Appendix C: Natural Heritage & Endangered Species Program Summary Letter and Fact Sheets for State-listed Species

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director*

February 14, 2013

Sylvia Willard
Town of Carlisle
Conservation Administrator
66 Westford Street
Carlisle, MA 01741

VIA E-MAIL

Re: Open Space Plan; NHESP #13-31866 (2013 update)
Town of Carlisle

Dear Ms. Willard:

Thank you for contacting the Natural Heritage and Endangered Species Program regarding the update for the Open Space and Recreation Plan for Carlisle. Enclosed is information on the rare species, vernal pools, and other aspects of biodiversity that we have documented in Carlisle.

For biodiversity conservation purposes, based on analysis for the BioMap2 and information discussed below, NHESP recommends land protection in the BioMap2 cores or protecting lands adjacent to existing conservation land. All of the areas discussed below are important for biodiversity protection in Carlisle.

Enclosed is a list from our database of rare species known to occur in Carlisle. NHESP has no records of any state-listed invertebrates or priority natural communities in Carlisle.

Carlisle was recently sent a town focused report on BioMap2 Core Habitats (BC) and Critical Natural Landscapes (CNL) and their components which can be included in the OSRP if desired. We were pleased to hear that the Carlisle OSRP committee has already downloaded fact sheets for state listed species from our website to include in the OSRP. Fact sheets for some of the other species of conservation interest are also available from our website: http://www.mass.gov/dfwele/dfw/nhesp/species_info/fact_sheets.htm and

NHESP produced fact sheets describing the various other components of BioMap2 (relevant to Carlisle are Forest Core, Aquatic Core, and Wetland Cores (Least disturbed Wetland complexes), and, in CNL, Upland Buffers of Aquatic and Wetland Cores, and Landscape Blocks) that are on our website at:

http://www.mass.gov/dfwele/dfw/nhesp/land_protection/biomap/biomap_methodology.htm

The components are described in full in the BioMap2 summary report available from:
http://www.mass.gov/dfwele/dfw/nhesp/land_protection/biomap/biomap2_summary_report.pdf

The rare animal species currently known from Carlisle are all associated with wetlands, although some of these species use upland habitat as well.

Carlisle has several known occurrences of Blue-spotted Salamanders (SC): these salamanders breed in vernal pools in the spring and spend the rest of their adult lives in the leaf litter of surrounding upland forest areas. The populations are scattered around the less developed parts of town; however, at least one has had the habitat fragmented by development. All of the Blue-spotted Salamander populations are on or near protected open space and are in BioMap2 Core Habitats (2266, 2344, and 2378), although the Core Habitats weren't always drawn to protect those particular populations. Four-toed Salamanders (delisted, that is removed from the state list because they have been shown to be more common than previously thought) nest in patches of

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sphagnum moss that overhang streams. The young drop into the streams where they live until they become adult, at which point they move to nearby forests to live. Both populations in Carlisle are in BioMap2 Core Habitat (2299 and 2378) but not on protected lands.

Four species of turtles of conservation interest occur in Carlisle. For all of the turtles loss of only a few adults annually can cause populations to decline as they do not reproduce until they are at least several years old, often into their teens, and have low replacement rates due to low nest and juvenile survivorship. Roads are the primary cause of adult mortality. All of the turtle species travel to appropriate nesting sites, usually open sandy areas. Blanding's Turtles (T) have an excellent population in BioMap2 Core Habitat 2378 in the wetlands and forests of the eastern part of town. Blanding's Turtles inhabit a mix of seasonal pools, marshes, shrub swamps, forest, and open uplands. These turtles move overland to vernal pools and shrub swamps to feed and mate, as well as to nesting areas. Wood Turtles (SC) overwinter in stream banks and tend to stay in the vicinity of the streams and wetlands through the year, although they may follow a stream for miles or go cross country to reach a nesting area; a very small population is known from the eastern part of town in Core Habitat 2378. The Eastern Box Turtle (SC) is a terrestrial turtle, inhabiting dry and moist woodland habitats. In Massachusetts, the main populations are in the southeast and the Connecticut Valley. The very small population in northern Carlisle is towards the northern edge of its range. The delisted Spotted Turtle favors wetlands and adjacent forests, and, like all the turtles, use open sandy areas for nesting. They are often associated with Vernal Pools. The multiple occurrences in Carlisle are scattered around town, usually near vernal pools, in Core Habitats 2344 and 2378, as well as elsewhere in town on and off of conservation land.

