

10. A CONSERVATION VISION

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Adult male Wood Turtle in New England. MIKE JONES



10.1—Relictual and remnant Wood Turtle populations—as well as individual Wood Turtles—may still be found in a wide variety of stream conditions from Nova Scotia to Minnesota to Virginia, conveying an appearance of versatility and adaptability and masking the extent of recent decline. An isolated population has persisted for more than 15 years at extremely low population levels—evidently fewer than five adult Wood Turtles—in this small stream in central New England, but it is generally not an ideal target for regional conservation resources. MIKE JONES

Despite startling levels of recent habitat loss and troubling demographic trends throughout much of the historic range, we remain hopeful there is a strategic path forward to ensure the survival of the Wood Turtle as an evolutionary lineage *in the wild*. We conclude this book with suggestions for a conservation vision aimed at protecting the evolutionary potential of the species. We emphasize conservation measures that reflect temporal and spatial scales relevant to the life history, ecology, and behavior of this unusual species.

Wood Turtles are still regularly found throughout their pre-colonial geographic range, superficially conveying the appearance of versatility and adaptability to human-dominated environments (10.1). In reality, however, the majority of occurrences seem to represent relictual and remnant populations that continue to persist on the landscape due to the remaining individuals' longevity, but which may be functionally extinct from an ecological and demographic perspective. In general, it is a mistake to presume that Wood Turtles can be easily conserved—through land protection or through the application of best management practices—within relatively small sections of those streams where Wood Turtles have been simply documented to occur.

Successful conservation of Wood Turtle populations—as for any threatened vertebrate—will be imagined and measured in multiple generations, a difficult proposition considering the rapid pace of anthropogenic change. At more than 30 years, the Wood Turtle's generation time is relatively long among terrestrial North American vertebrates. Therefore, conservation and management of this species will require a temporal outlook of a century or more, rather than a decade. This often-overlooked time horizon can prove challenging for conservationists to envision (van Dijk

and Harding 2011; Jones and Willey 2015), but must be central to any conservation plan or management strategy at the scale of the entire species' range. Management actions will have little positive influence on local Wood Turtle populations unless they are fundamentally long-term (i.e., multi-decade) in nature.

Furthermore, demographically stable and resilient Wood Turtle populations require long-term landscape complementarity. That is, a configuration of landscape features that reliably maintains important resources within close spatial proximity. Wood Turtle survival and recruitment are generally higher where there is pronounced convergence of suitable stream geomorphology and substrate, nesting site availability, stable in-stream overwintering sites, abundant in-stream woody structure and terrestrial basking areas, and upland vegetation consisting of diverse mosaics of varying successional stages. When these conditions coincide with low levels of roads, development, human recreation, and intensive agriculture in the surrounding uplands (i.e., low mortality across age classes), Wood Turtle populations will generally show demographic resilience necessary for long-term persistence (Chapter 7). Among stream-dwelling or fluvial North American turtles (10.2), the Wood Turtle is unusual in its tendency to spend many months active on land; among the terrestrial North American turtles, the Wood Turtle is noteworthy for its tendency to spend many months underwater (10.3).

Fortunately, adult Wood Turtles appear to exhibit pronounced fidelity to these locations over decades with minimal rates of inter-annual home range drift or dispersal away from familiar areas (Compton 1999; Compton et al. 2002; Jones 2009), suggesting that documented areas of Wood Turtle occurrence will remain relatively stable over time, allowing for the implementation of long-term conservation or restoration programs. However, it is abundantly clear that landscape complementarity for Wood Turtles is not maintained naturally without unimpeded disturbance dynamics (e.g., seasonal flooding that periodically generates and maintains critical nesting, foraging, overwintering, and basking areas). Thus, the conditions that generally promote robust, stable, or resilient Wood Turtle populations are often influenced by conditions upstream in the



10.2—Other North American turtles that are primarily stream-dwelling (i.e., they exhibit fluvial habitat requirements), such as (from the top) Western Pond Turtles (*Actinemys* spp.), Sonoran Mud Turtles (*Kinosternon sonoriense*), and Flattened Musk Turtles (*Sternotherus depressus*), do not generally forage extensively on land. MIKE JONES



10.3—Other strongly terrestrial North American species such as the box turtles (e.g., *Terrapene carolina carolina*, pictured at left) and gopher tortoises (e.g., *Gopherus polyphemus*, pictured at right) utilize varied upland habitats that are not further constrained by the need to be near a suitable stream or river. MIKE JONES

watershed—including areas that may not support Wood Turtles. Indeed, relative Wood Turtle abundance has been shown to be best-predicted by variables at broad scales (e.g., greater than 5 km; Jones et al. 2018) reflective of watershed habitat integrity. While the spatial footprint of a typical Wood Turtle subpopulation may appear relatively small in comparison to the watershed, it is clear that protection of the broader landscape and associated ecological processes must be central to Wood Turtle conservation initiatives if they are to be sustainable in the long-term without intervention.

