

# 2

## Ecology of Bog Turtles



Dennis W. Herman

Bog turtle eggs (*Clemmys muhlenbergii*).

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Scientifically known as *Clemmys muhlenbergii* and formerly called the “Muhlenberg’s” turtle, the bog turtle is North America’s smallest turtle species. Bog turtles are characterized by their small size, dark coloration, and large yellow to orange blotches on both sides of the head. Shell lengths of bog turtles average between 3 and 4 inches, and the largest bog turtle ever recorded was 4.5 inches.

The main identifying character of bog turtles is the brightly colored blotch located behind the eye on each side of the head. These blotches vary in coloration from yellow, yellow-orange, orange, and orange-red from population to population. Turtles with yellow or orange blotches may be found within the same population and in some sites the turtles’ head blotches may be only yellow or orange. The size and shape of the blotches also vary from population to population and are dependent on the turtle’s age. Juvenile and newly hatched bog turtles possess large blotches that are light in coloration, whereas older adults have brighter and more intensely colored blotches that are usually diffused with darker pigment and are often broken up and incomplete.

The upper shell or carapace is usually black to mahogany-brown and may be marked with lighter whitish to yellowish sunburst rays of color in the individual scutes. The lower shell, or plastron, is usually black with varying amounts of white or pale yellow patches. The neck, limbs, and tail are very dark brown or black, with or without streaks of red or orange. The top of the head is usually speckled with black and the lower jaw may be spotted with red or orange. The upper jaw is notched, creating two sharp points on the beak. Along the back is found a mid-dorsal keel or ridge and pronounced sculptured growth rings around the scutes are present on the carapace



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*The large blotch on each side of the head is characteristic of the species. The shape and color of the blotches may vary from region to region.*

in juveniles and middle-aged adults. Older adults usually possess smooth worn shells and lack mid-dorsal keels and distinct growth rings due to years of digging or burrowing in mucky soils and vegetation.

Sexual dimorphism is pronounced in this species. Unlike many other turtles the males are larger than females and possess larger, more robust heads. Carapace lengths average 3.5 to 4 inches in males, while females are slightly smaller with an average of 3 to 3.75 inches in length. Females have greater carapace width to length ratios and shell heights than males. The rear marginal scutes are usually flared in males giving them a more streamlined appearance from above, while female bog turtles appear more circular. The plastron is dished out or concave in males and is flat in females. Male bog turtles have long, thick tails with the anal (cloacal) opening extending past the edge of the plastron, and females have short tails with the cloacal opening inside the plastron edge.

## Protected Status

Bog turtles have been variously protected by every state in which they occur. The bog turtle is listed as "Threatened" in Georgia, North Carolina, South Carolina, and Tennessee, and "Endangered" in Virginia. Because of inconsistent state protection throughout the turtle's range, the U.S. Fish and Wildlife Service placed the bog turtle on the Endangered Species list in November 1997. The bog turtle is listed as "Threatened" for the northern population (CT, DE, MA, MD, NJ, NY, and PA) and "threatened due to similarity of appearance" for the southern population (GA, NC, SC, TN, and VA); this designation is based on the naturally occurring 250-mile gap between the population in southern Virginia and that of Maryland. The southern bog turtle population is not fully protected under the Endangered Species Act (ESA), but may not be possessed, sold, traded, or collected. Landowners in the southern states can continue to develop bog turtle habitat by any legal means available to them, as long as the proper permits are obtained beforehand. In the northern states, bog turtles are fully protected under the ESA. A summary of the ESA is included in the Example Handout in Appendix C.

## Population Dynamics

Little is known about the dispersal or movement patterns of bog turtles. Individual bog turtles have been found crossing roads more than a mile from their wetland home or other suitable habitats. These migratory movements take them into forested uplands, distant ridges, lowland valleys, and cultivated areas. Summer and early fall movements are sometimes long, bringing them into areas where their occurrence is unexpected. Males tend to move more frequently and over greater distances than females. Bog turtles may exist in moderate to high densities in suitable habitats. Mark-and-recapture studies in the southern part of the bog turtle's range indicate that suitable habitats have densities of 15 to 20 turtles per acre. Home ranges for bog turtles are estimated to be less than 0.5 acre (.23 ha) in area and are slightly larger for males than for

females. Sex ratios in the bog turtle's southern range average 1 male to 1.3 females per site.

