

# 1. INTRODUCTION

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Adult male Wood Turtle, Maine. MIKE JONES





1.1—Wood Turtle populations throughout the range of the species have been negatively influenced by habitat fragmentation and habitat loss. Most of the large, demographically robust, and stable populations are associated with streams in areas that have not been fragmented. AMERICAN TURTLE OBSERVATORY

## Conservation Context

The Wood Turtle (*Glyptemys insculpta*) has experienced dramatic population declines as a result of habitat loss, road mortality, detrimental anthropogenic land-use practices, and numerous other factors over the past century. Agriculture, textiles, industry, deforestation, and habitat fragmentation have degraded many of the major streams that formerly supported large Wood Turtle populations. The remaining, viable populations of Wood Turtles are mostly found in areas with relatively little development or fragmentation (1.1).<sup>1</sup> In this chapter, we provide a broad overview of the ecology of the Wood Turtle, introducing material that is covered in more detail in later chapters, and we provide a detailed and illustrated overview of the species' appearance.

Wood Turtle populations are typically associated with sections of clear, cold, medium-sized streams and rivers, often situated within a mosaic of mature forest and early-successional habitats (Saumure 2004; Akre and Ernst 2006; Ernst and Lovich 2009; Jones and Sievert 2009a) (1.2).<sup>2</sup> These streams are generally characterized by sand, gravel, cobble, and/or bedrock substrates and significant accumulations of within-stream woody structure such as fallen trees, branches, and root-masses that play a critical role in providing overwintering sites, basking areas, cover, and stability during periods of elevated flows. Although single individuals and small populations may

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1 A comprehensive account of the species' distribution is provided in Chapter 4.

2 More detailed descriptions of the species' habitat preferences, common ecological associates, and noteworthy associated taxa are provided in Chapter 5.



1.2—Wood Turtle populations are generally associated with clear, cold, medium-sized streams and rivers within a mosaic of forested and nonforested floodplain and riparian habitats. Streams are often characterized by inorganic substrates and low to moderate stream gradient. Typical habitat in the Lake Huron watershed of southwestern Ontario, Canada is pictured. JOE CROWLEY



1.3—Although they are fluvial (stream and river) specialists throughout their range, Wood Turtles range extensively in floodplain and upland habitats through most of the warmer months. Floodplain habitat dominated by Silver Maple (*Acer saccharinum*) and Ostrich Fern (*Matteuccia struthiopteris*) in New Hampshire is pictured. MIKE JONES

be found with regularity throughout the species' range, it is clear that robust, demographically stable populations are generally found within landscapes and stream systems that sustain dynamic fluvial, geomorphic, and biological disturbance processes. Examples include: (1) seasonal flooding, (2) meandering stream channels, and/or (3) periodic Beaver (*Castor canadensis*) activity. Each of these features allows for frequent deposition of nesting material and maintenance of ephemeral early-successional habitats.



1.4—In many areas, Wood Turtles are limited by the availability of high-quality nesting habitat, which often consists of well-drained sand, gravel, sandy loam, or alluvium. These areas may occur along the bends of larger rivers, as pictured here in southern Wisconsin. ANDREW BADJE

Although Wood Turtles require streams for overwintering and mating, they also rely upon adjacent terrestrial habitats. They spend much of the warm months of late spring to early fall in the surrounding landscape, sometimes hundreds of meters from their overwintering stream (1.3). Terrestrial habitat preferences vary by geographic region and season, but Wood Turtles will typically occupy a mosaic of habitats including mature forest and early-successional cover types. Ecotones<sup>3</sup> and “edge habitats” serve an important function for Wood Turtles by providing opportunities to balance both thermoregulation and food requirements. Ephemeral pools (especially within river floodplains) and temporary wetlands appear to serve as complementary habitat, but generally do not support overwintering activity.

