles not only against most direct habitat losses (*e.g.*, filling, clearing, draining), but also against some of the more immediate and severe aspects of habitat degradation caused by adjacent development.

In 1993, New Jersey assumed the Clean Water Act jurisdiction and regulation of freshwater wetlands in the State, including all wetlands supporting bog turtles. The Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 *et seq.*) (FWPA) and its implementing regulations (N.J.A.C. 7:7A) are the basis for State assumption, and must therefore, be at least as protective as the Federal section 404 program. The FWPA also includes several provisions that are more restrictive than the Clean Water Act. For example, the FWPA regulates essentially all activities in wetlands (*e.g.*, disturbances to soils, vegetation, or the water table), while the Clean Water Act only regulates the placement of fill material. The FWPA also regulates “transition areas” or upland buffers, either 50 or 150 ft wide, while the Clean Water Act provides no regulation of uplands. As a State law, the FWPA retains full jurisdiction over isolated and non-navigable waters and wetlands, while Federal jurisdiction over these areas has been curtailed by recent court decisions. The FWPA requires the larger, 150-ft buffer on wetlands that support federally listed species or state-listed wildlife.

New Jersey Coastal Zone Management rules (covering two bog turtle wetlands) prohibit development of habitat for state-listed plants or wildlife, unless such habitat would not be adversely affected either directly or through secondary impacts. Habitat for listed species is defined to include a sufficient buffer area to ensure continued survival of the population (N.J.A.C. 7:7E-3.38). The Pinelands Comprehensive Management Plan (covering two bog turtle populations) prohibits development unless it is designed to avoid irreversible adverse impacts upon the survival of any local populations of federally or state-listed plant or animal species (N.J.A.C. 7:50-6.27 and 6.33). The Highlands Water Protection and Planning Act (covering at least 27 bog turtle occurrences) requires 300-ft buffers on wetlands and open waters, and

prohibits major developments unless the proposed activity will not jeopardize the continued existence of, or result in the likelihood of the destruction or adverse modification of habitat for, federally or state-listed plant or animal species (N.J.A.C. 7:38-3.11).

New York: Wetlands containing threatened and endangered species are ranked as “Class 1”, and as such, receive more stringent standards for permits. New York also regulates a 100-ft upland buffer around all wetlands with or without threatened and endangered species. In New York, biologists, as well as personnel from the U.S. Army Corps of Engineers and other agencies, receive periodic training on the environmental project review process and assessing potential core habitat.

Regulated activities in New York include filling for agricultural purposes; draining and altering water levels, except as part of an agricultural activity; removing or breaching beaver dams; clear-cutting trees and other wetland vegetation; grading, dredging, or mining; constructing roads; drilling a water well to serve an individual residence; installing docks, piers, or wharfs; constructing bulkheads, dikes, or dams; constructing a residence or related structures or facilities; constructing commercial or industrial facilities, public buildings, or related structures; installing utility services; and applying pesticides. Unregulated activities that may affect bog turtles include projects that are outside the 100-ft upland buffer and may impact the bog turtle wetland or that might affect connectivity or gene flow between sites within a metapopulation.

Pennsylvania: Wetlands supporting threatened and endangered species are considered "exceptional value" wetlands under the State’s wetland permitting regulations. As such, there are more stringent requirements to receive a permit for wetlands encroachment. Only encroachments for health and/or safety reasons are considered for permitting. However, no upland buffers around any wetlands are regulated or protected at the State level.

Most agricultural (*e.g.*, crop production, tilling) and timber harvest practices are not reviewed under State wetland regulations, unless fill in the wetland is proposed (*e.g.*, for a road crossing) and a permit is sought. Upland activities that do not involve a wetland encroachment, including residential and commercial development, are typically not reviewed or regulated under State wetland laws, although some type of stormwater permit and/or earth disturbance permit may be necessary, in addition to complying with local municipal zoning requirements. Consequently, a review for endangered and threatened species is typically not done for these upland activities.

In summary, state and Federal regulations in the northern population have likely partially curtailed habitat degradation from adjacent development. However, current regulations are not sufficient to halt habitat degradation over the long-term at all sites, and many bog turtle wetlands continue to be degraded by adjacent development that was constructed prior to more recent and stringent rules. In addition, even the largest (300-ft) upland buffers required by these regulatory programs are not likely to provide sufficient long-term habitat protection in all cases.