Protecting all types of wetlands and their surrounding forests and other uplands enhances the habitats of all these species and others, as well as protecting water quality.

Of the seven state-listed and three unregulated Watch Listed (WL) species of plants known from Carlisle, six state-listed and one of the WL species are considered to be historic, not seen in town in over 25 years, most with observation dates a century or more ago. These are species of open areas that have all decreased state wide as forests have grown where open agricultural land with its open or partially forested edges used to be. Even the rare species currently occurring in town are species that grow best where there are openings. Before these lands were in agriculture, the currently rare species would have been uncommon, as now, dependent on natural disturbances to create small openings in the prevailing forest. However, now, unlike the distant past, some of the disturbances are controlled (less beaver activity and less natural flooding, for example), and much of the landscape is now not available as habitat where residential and other development occur.

Climbing Fern (SC) does not have the characteristic overall shape of most ferns. Instead, it is an evergreen, ivy-like plant that sprawls over the ground or climbs clockwise short distances up shrubs and coarse herbs. Climbing Fern does best in open areas such as old fields and power line rights of way, but populations persist in moist pine-oak-maple woods with an open understory, in moist thickets, and along stream margins.

Britton's Violet (T) is a low-growing, herbaceous, purple flowered perennial found along the edges of river floodplains. It, too, is a species that does best without shade, but in this case it is restricted to floodplains and wet meadows associated with them. The occurrence in Carlisle is on conservation land in Core Habitat 2378 with Blanding's Turtles and other wetland species. Threats include disruption of the hydrologic regime, and shading from shrubs or trees that might become established if water patterns change.

River Bulrush (WL) is an uncommon (but not MESA-listed) plant currently known to be in Carlisle in Core Habitat 2378. It is a 2 to 5 foot tall sedge that grows in wetlands along lakes, ponds, and rivers.

Orange Milkweed (WL), an orange flowered 1 to 2 foot herbaceous plant of the milkweed family, grows in open, dry sandy areas such as old fields and clearings. It is known from Core Habitat 2378.

The other rare plants that were collected in Carlisle many years ago are all species that tend to disappear when their open habits become shaded by dense shrubs and trees. The records are from museum (herbarium) specimens that give only the town name. Even so, most have been sought in appropriate habitats and not found in the past few years. Arethusa (T), an orchid of bogs, was collected in a "grassy bog" in town in 1904 and in a swamp in the Great Brook Farm area in 1902 (should anyone find it, NHESP would be thrilled to hear of it). Purple Milkweed (E), an herbaceous perennial of open sparsely vegetated woodlands and borders has declined dramatically statewide, only 3 of 43 records are current. Hayden's Sedge (WL) grows in wet meadows. Few-fruited Sedge (E) is a grass-like plant of acidic peatlands. Collected from a "meadow in

Carlisle" almost a century ago, it has recently been found in Bedford in Core Habitat 2378, so it is possible that new surveys in open, peaty wetlands would relocate it in Carlisle. Cornel-leaved Aster (E) is a white flowered aster that inhabits non-acidic, dry rocky, wooded slopes in partial shade. New England Blazing Star (SC), an endemic, globally rare, purple flowered perennial of dry, sandy grasslands and clearings, thrives in fire-influenced natural communities that are periodically disturbed and devoid of dense woody plant cover.

With 69 Certified Vernal Pools (CVPs), Carlisle has done an impressive job of identifying this special type of habitat. Of the 88 Potential Vernal Pools (PVPs) (identified from aerial photographs, needing verification on the ground) in town, some have been certified as CVPs and some will be not be functioning as vernal pool habitat and are not certifiable. Remaining PVPs, and other likely areas of town, should be visited and evaluated for certification and the protections that gives them under the Wetlands Protection Act. Clusters of vernal pools provide particularly good habitat for species that depend on vernal pools. The clusters mean that there are alternate habitats if something happens to one pool, and slightly different conditions in each may provide different habitats for pool dependent species. Clusters of vernal pools are good targets for biodiversity protection: there are clusters in BioMap2 Core 2378 and 2299. In addition, areas of swamps provide habitat for vernal pool species.