While landscape-oriented conservation is a challenging task, permanently protecting critical habitat and preserving stream disturbance dynamics in areas that still support robust populations represents a longer-lasting and more cost-effective approach than continual deployment of intensive management actions that are short-term in nature and challenging to assess. Relatively intact landscapes still exist that support self-sustaining Wood Turtle populations. Given this reality, we argue that it is essential that resources devoted to range-wide and/or regional conservation are used to identify and protect those rare watersheds that are: (1) not fragmented or otherwise degraded by roads, development, recreation, or agriculture, particularly within 300 m of streams (but see Carroll 2018); (2) characterized by natural flood dynamics (i.e., limited human impoundments, bank stabilization, and channelization); and (3) documented to support robust Wood Turtle subpopulations that ideally exhibit typical metapopulation dynamics (i.e., varying reproductive and survival rates, successful immigration and emigration). Through targeted land protection and conservation easements of key locations within priority watersheds, and a successful landscape-scale conservation strategy within the basin, it can be possible to achieve not only population persistence over multiple Wood Turtle generations, but also levels of gene flow to sustain genetic connectivity and diversity. Because comprehensive protection of entire watersheds will be unfeasible in nearly all cases, conservation efforts within watersheds will require a multi-pronged strategy that: (1) prioritizes as much land protection as possible within optimal habitat; (2) minimizes anthropogenic stressors; and (3) restores or maintains natural fluvial dynamics to Wood Turtle streams.

Though large landscape protection can achieve a variety of conservation goals for this species, an additional challenge at the forefront of Wood Turtle conservation is that of collection by humans. The removal of Wood Turtles from the wild will continue to undermine conservation efforts directly, through the loss of adult turtles, but also indirectly, by discouraging open sharing of spatially explicit site information, even for conservation purposes. Illegal collection should



10.4—The strategic protection of functional, core wetland and riverine habitats and surrounding uplands must remain the priority for regional conservation partnerships. While true for Wood Turtles, it is also the case for related species across North America such as (clockwise from top left) the Bog Turtle (*Glyptemys mublenbergii*), Spotted Turtle (*Clemmys guttata*), Blanding's Turtle (*Emydoidea blandingii*), and the western pond turtles (e.g., *Actinemys pallida*, pictured), among others. MIKE JONES

remain a high priority for federal and state law enforcement, and we highlight that the primary emphasis should remain on preventing the *original collection*, and less on how to manage the individual turtles that are seized or confiscated. The Wood Turtle could benefit from a federal permitting system that places the burden of proof for legal acquisition on the seller/buyer/owner rather than law enforcement officers. At present, the species is easily laundered in and out of states that do not protect the species under state law. Neither land protection or management actions can counter the effects of removing reproductive adult Wood Turtles from populations. Ultimately, if progress is not made in curtailing the expansion and continuation of illegal collection, our general conservation approach will be undermined.

While we contend that landscape-oriented conservation actions outlined thus far represent the most promising actions for preserving the evolutionary potential and long-term persistence of the Wood Turtle, we recognize they are not realistic possibilities for conservationists within portions of the species range where landscapes and fluvial systems are more degraded. Too much emphasis on the highest-quality habitats does not adequately represent the importance of less intact habitats that provide important connectivity between intact or dynamic landscapes. We maintain that valuable actions can still be implemented within human-dominated portions of the range that can have a positive impact for Wood Turtle conservation as a whole (and see Wiedenfeld et al. 2021). For example, in degraded streams, progress can be made through restoration of the original river channel, experimental addition of large wood, nest area management, time-of-year restrictions for machinery in hayfields and pastures, and/or targeted law enforcement efforts (Chapter 9). It is important to acknowledge, however, that while these options may be locally sustainable, they are often expensive and require nearly constant maintenance when

compared to the theoretical ideal of conserving naturally functioning fluvial systems within unfragmented landscapes. Furthermore, when considering the monetary and logistic challenges of these management actions within the context of the life history of the Wood Turtle (extremely slow population growth even under favorable conditions), it becomes clear that such strategies require a long-term (multi-decade) outlook to achieve positive outcomes. However, despite our emphasis on large-landscape conservation—and our insistence that individuals not be confused for functional populations—based on our own experience with many extremely small Wood Turtle populations in urbanized landscapes, we acknowledge the value of attempting restoration efforts with local resources.