Prime nesting areas consist of well-drained, elevated, and exposed alluvium, poorly graded sand, fine to medium gravel, or sandy loam, and the availability of such locations limits the Wood Turtles’ available habitat (1.4). These areas may be associated with a wide range of natural and anthropogenic settings. Natural nesting areas include sandy point bars on the inside of river bends, cutbanks on the outside of river bends, sand and gravel bar deposits in the stream channel (associated with stream obstructions, constrictions, or directional changes in flow), areas of overwashed sand in open floodplains, and dry stream beds. Anthropogenic nesting features include sand and gravel pits, gravel boat ramps, exposed areas along power line/pipeline corridors and rights-of-way, roadsides, unpaved farm roads near streams, railroad beds, gravel piles in waste areas such as junkyards, golf course sand traps, and nesting areas created specifically for turtles.

Individual movement patterns among Wood Turtle populations vary. In some streams, especially where winter ice cover is low or nonexistent, Wood Turtles may be detected year-round even where activity may be minimal in mid-winter. Broad characterizations of movement and space-use are valuable when contextualizing many of the challenges associated with Wood

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3 Ecotones are transitional zones between distinct, adjacent habitats, such as the transitional area between a hayfield and a floodplain forest.



1.5—In much of their range, Wood Turtles overwinter or brumate underwater in streams or associated floodplain channels and oxbows during the coldest months of the year, which may extend from November to April. In Massachusetts (pictured), Wood Turtles may overwinter in deep pools associated with bends in the river (left), or in the roots of large trees such as this Eastern Hemlock (*Tsuga canadensis*) (right). MIKE JONES

Turtle conservation.<sup>4</sup> Wood Turtles’ “active period” varies with latitude and elevation (i.e., Wood Turtles are generally active for longer periods in warmer regions), but generally spans from April to October in northern or high-elevation areas, and from March to November in more moderate areas. Wood Turtle activity can be subdivided into at least five distinct periods: (1) emergence and pre-nesting, (2) nesting, (3) post-nesting, (4) pre-brumation, and (5) brumation.

Wood Turtles then retreat to streams and settle into overwintering locations within the stream channel (1.5). The overwintering period occurs during the coldest months of the year from November or December to March or April. Wood Turtles remain largely immobile while overwintering, but may make occasional small underwater movements.

Similar to related turtle species, Wood Turtles display delayed sexual maturity and small clutch sizes. In addition, Wood Turtle populations typically suffer high nest predation and juvenile mortality rates even without the presence of anthropogenic pressures. These factors are only offset by their longevity (>70 years in the wild), high adult survival rates, and continued reproduction into old age. In fact, Wood Turtle generation time may exceed 45 years. It is clear from studies of related species with similar life history characteristics that even small increases in the adult mortality rate can lead to steady population decline and local extirpation. Their precarious balance of life history traits—which require adult turtles to have high annual survivorship—coupled with the Wood Turtle’s highly terrestrial nature, has made the species particularly susceptible to the broad array of anthropogenic threats affecting streams throughout its range in the United States and Canada.

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4 A detailed description of Wood Turtles’ spatial ecology is provided in Chapter 6.



1.6—Adult Wood Turtles are medium-sized emydid turtles. The carapace is usually brownish, broad, flat, ovate, and lightly to strongly keeled with a heavily “sculpted” or “engraved” appearance. A typical adult female from western Lake Superior is pictured. MIKE JONES

Individual Wood Turtles face numerous threats directly or indirectly associated with anthropogenic development. Habitat loss, fragmentation, and degradation due to development, road mortality, and human land use (e.g., agriculture) are widely considered the primary causes of population declines throughout the range.<sup>5</sup> However, Wood Turtles are also vulnerable to incidental and commercial collection for pet markets, pathogens, human-subsidized predators, pollution, stream bank stabilization, and loss of functional nesting areas from invasive plant species. These factors, which affect Wood Turtle populations in varying combinations and degrees of severity, contribute to the overall decline experienced by the Wood Turtle throughout the global species range.