The BioMap2 core areas and Contributing Natural Landscape are particularly valuable in ecological terms, and important to the conservation of a variety of species. Completing conservation protection of remaining unprotected land in those areas would enhance the viability of these habitats - size and continuity of open space is particularly important for supporting wildlife populations. Preventing habitat fragmentation is vital in protecting the ecosystem, for the rare species on the enclosed list, as well as for additional common species, particularly reptiles and amphibians (several are noted in the BioMap2 write-up as species of conservation concern from the State Wildlife Action Plan (SWAP).

The NHESP produces maps for use under the Wetlands Protection Act (Estimated Habitat maps, provided to the Conservation Commission and shown in reduced form in the *Natural Heritage Atlas,* and the Massachusetts Endangered Species Act (also in the *Natural Heritage Atlas*). These data layers are also available from MassGIS, requiring access to some form of GIS to view them, at http://www.state.ma.us/mgis/wethab.htm and http://www.state.ma.us/mgis/prihab.htm. These two sets of maps are created for regulatory use. BioMap2 and the original BioMap and Living Waters projects are focused on conservation and cover broader areas and non-regulated components of biodiversity. Town commissions and boards are encouraged to request the assistance of the Natural Heritage and Endangered Species Program in reviewing any project proposed in the habitat areas of the regulatory areas of the maps in the *Natural Heritage Atlas* (the 2008 Atlas, the 13th edition is the current version).

Management and monitoring of conservation lands become important as acquisition and protection are accomplished. All wetlands particularly need to maintain their natural water regime, including normal fluctuations and connections with the uplands and other wetlands. Water quantity and quality are ongoing issues for wetlands. Another aspect of managing conservation lands that is important in many areas is controlling invasive non-native species that alter the habitat and occupy space that native species would otherwise use. We strongly recommend monitoring conservation land, and removing non-native species before they become a problem and impact native species.

Please note that this evaluation is based on the most recent information available in the Natural Heritage database, which is constantly being expanded and updated through ongoing research and inventory. Should new rare species information become available, this evaluation may need to be reconsidered.

Please do not hesitate to contact me at (508) 389-6352 or by email at pat.swain@state.ma.us if you have any questions.

Sincerely,

Patricia Swain

Patricia C. Swain, Ph.D.
Ecologist

cc: Melissa Cryan, EOEEA, DCS

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Program

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Blanding's Turtle

Emydoidea blandingii

State Status: **Threatened**
Federal Status: None

Photo by Susan Speak

DESCRIPTION: The Blanding's Turtle is a mid-sized turtle ranging between 16 and 22 cm (6-9 in.) in shell length. Its high-domed carapace (top shell) is dark and covered with pale yellow flecking. The lower shell (plastron) is yellow with large black blotches on the outer posterior corner of each scute (scale). The plastron is hinged, allowing movement; however, the shell does not close tightly. In older individuals, the entire plastron may be black. The most distinguishing feature is its long, yellow throat and chin, which makes it recognizable at a distance. Males have slightly concave plastrons, females have flat plastrons. The tails of males are thicker and their cloacal opening (the common orifice of the digestive, reproductive and urinary systems) is located beyond the edge of the carapace. Hatchlings have a brown carapace and brown to black plastron, and range between 3.4 and 3.7 cm (1.3-1.5 in.) in length.

SIMILAR SPECIES: This species could be confused with the Eastern Box Turtle (*Terrapene carolina*). The Eastern Box Turtle can have a yellow chin but lacks the yellow throat and neck. Box Turtles are smaller, 10-18 cm (4-7 in.) in shell length. In addition, the Box Turtle has a prominent mid-line ridge (keel) on the carapace, which is absent on Blanding's Turtles. The Blanding's Turtle may also be confused with the Spotted Turtle. However, The Spotted Turtle is much smaller, 3.5-4.5 inches in length and has very distinct round yellow spots.

HABITAT IN MASSACHUSETTS: Blanding's Turtles use a variety of wetland and terrestrial habitat types. Blanding's Turtles have been observed in seasonal pools, marshes, scrub-shrub wetlands and open uplands (Sievert et al. 2003). Habitat use appears to vary according to the individual and the amount of precipitation, with more upland utilization during dry years (Joyal at al. 2001). Wetlands are used for overwintering during their inactive season (Nov-Mar).