Of course, there are also strategies that aim to actively manage the populations themselves, such as captive breeding, repatriation of confiscated turtles (Jones et al. 2018), and headstarting juveniles from wild nests (Mullin et al. 2020). On one hand, many of the contributing authors to this book have been involved in such intensive population management, but these methods are not central to the range-wide stability of the species. While these methods may eventually prove valuable in buying time for small populations within areas of marginal habitat suitability and may have important educational or support-building outcomes, scientific evidence for such a strategy remains lacking. On the other hand, if population management is conducted responsibly and effectively, based on a sound understanding of the local population, there may be value in bringing public attention to the conservation needs of the species. There may also be meaningful applications of population management as part of a landscape-focused conservation program, but actions should be taken to ensure such efforts do not distract and pull resources from the landscape-level needs of the species. The best possible outcome of direct population management through headstarting, in our judgment, is leveraging the headstarting program for meaningful landscape-level habitat restoration programs.

But in the end, the ultimate factors that will influence sustainable Wood Turtle conservation outcomes on evolutionary timescales are mostly related to the strategic conservation and restoration of large landscapes that encompass whole rivers and their floodplains. In our experience, some of the best examples of effective landscape-level conservation for Wood Turtles have been stitched together accidentally from patchworks of public and private land. Strategic protection of functional core habitats and surrounding upland must remain the priority for regional conservation partnerships. While large landscape conservation, management, and restoration informed by natural disturbance regimes is clearly the driving conservation need for Wood Turtles in most of their range, it is also a necessary component of successful conservation strategies for related, widespread, semi-terrestrial turtles, such as the Bog Turtle (*Glyptemys mublenbergii*), Spotted Turtle (*Clemmys guttata*), Blanding's Turtle (*Emydoidea blandingii*), and western pond turtles (*Actinemys* spp.) (10.4), as well as countless other wetland-dependent species.

We close this volume with an acknowledgment of the proverbial elephant in the room: the climate conditions that have prevailed over the past several decades of Wood Turtle inventory and monitoring and research are not what we should expect in coming decades. Some perennial streams will seasonally run dry. Many will flood severely at inopportune times. Coldwater streams will transition to warmwater habitats. Invasive plant species will continue to proliferate in sensitive riparian areas. The specific effects of climate change at the site level are largely unpredictable, and this uncertainty further argues for dedicated efforts to conserve large, dynamic, diverse, and resilient landscapes where feasible to mitigate these changes (see Anderson et al. 2014; Baldwin et al. 2018).

Biology and Conservation of the Wood Turtle provides information for the interpretation, study, and conservation of the Wood Turtle and associated ecosystems. It is our hope that the collaborative and interdisciplinary nature of this book will provide guidance at the federal, state, and local level to accelerate appropriate land conservation, management, and restoration efforts. With this volume, we primarily provide generalized recommendations derived from years of field experience and a review of the existing scientific literature; however, given the broad geographic range of the species, which spans numerous ecological and jurisdictional zones, we urge all managers and conservationists to develop local and site-specific strategies. Last, because incidental and commercial collection of Wood Turtles remains a pervasive, accelerating, and often underperceived threat to local populations and the species as a whole, it is important that the conservation community continue to think creatively about this issue in addition to best methods for sharing important spatial information about conservation priorities without further compromising priority populations (10.5).



10.5—As conservation biologists and managers, we must continue to think creatively about how to share important spatial information about conservation priorities without further compromising priority Wood Turtle populations. It is also essential to continue to pursue the conservation and restoration of large, forested landscapes centered on suitable streams and rivers. Pictured: Wood Turtle habitat in West Virginia. DONALD BROWN

BIOLOGY & CONSERVATION
of the **WOOD TURTLE**

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Editors

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