As a result of perceived rarity, documented population declines, and localized extirpations, agencies and organizations throughout the species’ range have listed the Wood Turtle as endangered or threatened. Current levels of protection—and the tools available to the partners working for its long-term conservation—are clearly inadequate for the long-term preservation of the Wood Turtle’s evolutionary potential. Meaningful conservation of this elegant and distinctive creature will require a renewed commitment to land conservation at large spatial scales, creative and careful stream restoration efforts, and attention to the unfolding climate crisis.<sup>6</sup>

## Appearance

The Wood Turtle is a medium-sized turtle with a broad, flat, ovate, lightly to strongly keeled, brownish carapace (1.6). The carapace may be solid in color or have radiating or reticulated yellow marks or spots, with or without a sculpted or engraved appearance (Surface 1908; Logier 1939;

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5 The threats influencing Wood Turtle populations are enumerated and described in Chapter 8.

6 Restoration opportunities for Wood Turtle populations are discussed in Chapter 9.



1.7—The Wood Turtle's carapace, while usually brownish, can be highly variable in coloration based on the turtle's age and environment, the season, and whether the animal is wet or dry. Adult male Wood Turtles are pictured from across the range.



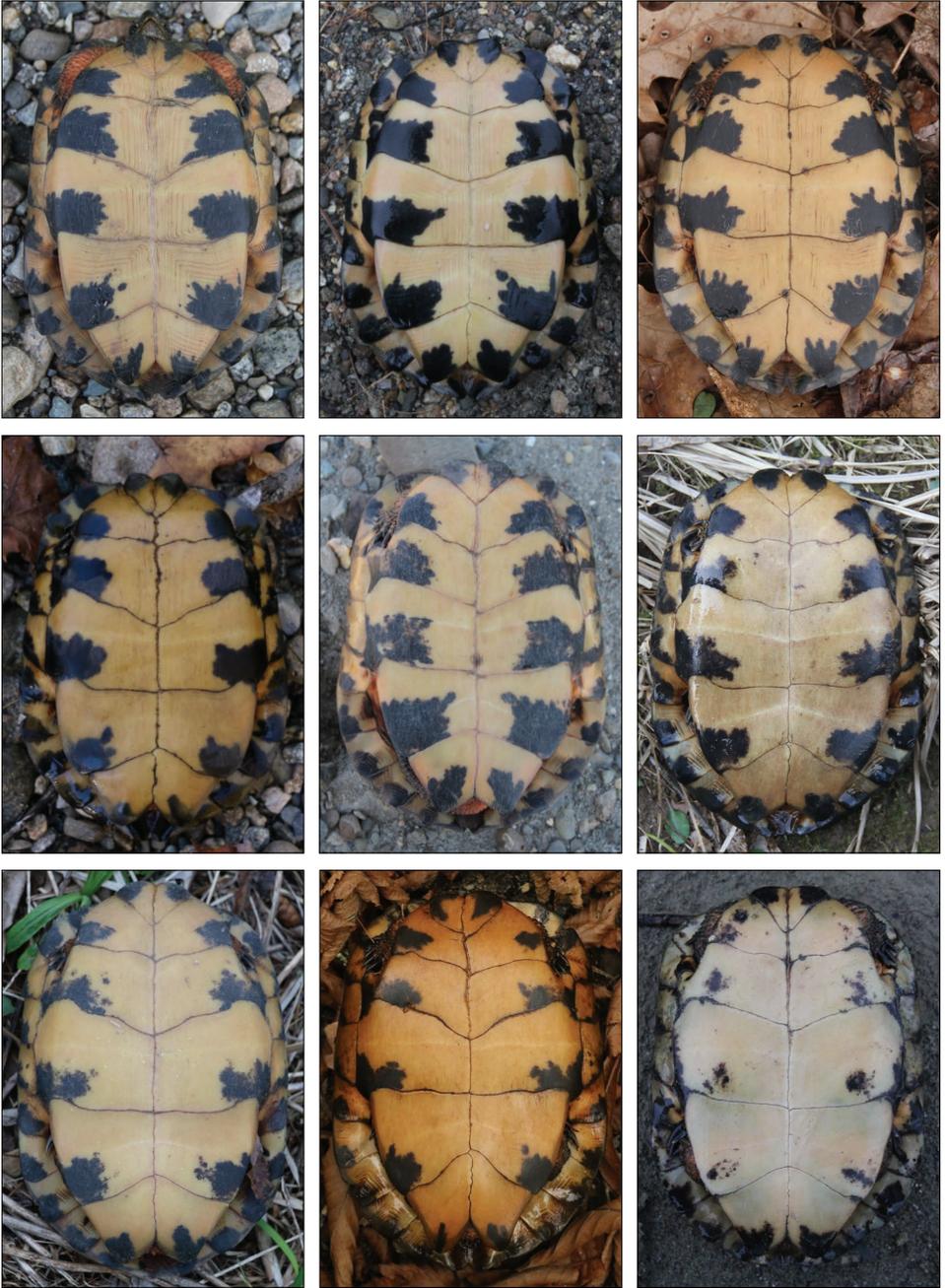
1.8—In some adult male Wood Turtles, the posterior margin of the carapace may be strongly flared. An adult male from Vermont is pictured. MIKE JONES