RANGE: The Blanding's Turtle is found primarily in the Great Lakes region, extending to Kansas. Several smaller, disjunct populations occur in the East: in southern Nova Scotia, in an arc extending from eastern Massachusetts through southeastern New Hampshire to southern Maine, and in the lower Hudson Valley of New York. These populations (with the exception of those in New Hampshire) are all listed as Threatened or Endangered at the state or provincial level.

Distribution in Massachusetts
1980 - 2006
Based on records in Natural Heritage Database

LIFE CYCLE & BEHAVIOR: Blanding's Turtles overwinter in organic substrate in the deepest parts of marshes, ponds, and occasionally, vernal pools. Some individuals overwinter under hummocks in red maple or highbush blueberry swamps. Upon emergence from overwintering, Blanding's Turtles often leave permanent wetlands and move overland to vernal pools and scrub-shrub swamps, where they feed and mate. It is during the summer months that females estivate in upland forest or along forest/field edges. At night and during periods of hot weather, Blanding's Turtles retreat to "forms". These small terrestrial shelters are found beneath leaf litter, in the grass, under logs or brush located up to 110 m (361 ft) from the nearest wetland. They are called "forms" because when the turtle leaves them, they retain the shape of the turtle's shell.

Blanding's Turtles are omnivores, eating both plants and animals. They eat while on land and in the water. The animals Blanding's Turtles are know to eat, either alive or as carrion, consist of Pulmonate snails, crayfish, earthworms, insects, golden shiners, brown bullheads, and other small vertebrates. Vernal pools are an important source of many of these prey items. The plants that Blanding's Turtles have been known to eat include coontail, duckweed, bulrush, and sedge.

Courtship and mating takes place during the spring and early summer and typically occurs in water. Baker and Gillingham (1983) reported that in seminatural conditions male Blanding's Turtles exhibit a variety of behaviors during mating including: chasing, mounting, chinning, gulping, swaying, violent swaying, and snorkeling. Chinning occurs after the male is mounted, if the female moves forward the male will start gulping (taking in water and expelling it over the female's head). Gulping is typically followed by swaying and escalates to violent swaying if the female remains motionless.

Females will remain in wetland or vernal pool habitat until they begin nesting. The majority of nesting occurs in June in open areas with well-drained loamy or sandy soils, such as: dirt roads, powerline right-of-ways, residential lawns, gravel pits and early successional fields. Female Blanding's Turtles reach sexual maturity at 14-20 years of age (Congdon *et al.*, 1993; Congdon and van Loben Sels, 1993) and may travel great distances, often more than 1 km (3280 ft), to find appropriate nesting habitat (Grgurovic and Sievert, 2005). Females typically begin nesting during the daylight and continue the process until after dark.

Blanding's Turtles display temperature-dependent sex determination; eggs incubated below a pivotal temperature that lies between 26.5°C and 30°C (79.7-86°F) produce males, and higher temperatures produce females (Ewert and Nelson 1991). Typical clutch size ranges from 10 to 12 eggs. Hatchlings emerge in the late August and September. The typical size of a hatchling is about 3.5 cm (1.4 in.) and 10 g (0.35 oz).

ACTIVE PERIOD

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

THREATS: Blanding's Turtles are particularly vulnerable because they travel very long distances during their active season, do not reproduce until late in life (14-20 yrs), and have low nest and juvenile survivorship. These traits make them extremely sensitive to even a 1-2% increase in adult mortality. Roads are the primary cause of adult mortality. Blanding's Turtles travel to multiple wetlands throughout a single year (typically 3-6) and adult females travel to nesting habitats, crossing roads in the process.

As this turtle is relatively difficult to study, it is not known how great a decline this species has experienced. In Massachusetts, few nesting sites are currently known and a variety of factors are attributed to this species' low numbers. Habitat loss, degradation, and fragmentation (i.e. roads) are driven by human activities such as commercial and residential expansion. Other threats include illegal collection, unnaturally inflated rates of predation in suburban and urban areas, agricultural and forestry practices, and natural succession (i.e. loss of nesting habitat).

MANAGEMENT RECOMMENDATIONS:
Using a turtle habitat model developed by UMass and NHESP records, Blanding's Turtle habitat needs to be assessed and prioritized for protection based on the extent, quality, and juxtaposition of habitats and their predicted ability to support self-sustaining populations of Blanding's Turtles. Other considerations should include the size and lack of fragmentation of both wetland and upland habitats and proximity and connectivity to other relatively unfragmented habitats, especially within existing protected open space.