Given that threats are continuing even with ESA protections, absent protections from the ESA, we anticipate habitat loss or alteration from altered hydrology and changes in vegetation (succession and/or invasive species) (Factor A), collection (Factor B), and road mortality, pollution, and contaminants (Factor E) to continue. The ESA currently provides more than

protections from collection, trade, take, etc. for the bog turtle; it also provides funding opportunities for addressing ongoing threats. Without federal protections, funding for efforts to conserve land that protects this species and the expansion of suitable habitat through restoration by programs such as the Service's Partners for Fish and Wildlife Program and NRCS's WLFW Initiative would likely end. A lack of funding for land protection would lead to an increase in development pressure near extant populations and a lack of habitat restoration would lead to continued hydrologic issues in wetlands with bog turtles and invasive species encroachment/succession of essential habitat required for feeding, breeding, and sheltering.

Synthesis

The bog turtle was listed in 1997. Prior to listing, there was a historical range reduction (primarily in New York), but since the species was listed, significant progress has been made in finding new bog turtle wetlands/individual populations across the northern range. One hundred ninety-one individual populations were known at the time of listing, but since that time using the new definition of population, 317 individual populations have been located. Also using our current definitions, we are now aware of 330 extant bog turtle metapopulations (made up of 508 individual populations; 244 of the metapopulations are single, isolated populations) across the range. In addition, there has been no discernible range reductions since the time of the listing as bog turtles continue to occur throughout the northern population range with the majority of metapopulations found within the Delaware and Susquehanna-Potomac RUs. For example, Pennsylvania has 7 new individual populations in new WBDHU 12-level watersheds. However, throughout the northern range, 37 individual populations are considered historical and likely extirpated as survey efforts have been unsuccessful in locating turtles, and 40 additional individual populations are considered extirpated due to no suitable habitat remaining across the range.

Since listing, the Service and multiple partners have made progress in managing the threat of habitat loss or alteration, but ongoing management is required after an initial successful restoration of habitat.

Of the known extant metapopulations, 6–30 percent are considered to have good resiliency (anticipated to be able to continue to respond to environmental and demographic stochasticity). The remaining metapopulations are considered to have poor to fair resiliency due to their small population size or degradation of habitat and/or isolation. Many of these isolated populations have the potential for higher resiliency in the future if habitat was restored and managed. We are aware of 127 habitat management projects that have been accomplished within the northern range, but many are reported at the landowner parcel-level and may not include the entire core habitat.

Smaller individual populations or populations with reduced reproductive success due to degraded habitat conditions are at greater risk of extirpation associated with additional development on the landscape, predation, pollution and contaminants, and from flooding and drought events. They are also at greater risk of extirpation associated with illegal collection or disease, although these kinds of catastrophic events could occur at larger sites as well. Any future loss of individual populations can reduce overall genetic and ecological diversity of the species, further limiting the species' representation and adaptive capacity. Due to its specific habitat requirements and

limited dispersal capacity and behavior, it is unlikely that bog turtles will frequently be able to move from current fen locations to other wetlands. In addition, it is likely that if they moved to another wetland that it would also be in a degraded condition given the high percentage of wetlands in that situation.

Overall, there is not a significant change in the status since the time of listing and none of the 2001 Recovery Plan recovery criteria have been met. While the bog turtle may appear to have high redundancy and representation (large number of metapopulations throughout the range), few of the known metapopulations are considered to have high resiliency (table 8). The primary threat of loss or alteration of habitat has continued despite the protections of the ESA. It is especially challenging to understand and abate changes in hydrology associated with adjacent upland activities. Further, the early successional vegetation required by bog turtles for successful nesting relies upon habitat management. While the Service, states, NRCS, and other partners have restored many individual wetlands or portions of wetlands, ongoing management is a challenge. The bog turtle is a long-lived species and can tolerate some degree of suboptimal habitat for several years. However, at some point the continued degradation results in reduced population size and resiliency, putting these populations at greater risk of impacts from stochastic events, such as drought conditions. Catastrophic events such as disease, predation, or illegal collection are also more likely to result in extirpation if the population is already reduced in numbers and individual turtles are already stressed.

Table 8. A summary of bog turtle current condition in the northern population.