1.9—The scutes of the carapace gradually become worn smooth, and the annuli become less distinct in older adult Wood Turtles. The carapace generally takes longer to become completely worn than the plastron. *Top*: females from New York. *Bottom*: females from Maine. MIKE JONES



1.10—The Wood Turtle's plastron is usually yellowish-cream or horn-colored, with prominent blackish pigmentation blotches. Adult male Wood Turtles are pictured from across the range.



1.11—The pigment blotches on the Wood Turtle's plastron diminish with age in some populations. Progressive plastral pigment loss is pictured in female Wood Turtles from across the Northeastern United States.

Ernst and Lovich 2009).<sup>7</sup> Carapace scutes typically number 38 following the pattern of most living emydid turtles (Holbrook 1838, 1842; Storer 1840): twelve marginal and four pleural scutes on both sides; five vertebral scutes; a single, narrow nuchal scute. The color of the carapace may be brown, reddish brown, tan, grey, or black in adults (Surface 1908; Ernst and Lovich 2009), with or without radiating or reticulated yellow-gold and blackish markings, and with or without radiating striae (Le Conte 1830; Storer 1840) (1.7). The scutes of the carapace accumulate growth rings in the outer layers of keratin; these may contribute to a sculptured or pyramidal appearance in young adult turtles, but are not strongly reflected in the underlying bone (Phillips 2006).<sup>8</sup> The posterior margins of the carapace are serrated (Vogt 1981), and sometimes strongly flared (Surface 1908), especially in males (1.8). The scutes of the carapace become worn and smooth in older adults (Le Conte 1830; Gray 1831; Jones 2009) (1.9).

The plastron is yellowish-cream or horn-colored, deeply notched posteriorly, with prominent blackish pigmentation located posteriolaterally on each plastral scute (Surface 1908; Vogt 1981) (1.10). Similar black blotches are found on the ventral surface of the marginal scutes (Holbrook 1838; Babcock 1919; Ernst and Lovich 2009). The pigment of the plastral scutes is lost with age (Jones 2009) (1.11). Like the carapace, the plastron accumulates growth rings visible in the outer layers of keratin. Older rings accumulate along the medial and cranial edges of each plastral scute. In younger turtles, areas of new growth on the plastron are evident as lighter-colored annuli along the ventral midline (1.12). Individual turtles may be stained by tannins or iron oxide and thus appear to have a reddish-brown coloration; this condition may affect entire populations or only certain individuals within a population based on individual habitat use. Wood Turtles may also experience discoloration from silt or algae deposited during the winter (1.13).