The bog turtle is an ectothermic reptile (cold-blooded), and undergoes a definite annual cycle related to seasonal changes of temperatures in its environment. Bog turtles alternate seasonal warm-weather activity with cold-weather inactivity. Winter survival requires that bog turtles undergo a period of cold-weather dormancy through the winter. Winter dormancy is probably longer at higher elevations than in the Piedmont. Depending on the weather, bog turtles sometimes begin surface activity during mid-March in the South. The greatest bog turtle activities occur from mid-April through September. Elevation affects the timing and length of the major phases of the activity cycle. In the Piedmont, bog turtles have a longer active season than turtles in the higher Mountain sites.

The bog turtle's life span is estimated to be in excess of 40 years based on recapture studies. Female bog turtles reach sexual maturity at approximately 3 inches in carapace length or from 5 to 7 years of age. The secondary sexual dimorphic characters of males (longer tail and concave plastron) begin to appear at around 2 1/2 inches in carapace length. Bog turtles in the wild are capable of reproducing between 5-7 years of age under the most ideal conditions, but the actual age of first egg deposition is closer to 10 years. Reproduction may take place annually, but most likely occurs every second or third year. Female bog turtles may reproduce from 10 to 15 times over a 40 to 50 year life span. Egg clutch sizes range from 1-6 eggs with an average of 3 eggs per clutch.

## Distribution

Bog turtles are known from Georgia, North Carolina, South Carolina, Tennessee, and Virginia in the southern part of their range (Figure 2.1). The majority of records are known from the Blue Ridge Intermountain Plateau, but many have been found in the upper Piedmont along the base of the Blue Ridge Escarpment. Elevations of bog turtle sites range from 710 to 4500 feet, with the majority known from 2000 to 3000 feet elevation. Bog turtle populations

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**Figure 2.1** Range of bog turtles (*Clemmys muhlenbergii*) in the Southeast.

have been found along ten river basins in the Southeast in both the Mississippi-Ohio and Atlantic drainages.

### Habitat Dynamics

Wetlands preferred by bog turtles are spring-fed with saturated soils and modest amounts of running water. The sites do not have standing water of significant depth. Viable bog turtle populations occur in seepage slopes or terraces along headwaters of small to moderate size streams. Sites occupied by bog turtles are infrequently flooded, so they are not found on large, flat floodplains of major rivers or streams. Bog turtle habitat is characterized by being sedge-dominated, wet meadows with little or no canopy and are referred to as sedge meadows or Meadow Bogs.

Bog turtles are not found in true “bogs” in the Southeast. True bogs are typically

composed of vegetation mats that grow over small depressions, ponds, or small lakes. They are fed primarily by rain and water runoff. Peat moss (*Sphagnum* sp.) and other bog building plants along the shore grow out into water-filled depressions, eventually filling them with decomposed vegetation.

The common denominator of all bog turtle habitats in the South is that they are spring-fed. Technically speaking, the wetlands preferred by bog turtles are known as fens. To most ecologists a fen is a spring-fed wetland located over calcareous or mafic rock and enriched by nutrients, creating a wetland with great plant diversity. Only one such wetland has been described from the southern Mountains, although fens are common further north. Bog turtle habitats are, in fact, “poor or acidic” fens located over granite or metamorphic gneisses. These spring-fed wetlands are acidic with



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*Bog turtles are often found in grazed wetlands.*

many floral components common to both true bogs and nutrient rich fens. Sphagnum, usually associated with acidic bogs, can be the dominant ground cover in many bog turtle habitats. Because of the acidic nature of these nutrient-poor fens and plant assemblages linked to true bogs, some ecologists refer to them as bogs. In fact, one rare natural community, the Southern Appalachian Bog, is so named because of these characteristics. Sedge meadows (also known as Meadow Bogs) are a major component of these natural communities, and wetlands that have little or no sedge meadow habitat are inhabited by small populations of bog turtles or no turtles at all. The open nature of meadow bogs allows maximum sunlight to warm the herbaceous layer providing bog turtles with basking and nesting sites. One of the bog turtle's ultimate limitations is a closed canopy, which cuts off surface light and warmth.