Given limited conservation funds, alternatives to outright purchase of conservation land is an important component to the conservation strategy. These can include Conservation Restrictions (CRs) and Agricultural Preservation Restrictions (APRs). Another method of protecting large blocks of land is through the regulatory process by allowing the building of small or clustered roadside developments in conjunction with the protection of large areas of unimpacted land.

Habitat management and restoration guidelines should be developed and implemented in order to create and/or maintain consistent access to nesting habitat at key sites. This is most practical on state-owned conservation lands (i.e. DFW, DCR). However, educational materials should be made available to guide private land owners on appropriate management practices for Blanding's Turtle habitat.

Alternative wildlife corridor structures should be considered at strategic sites on existing roads. In particular, appropriate wildlife corridor structures should be considered for bridge and culvert upgrade and road-widening projects within Blanding's Turtle Habitat. Efforts should be made to inform Mass Highways of key locations where these measures would be most effective for turtle conservation.

Educational materials are being developed and distributed to the public in reference to the detrimental effects of keeping our native turtles as pets (an illegal activity that reduces reproduction in the population), releasing pet store turtles (which could spread disease), leaving cats and dogs outdoors unattended (particularly during the nesting season), feeding suburban wildlife (which increases numbers of natural predators to turtles), and driving ATVs in nesting areas from June-October. People should be encouraged, when safe to do so, to help Blanding's Turtles cross roads (always in the direction the animal was heading); however turtles should never be transported to "better" locations. They will naturally want to return to their original location and likely need to traverse roads to do so.

Increased law enforcement is needed to protect our wild populations, particularly during the nesting season when poaching is most frequent and ATV use is common and most damaging.

Forestry Conservation Management Practice guidelines should be applied on state and private lands to avoid direct turtle mortality. Seasonal timber harvesting restrictions apply to Blanding's Turtle habitat and to stands with wetlands. Motorized vehicle access to timber harvesting sites in Blanding's Turtle habitat is restricted to times when the Blanding's Turtle is overwintering. Hand felling in wetland areas is required in order to maintain structural integrity of overwintering sites.

Finally, a statewide monitoring program is needed to track long-term population trends in Blanding's Turtles.

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Updated 2007

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Blue-spotted Salamander
Ambystoma laterale

State Status: **Species of Special Concern**
Federal Status: None

Photo by Bill Byrne

Description: The blue-spotted salamander is a slender salamander with short limbs, long digits, and a narrow, rounded snout. A dark blue to black dorsum with brilliant sky-blue spots or specks on the lower sides of the body makes the coloration of this species quite distinct and reminiscent of antique blue enamel pots and dishware. The ventral surface is a paler grey with black pigmentation surrounding the vent. The tail is long and laterally compressed; averaging 44% of the total body length. Adults range from 4.0 to 5.5 inches (10 to 14 cm) in total length.

Determining the sex of this species is easiest done during the breeding season, when males are identifiable by a swollen vent area caused by enlarged cloacal glands. Additionally, the larvae are also difficult to differentiate from other *Ambystoma* species; larvae are olive green to black and have a long dorsal fin that extends from behind the head along the back and tail.

Similar species: The blue-spotted salamander is a member of the Jefferson / Blue-spotted complex salamander (*A. jeffersonianum / A. laterale* complex). Jefferson salamanders (*A. jeffersonianum*) and blue-spotted salamanders were separated by ice age glaciation, but after the ice melted, the two species came into contact with each other and began interbreeding producing hybrid populations. The hybridization of these two species has led to the development of two completely female populations that are all polyploids – that is, they have multiple sets of chromosomes rather than the normal set of two (diploid). Although Jefferson salamanders and blue-spotted salamanders are fairly easy to differentiate from each other, the identification of the hybrid species is very difficult to distinguish on the basis of appearance alone; typically, identification can only be completed through chromosome counts or size of red blood cells in conjunction with their external appearance. Even though, these two hybrid populations have been formally named as the Silvery salamander (*Ambystoma platineum*) and the Tremblay's salamander (*Ambystoma tremblayi*), the hybrid salamanders are simply referred to as the Jefferson / Blue-spotted complex salamander.