3 Rs	Requisites	Description	Current Condition
<p>Resiliency (able to withstand stochastic events)</p>	<p>Healthy populations</p>	<p>Populations with:</p> <ul style="list-style-type: none"> • sufficient number of adults • presence of males and females • high adult survival • sufficient recruitment and age structure • interconnectedness to habitat (part of metapopulation) • suitable soils and associated vegetation • intact hydrology and ecological processes • intact upland buffer 	<p>Rangewide 6–30 percent of metapopulations have good resiliency</p> <p>26–50 percent have fair resiliency, and</p> <p>20–67 percent have poor resiliency</p> <p>37 historical (individual populations)</p> <p>40 extirpated (individual populations)</p>
<p>Representation (to maintain evolutionary capacity)</p>	<p>Maintain adaptive diversity</p>	<p>Healthy populations distributed across areas of unique adaptive diversity (e.g., across latitudinal gradients) with sufficient connectivity for periodic genetic exchange</p>	<p>Metapopulations occur throughout the range. However, most are in poor to fair condition within each recovery unit (RU).</p> <p>Delaware RU 162 metapopulations poor (20–71 percent) fair (24–49 percent) good (5–31 percent)</p> <p>Hudson-Housatonic RU 66 metapopulations poor (17–65 percent) fair (23–47 percent) good (12–36 percent)</p> <p>Outer Coastal Plain RU 1 metapopulation = fair 2 metapopulations = poor or good (too many unknowns)</p> <p>Prairie Peninsula-Lake Plains RU 1 metapopulation = poor 2 metapopulations = fair 1 metapopulation = good 1 metapopulation = poor or fair (too many unknowns)</p>

			Susquehanna-Potomac RU 94 metapopulations poor (23–64 percent) fair (32–55 percent) good (4–21 percent)
Redundancy <i>(to withstand catastrophic events)</i>	Sufficient distribution of healthy populations	Sufficient distribution to guard against catastrophic events (e.g., novel disease, drought, and floods) significantly compromising species adaptive diversity.	Bog turtles continue to have a large distribution with extant metapopulations known throughout the range and within each 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).
	Sufficient number of healthy populations	Adequate number of healthy populations to buffer against catastrophic losses of adaptive diversity.	Most bog turtle metapopulations are in poor to fair condition.

RESULTS

Recommended Classification:

Downlist to Threatened

Uplist to Endangered

Delist (*Indicate reasons for delisting per 50 CFR 424.11*):

Extinction

Recovery

Original data for classification in error

No change is needed

New Recovery Priority Number (*indicate if no change; see 48 FR 43098, September 21, 1983 & 48 FR 51985, November 15, 1983 - Correction*): **No change is needed.**

Brief Rationale: It is ranked 12C, based on a moderate degree of threat, low potential for recovery, taxonomic standing as a distinct vertebrate population, and an imminent conflict with development activity.

RECOMMENDATIONS FOR FUTURE ACTIONS

- Continue working with conservation partners on land protection of core habitat, buffers and connecting corridors, and habitat restoration at priority sites.
- Increase outreach to landowners to increase efforts on land protection and habitat restoration.
- Continue to proactively identify new sites via use of qualified personnel and grant programs to identify and survey high quality potential habitat.
- Complete phase 3 of the SSA, future condition of bog turtles, to inform recovery planning.
- Update Recovery Plan, including re-evaluating the recovery criteria.
- Continue development of the regional database to ensure greater efficiency with data use for future 5-Year Reviews and conservation planning efforts.
- Continue with regional monitoring program for assessing habitat and populations to determine trends and success of recovery actions.
- Conduct research on hydrology mechanisms at sites to help inform guidance for project reviews and habitat restoration.
- Coordinate a program with law enforcement to address poaching concerns, including building a genetic library to determine origin of collections.
- Conduct research on climate change to better understand how bog turtles may be impacted in the future and to inform recovery actions.
- Develop guidance and best management practices for various project activities (*e.g.*, road and pipeline projects) during the environmental review process that are compatible with bog turtle conservation and for conservation purposes (*e.g.*, radio-telemetry, predator control).
- Conduct research on the effects of agriculture, including contaminants of emerging concern, to determine if any impacts are occurring at sites.
- Continue to implement nest protection and perform predator control, where possible.

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of the BOG TURTLE
(NORTHERN POPULATION)**

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: 12C

REGIONAL OFFICE APPROVAL

Assistant Regional Director, Endangered Species

Approve **SHARON MARINO** Digitally signed by SHARON MARINO
Date: 2022.08.29 17:20:13 -04'00' Date _____

The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. Written concurrence from other regions is required and should be documented in the administrative record.

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