Habitats in the upper Piedmont may or may not have floral components similar to those along the Blue Ridge. Most Mountain sites have peat moss (*Sphagnum* sp.) as ground cover; some exhibiting extensive mats, while others have only a few patchy areas.

Piedmont sites, on the other hand, vary greatly in the amount of peat moss growth with many having no peat moss at all. Needle rushes (*Juncus* sp.) appear to be more prevalent in Piedmont sites, while sedges dominate Mountain sites.

Meadow Bogs are defined as "impacted" natural areas, usually grazed by livestock or

located adjacent to pastures and are created and maintained by agriculture, livestock, beaver, and possibly fire. Today livestock have replaced the large herds of herbivores (bison, elk, and earlier the larger Pleistocene megafauna) that once seasonally migrated through and lived in the wetlands, grazing and browsing on low shrubs and sedges, maintaining the open wet meadows preferred by bog turtles and other species. The majority of bog turtle populations in the Southeast occur in sites that are currently grazed or formerly grazed by livestock. The turtle's dependence on livestock grazing and browsing has been well documented.

Beavers were once a major creator of ponds (see *Wetland Management by Beavers*, Chapter 6). These ponds filled in over time to become open wet meadows used by bog turtles. Today beavers have rebounded from near extinction and these industrious rodents may create short-term negative impacts to existing bog turtle habitats by flooding them. The beaver's importance in creating and maintaining bog turtle habitat may not be as evident today as it was in the past. As bog turtle sites are protected along common stream corridors, beavers may once again be beneficial to the bog turtle's long-term survival.

### Threats to Bog Turtles and Their Habitat

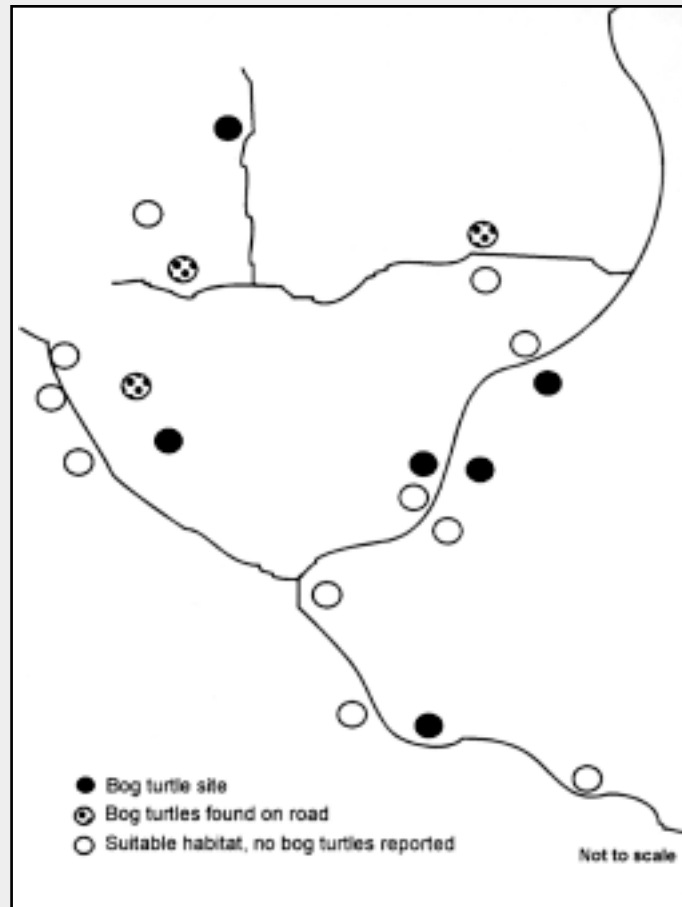
Wetlands inhabited by bog turtles are under constant threats from agricultural use, development, and natural succession. The illegal collecting of bog turtles for the pet trade, both domestic and international, directly threatens the turtle itself. These threats are having an adverse effect on bog turtle populations in the South, as well as throughout the turtle's range. Habitat loss has accelerated over the past 20 years from fragmentation due to human encroachment and natural succession. The decline in bog turtle populations can be attributed directly to these threats.