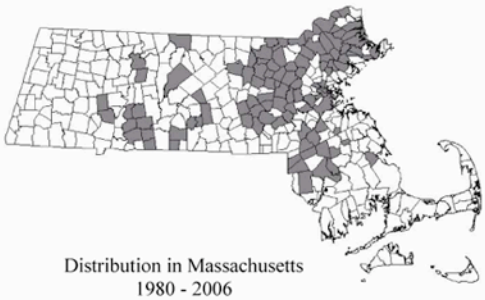
When the Jefferson / Blue-spotted complex hybrids are present in an area, they may outnumber the blue-spotted or Jefferson salamanders by a 2:1 margin. A population with many more females than males is a good indicator of the presence of hybridization of these species. The mode of reproduction of the female hybrids is gynogenesis: sperm is obtained from male diploids to stimulate egg division, but no genetic recombination occurs. However, additional hybrid forms such as triploid males and tetraploid and diploid females have been found, indicating that some offspring retain genetic material from two parents.

The members of the complex form a continuum in appearance from the grayish-brown coloration, pale blue flecks, and wide snout of the Jefferson salamander to the bluish-black coloration, prominent blue spots, and narrow snout of the blue-spotted salamander.

Range: The ranges of the Jefferson and blue-spotted salamanders overlap in New England. Populations of pure blue-spotted salamanders therefore occur north of the hybridization zone with Jefferson salamanders. The area of populations of pure blue-spotted salamanders and hybrids extends from the Canadian Maritime

Provinces, south along the Atlantic coast to northern New Jersey. The range extends westward through to northern Indiana and northeastern Illinois, through most of Wisconsin, eastern Minnesota and the southern half of Ontario.

In Massachusetts, they occur predominantly within Middlesex and Essex counties and in the adjacent eastern towns of Worcester County. Some occurrences also lie within Bristol and Plymouth counties as well. In general, Jefferson - Blue-spotted complex salamanders found east of the Connecticut River are more likely to be blue-spotted salamanders.



Distribution in Massachusetts
1980 - 2006
Based on records in Natural Heritage Database

Habitat: Blue-spotted salamanders require moist, moderately shaded environments; they favor northern hardwood/hemlock forests occurring in glaciated areas having depressions available for seasonal flooding. Vernal pools, or temporary ponds, are necessary for reproduction and need to be full of dead and decaying leaves for cover and overhanging bushes or grass for egg deposition. Roadside drainage ditches, small kettle holes, and temporary pasture ponds also provide habitat when flooded in the spring.

Life Cycle / Behavior: Blue-spotted salamanders are rarely encountered above ground, except as adults during their early spring breeding season, or as metamorphosed juveniles in the late summer. Adults reside most of the year beneath leaf litter or underground to a depth of one meter, usually within 500 meters of their breeding pond. The breeding season is brief, lasting from mid March to late April. As soon as the ground surface thaws, males migrate above ground to temporary ponds and females join them a few days later. An elaborate courtship, similar to the Jefferson salamander, occurs including approach, contact, nudging, and tail-fanning routines that takes place in the water between a single male and single female. Following a period of amplexus, the female will follow the male, pick up a deposited spermatophore, and store it in the cloaca for egg fertilization. (Normal sexual reproduction occurs in the diploid females, while no true fertilization or recombination of chromosomes takes place in the triploid hybrids.) Eggs are often laid singly or in a small egg mass, with 6 to 10 eggs per mass, for a total clutch ranging from 82 to 489 eggs. The egg masses cling lightly to overhanging vegetation or fall to the bottom of the pond. Hatching about a month later, larvae are voracious eaters, preying on insect larvae and other small aquatic animals. No over wintering of larvae has been reported in Massachusetts, so by late August larvae have metamorphosed completely into air-breathing adults.

Blue-spotted salamanders have been found to migrate to and from breeding pools an average of 100 to 900 feet from their terrestrial habitat. A study of vernal pool species in Massachusetts found that at least half of the blue-spotted salamanders that were breeding in the studied vernal pool moved more than 300 feet to overwintering sites; the maximum known movement distance of an adult is 2050 feet (625 m) in Indiana.

Adult blue-spotted salamanders feed on small invertebrates such as larval and adult insects, spiders, worms, and centipedes. They produce noxious skin secretions from specialized poison glands in their tail and are thus rarely preyed upon by native predators. If blue-spotted salamanders reach adulthood and their habitat is secure, they may live for decades.