The head, outer surfaces of the forelimbs, and tail of Wood Turtles are typically black. Both males and females often exhibit bright orange to red neck, forelimbs, and hind feet (Ernst 1972; Ernst and Lovich 2009), while some populations may be dull yellowish. Specifically, Wood Turtles from the Great Lakes region have light yellow or yellow-orange limbs and neck; more reddish-orange tones are native to the Appalachian region (Harding and Bloomer 1979; Ernst and Lovich 2009) (1.14). The nape of the neck and throat may be dark gray, and the throat may be adorned with yellow in young individuals. Skin coloration reportedly varies in intensity seasonally or geographically (Harding and Bloomer 1979) and by sex (Ernst and Lovich 2009).

The upper jaw is strongly hooked and notched at the tip, and the lower jaw is similarly hooked upward. Mottled lines of black, white, blue, and yellow may be present on keratinized surfaces of

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7 John Eatton Le Conte (1830), John Edward Gray (1831), and John Edwards Holbrook (1838) provided most of the defining characteristics of the Wood Turtle during the decade of its initial description. A full account of the Wood Turtle's description and historical biology are provided in Chapter 3.

8 Phillips (2006) provides a uniquely detailed anatomical review of Wood Turtle skeletal remains in the context of paleontological research in Mississippi. On this point, he says: "Individual scutes in [the Wood Turtle] represent a multilayered composite of annually deposited scutes, each new scute attached to the bottom and larger than that of the preceding year's scute. A Wood Turtle scute, or scute growth complex, overlies a less interesting and more subdued corresponding bony substrate, delimited by seam lines, upon which the scute grows. The growth of the Wood Turtle's pyramidal scutes produces an interesting surface texture in which each scute possesses a pattern of regularly spaced radiating ridges. These ridges are combined with and intersect a pattern of equally spaced concentric ridges, the two together producing a peculiar texture on the scute pyramid that is not realized in the underlying, almost featureless bone."



1.12—New growth is evident in younger Wood Turtles as a lighter-colored segment along the midline (medial) and anterior portion of each plastral scute. When observed in the spring, the whitish area of growth closest to the plastral midline represents the previous year’s growth. As measurable growth ceases with the onset of maturity, the lighter areas take on the more typical yellowish coloration. Young Wood Turtles from Maine are pictured. MIKE JONES



1.13—Tannins, silt, and algae cause temporary discoloration in some Wood Turtle populations. *Top left:* Tannin-stained adult male from New Hampshire. MIKE JONES. *Top right:* Tannin-stained adult male from Wisconsin. ANDREW BADJE. *Bottom right:* Algae-covered adult female Wood Turtle from Massachusetts. MIKE JONES. *Bottom left:* Silt-covered adult female from Ontario, Canada. JOE CROWLEY.



1.14—Wood Turtles from the western Great Lakes region have light yellowish skin. Wood Turtles from the Appalachian regions have a more reddish- or orange-colored skin. Pictured are a female from western Lake Superior (*top*), and a female from northern New England (*bottom*, eating an earthworm). MIKE JONES

the beak. Some adults of both sexes possess a prominent golden ring in the iris, the function of which is unknown (1.15).

### **Size and Sexual Dimorphism**

Male Wood Turtles are larger than females in most living populations (Table 1.1). Female Wood Turtles are typically 170–200 mm minimum straight-carapace length (SCL<sub>min</sub>); and males typically range from 180–215 mm SCL<sub>min</sub>. Lovich et al. (1990) reported that males are



1.15—Some adult Wood Turtles have a prominent golden iris. The trait seems to be more common in adult males and may be progressive with age, although it is sometimes present in females and younger turtles. An adult male Wood Turtle from New England is pictured. MIKE JONES

Table 1.1—Wood Turtle morphometric data summarized from across the species' range, with standard errors. Where provided, the number in parentheses indicates the number of turtles weighed.