Prior to European colonization in the 1700s, the dynamic wetlands used by bog turtles were a complex of habitat units and potential habitats interconnected by a mosaic of dispersal routes. The long-term dynamic ecosystem could

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**Box 2.1 A Bog Turtle Metapopulation in North Carolina****By Dennis W. Herman**

The best known metapopulation in North Carolina, currently under study, is comprised of at least 20 wetlands ranging from 0.5 to 6 acres in size along a small stream with several tributaries. Bog turtles have been captured in six of these wetlands and found on roads at three locations within the drainage (see Figure 2.2). The first bog turtle site in this metapopulation was discovered in 1990. This site, which is located on a secondary tributary, has 35 marked turtles and is currently the largest turtle colony known in the metapopulation. Bog turtles were captured and marked in three other wetlands along the stream drainage during the early 1990s, the largest population with seven turtles recorded. Additional turtle captures have been made since the initial discovery of these wetlands. Searches in nine other wetlands have yet to produce bog turtles, for reasons yet unknown. This is a classic metapopulation with intact habitat units along the main corridor and four secondary tributaries, some with turtles and others without. The average distance between habitat units is roughly one mile, and the greatest distance between bog turtle sites is two miles. Currently, there are no impediments to dispersal, although a road does parallel the stream in some places and pasture is common in many areas. The entire stream drainage is under private ownership, with the exception of three small wetlands owned by the National Park Service (Blue



**Figure 2.2** Bog turtle metapopulation showing subpopulations. Roads not shown.

Ridge Parkway). Protection of the entire corridor and habitat units would preserve one of the best metapopulations known in North Carolina, but multiple ownership along the drainage makes it very difficult to do so using conventional purchase methods.

withstand the loss of a single habitat unit while providing bog turtles with other usable habitats. The biological need for individual bog turtles to disperse takes them out of their wetlands to explore and locate new sites to colonize. Individual turtles could move freely up or down the corridor, enriching the gene pool and helping to maintain genetically healthy population units. Bog turtle habitat units or single population sites interconnected along a common stream corridor are referred to as metapopulations (Box 2.1). Only a handful

of these metapopulations remain today because of habitat fragmentation. The most common types of fragmentation occur when streams are impounded to form lakes, highways are built across inhabited wetlands, and wetland habitat units are drained for agricultural use or development. Roads that bisect bog turtle wetlands are the single most detrimental threat to turtle populations. Highway mortality is high in areas where bog turtles must cross roads to get from one wetland to another. There is no doubt that roads and highways can

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be managed more effectively to reduce road mortality and some of these measures are discussed in Chapter 6 in the section on Managing Roadways.

Most of the metapopulations known today are fragmented, with great distances separating one population unit from the next. Bog turtles encounter impediments that make it difficult for dispersal to occur successfully. Some bog turtles have been found crossing ridges to locate wetlands in an adjacent valley. Overland dispersal may be more common than was previously thought, but it may also be a result

of habitat unit losses along the stream corridor that turtles used historically. As mentioned previously, very few metapopulations remain in the South today. Bog turtle populations are dynamic, fluctuating and shifting over long time periods. The survival of the bog turtle depends on connected habitat units along riparian corridors or habitat patches in adjacent valleys where dispersal into them is not impeded. A case study of the best metapopulation presently under investigation in North Carolina is presented in Box 2.1.

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