Population status in Massachusetts: The blue-spotted salamander (including triploid and other polyploid forms within the *A. laterale/A. jeffersonianum* complex) is currently listed as a "Species of Special Concern" in Massachusetts. There are 102 towns in Massachusetts where blue-spotted salamanders have been observed. One hundred and seventy-two occurrences have been documented since 1981, as well as 27 historic occurrences that were documented prior to 1981. The major threat to this species—and most salamanders in general—is the loss, degradation and fragmentation of both aquatic breeding pool habitat required for reproduction and terrestrial habitat needed for foraging, overwintering, growth and development to development and urbanization. For example, making temporary ponds deeper can create permanent ponds with fish populations which will predate amphibian eggs and larvae. Some population declines may be attributed to over collection, heavy road traffic, and pesticides or other toxic chemicals polluting breeding pool water.

Studies on the effects of acid rain on salamander eggs and larvae have been contradictory, and further studies must be made to resolve this issue, however, it appears that blue-spotted salamanders from eastern Massachusetts are highly tolerant of acid conditions and can hatch successfully down to a pH of 4.0.

Management Recommendations: In order to ensure the survival of this species in Massachusetts, the following recommendations regarding habitat preservation are suggested. There are two critical components in the life history of this species: vernal pool habitat required for reproduction and upland forest habitat required for foraging, hibernation, and other terrestrial and fossorial activities. Conservation of the blue-spotted salamander—and all native members of the genus *Ambystoma*—must therefore focus on the preservation of vernal pools and small ponds known to be inhabited by this species, as well as a significant parcel (250–1600 meter radius) of upland habitat surrounding such breeding sites. Provided these habitats are not significantly degraded—and that the salamanders are not subject to illegal collection or high road mortality—the salamander populations should be capable of maintaining themselves indefinitely.

It should be kept in mind, however, that every population is unique. The majority of the population, for instance, may be concentrated in a relatively small and discrete upland habitat, which would safely allow carefully conducted development within some portions of the "uninhabited" habitat around the breeding pool without serious effects on the population. The only way to determine if such a case exists, however, is through a detailed environmental study conducted by a qualified researcher(s) over a series of years, charting the movements of the animals to and from the breeding site. Unless such a study is conducted, it should be assumed that the salamanders are relatively evenly distributed around the pool and development should be strongly discouraged within a minimum radius of 500–1,000 meters surrounding the breeding pool.

Vernal pools and breeding ponds must be protected not only from draining, filling, and development, but also from degradation in the form of road and lawn run-off. If forestry activities are conducted within surrounding areas, a no-cut buffer zone of 50–100 feet should be established around the pool depression, and no slash or other debris should be dumped in the depression. While vernal pools receive some protection under the Massachusetts Wetlands Protection Act, and several vernal pool species (including the blue-spotted salamander) are protected under the Massachusetts Endangered Species Act, efforts should be made to certify all vernal pools and to enhance and promote the enforcement of the laws mentioned above. Because of their ephemeral nature, vernal pools are often difficult to locate during dry periods and may be inadvertently damaged if their locations are not surveyed and marked prior to forestry or construction operations.

Citizens must be encouraged to recognize and report blue-spotted salamanders and the locations of their breeding pools. Due to the rarity of this species, its ephemeral terrestrial occurrence, and its very specific habitat requirements, some populations undoubtedly remain undiscovered and therefore under protected.

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Originated: 1994
Updated: 2007

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Britton's Violet

Viola brittoniana

State Status: **Threatened**
Federal Status: None

Description: Britton's Violet (*Viola brittoniana*) is a low-growing, herbaceous perennial found within or at the edges of floodplains of freshwater rivers. It has variably dissected leaves, and purple flowers that bloom from the middle of May to early June.

Aids to identification: Britton's Violet grows 5 to 10 inches (12–25 cm) in height and has basal leaves arising directly from a rhizome. Two varieties of Britton's Violet (and their hybrids) are currently recognized and protected here: *V. brittonia* var. *brittoniana* and *V. brittoniana* var. *pectinata*. (Some authors consider these taxa separate species; this question is currently under evaluation by NHESP). The nominate variety has consistently dissected leaves, usually deeply dissected into three lobes; the center lobe is usually further divided into three sublobes, and the lateral ones into three or four sublobes. In *V. brittoniana* var. *pectinata,* the leaves are narrowly to (increasingly through the season) broad-triangular and uncut but with long-toothed margins, especially toward the base. In both varieties, closed, self-fertilizing (cleistogamous) flowers appear above ground but below the taller leaves during June and July. Fruits produced from both flower types are similar, round to ovoid dark tan capsules that become upright and split into three parts when mature. Forcible ejection of the seeds has been observed up to 9 feet (3 m) from the plant. Seeds are further dispersed by ants.