State/ Province	Females			Males			Source
	SCLmin (mm)	Mass (g)	<i>n</i>	SCLmin (mm)	Mass (g)	<i>n</i>	
QC	201.1±10.9	1083±168	83	214.5±4.2	1173±252	55	Walde et al. (2003)
QC	181.0±5.5	881.7±92.91	12	193.9±9.0	1008±147	15	Saumure and Bider (1998)
QC	200.5±11.6	1061±127	10	215.6±22.3	1219±361	9	Saumure and Bider (1998)
ON	195±5	1099±127	21(18)	205±19	1152±238	15(13)	Greaves and Litzgus (2009)
MI	182	-	105	200	-	86	Harding and Bloomer (1979)
ME	189.1±8.5	1060±145	69	207.2±10.6	1231±156	60	Jones and Willey (2013b)
ME	181.1±7.5	1006±100	102	196.2±8.1	1114±119.2	51	Jones and Willey (2013b)
ME	193.7±10.3	1121±174	23(29)	201±13.2	1210±179	9(11)	Compton (unpubl. data)
NH	184.3±8.6	973±126	37	200.4±10.1	1116±150	28	Jones and Willey (2013a)
NH	174.8±9.9	865.9±111	66	189.3±8.9	973±133	54	Jones and Willey (2013a)
MA	171.8±7.7	875±121	83(12)	182±7.6	872±121	83(15)	Jones et al., unpubl. data
MA	170.9±7.0	830±37	37(14)	184.4±7.5	889±102	42(16)	Jones et al., unpubl. data
MA	176.8±10.4	911±160	9(8)	185.4±6.3	939±91	18(16)	Jones et al., unpubl. data
MA	172±7.6	854±96	64(19)	186±9.6	887±120	49(2)	Jones et al., unpubl. data
NJ	165	-	464	178	-	311	Harding and Bloomer (1979)
NJ	170.9±9.3	-	49	177.0±8.9	-	69	Farrell and Graham (1991)
VA	185±9.5	-	78	195±12.5	-	43	Akre (2002)
WV	179±9.6	846.7±174	15	190.6±12.2	932±178	16	Breisch (2006)

approximately 1.07 to 1.1 times larger than females. Agri-forest and forest populations in Québec both had males 1.07 times that of females in the respective populations (Saumure and Bider 1998). Our unpublished data from Maine, New Hampshire, and Massachusetts correspond with this estimate (1.1, 1.08, and 1.06, respectively; Jones and Willey 2013a and 2013b). Jones et al. (2019) presented limited evidence that male-biased dimorphism may be plastic, based on a review of specimens from the 1850s. Jones et al. (2019) also presented evidence of smaller mean carapace lengths in the 1850s based on a single site in Massachusetts.

Wood Turtle shell dimensions generally increase with northerly latitude. The largest Wood Turtles, on average, are associated with the northernmost populations in Québec. The smallest average Wood Turtles have been reported in New Jersey. Mean body size of Virginia and West Virginia specimens reported by Akre (2002) and Breisch (2006) and the Brome County, Québec population studied by Saumure and Bider (1998) represent notable deviations



1.16—The largest documented Wood Turtles have usually been reported from the northern range-margin. The largest Wood Turtle currently on record, a young male from Maine, is pictured. MIKE JONES



1.17—Male Wood Turtles are larger than females, with a concave plastron and a longer, heavier, thicker tail. In the comparison above, the female is on the left and the male is on the right. Adult Wood Turtles are pictured from New England. MIKE JONES

from an otherwise clear trend. The unexpectedly small body size reported in the Brome County population is perhaps a result of the energy required to heal shell injuries from agricultural machinery (Saumure and Bider 1998; Saumure et al. 2007).

Exceptionally large Wood Turtles may exceed maximum carapace lengths of 250 mm, and are found primarily in the northern portion of the species' range. Jones and Compton (2010) reported an unusually large, 25-year-old male Wood Turtle (SCL<sub>min</sub>=240 mm; mass=1895 g) from northwestern Maine (1.16). Subsequently the largest turtle of 1,763 Wood Turtles measured in New England from 2004–2019 by Jones and Willey (unpubl. data) was another Maine male with SCL<sub>min</sub>=232.5 mm and mass of 1,340 g. Saumure (1992) presented evidence of two very large male Wood Turtles (SCL=238 mm and SCL=234.5 mm) from Pontiac County, Québec. The latter Québec specimen is equal to the largest *G. insculpta* reported by Conant and Collins (1991). This same Québec forest population had the largest adult female recorded (SCL=227.45 and mass of 1,450g), captured still gravid on a nesting site (Saumure, unpubl. data). Other large females (SCL=225 mm) have been encountered at the northernmost limits of the species' range in Ontario and Québec, Canada (Brooks et al. 1992; Walde et al. 2003). Another large female specimen of unknown origin was recovered during a confiscation event (SCL<sub>min</sub>=225 mm) (Northeast Wood Turtle Working Group, unpubl. data).

Adult male Wood Turtles have long, thick tails with the cloacal vent equal to or posterior to the carapace rim (Oliver 1955) and a strongly concave plastron (1.17). Males also have heavier scales on the forelimbs (1.18). Males' heads are absolutely and relatively larger than those of adult females (Akre 2002). Ernst and Lovich (2009) reported that some older males have carapace indentations at the bridge.

### Technical Descriptions

Ernst (1972) provided additional references for technical descriptions of the skull, shell, seam contacts, cervical vertebrae, nasal choanae, arterial canals of the ear, and penis (Parker 1901;



1.18—Male Wood Turtles have larger heads than females and heavier scales on the forelimbs. An adult male from New England is pictured. MIKE JONES



1.19—Wood Turtle hatchlings are usually gray-brown, with a mottled grayish or slightly peach-colored plastron. Hatchlings are pictured from across New England. MIKE JONES & DEREK YORKS

Zangerl 1939; Williams 1950; Romer 1956; Parsons 1960; McDowell 1961; Tinkle 1962; Zug 1966; Parson 1968). Phillips (2006) provided a comparative discussion of ancient Wood Turtle skeletal remains from Mississippi. Holman and Fritz (2001) provided detailed shell diagrams.

## Hatchlings

Hatchlings are generally uniform gray-brown, with a mottled grayish plastron and no carapace keel (Vogt 1981) (1.19). Hatchlings are typically between 30.4 and 39.5 mm in straight-carapace length and between 6.7 and 12.3 g in mass (Ernst and Lovich 2009; Dragon 2014). Adult skin coloration is usually evident by the second or third year in the wild.

## Summary

At this moment in their evolutionary arc, Wood Turtles are a species of wild rivers; seemingly perfectly adapted to the seasonal disturbance regimes of mid-sized streams. Viable, connected, persistent, and resilient populations occur most often in relatively remote areas where key features—such as nesting areas and overwintering sites—occur near one another. The Wood Turtle's long lifespan means that the species may be detected long after the population has ceased normal function. This phenomenon likely hinders long-range conservation efforts—especially those that are of consequence on evolutionary timescales—by redirecting resources to severely impaired sites. These and many other aspects of Wood Turtle natural history and habitat requirements are discussed in later chapters, but the persistence of representative populations of Wood Turtles on the North American landscape—for periods of time beyond what can be easily modeled or imagined—will require adequate preservation of high-quality, remote river and stream environments with minimal human disturbance.

In these streams, Wood Turtles can be remarkably variable in appearance, sometimes imbued with tannins or covered in silt or algae. The Wood Turtle's attractive appearance may be part of their ongoing downfall, as dedicated collectors target an ever-expanding network of sites, undermining well-meaning conservation efforts.



**BIOLOGY & CONSERVATION**  
*of the* **WOOD TURTLE**

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Editors

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