Gleason, H.A. 1952. *The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada.* Published for NY Botanical Garden by Hafner Press. New York.

Similar species: Several other violets occur intermingled with or near Britton's Violet populations. Bird's Foot Violet (*V. pedata*) is the only other species with deeply dissected leaves. In this species, leaves are divided into as many as 15 narrow segments. Leaves of other violets with purple flowers have different leaf morphology: Marsh Blue Violet (*V. cucullata*) has heart-shaped unlobed leaves; Early Blue Violet (*V. palmata*) has shallowly-lobed leaf sinuses; Arrow-leaved Violet (*V. sagittata*) has oblong to triangular leaves often with only basal lobes; Woolly Blue Violet (*V. sororia*) has kidney-shaped leaves. The nominate variety of Britton's Violet is known to hybridize with Marsh Blue Violet, Wooly Blue Violet and Arrow-leaved Violet; hybrids have unlobed early-season leaves and lobed later-season leaves.

Distribution in Massachusetts
1982-2007
Based on records in Natural Heritage Database

Petaliferous (Chasmogamous) Flowers Present in Mass.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Cleistogamous Flowers Present in Massachusetts

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Please allow the Natural Heritage & Endangered Species Program to continue to conserve the biodiversity of Massachusetts with a contribution for 'endangered wildlife conservation' on your state income tax form as these donations comprise a significant portion of our operating budget.

Habitat in Massachusetts: In Massachusetts Britton's Violet is found mostly between the upper part of the annually flooded zone and the 100-year flood line of freshwater rivers. The U.S. Fish and Wildlife Service classifies it as a facultative wetland species (FAC), indicating that it occurs equally often in wetland or upland areas of the floodplain. The wetlands are generally wet meadows. This terrestrial species occurs in two distinct habitats in Massachusetts: within mowed areas and along woodland trails (generally whose edges are occasionally mowed or cleared). The species is rare in Massachusetts because most of the suitable habitat has been altered by fill for development, floodplain diking, or conversion to or from agriculture.

Threats: Threats to Britton's Violet include disruptions to the natural hydrologic regime, changes in water quality due to sedimentation, trampling, and over-shading or competition from aggressive native and exotic invasive species. Glossy Buckthorn (*Frangula alnus*) is an exotic invasive species of particular concern at Britton's Violet habitat locations.

Range: The limited range of Britton's Violet extends from Massachusetts, Connecticut, and New York south to the Carolinas. It is also tracked as a rare in Connecticut, New York, Pennsylvania, North Carolina, and Virginia.

Population status in Massachusetts: Britton's Violet is listed under the Massachusetts Endangered Species Act as Threatened. All listed species are legally protected from killing, collection, possession, or sale, and from activities that would destroy habitat and thus directly or indirectly cause mortality or disrupt critical behaviors. It is currently known from Middlesex, Norfolk, and Suffolk Counties, and is historically known from Plymouth County.

Management recommendations: As with many rare species, the exact management needs of Britton's Violet are unknown. This species apparently does not compete well in successional areas; germination occurs in recently disturbed areas, but plants die out as taller native and exotic species become established. Successful management may include periodic mechanical removal of dense competing vegetation, and targeted treatment for particularly insidious invasive species. All active management of rare plant populations (including invasive species removal) should be planned in consultation with the Massachusetts Natural Heritage & Endangered Species Program to avoid inadvertent damage to rare species.

Updated June 2007

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Climbing Fern

Lygodium palmatum (Bernh.) Sw.

State Status: **Special Concern**
Federal Status: **None**

DESCRIPTION: Climbing Fern does not have the characteristic overall shape of most ferns. It is an evergreen, ivy-like plant which sprawls over the ground or climbs clockwise short distances up shrubs and coarse herbs. In very favorable conditions, Climbing Fern may carpet up to an acre of more of the forest floor. The rootstalk is black, wiry, widely creeping, and branching. The root sends up a row of twining delicate fronds to a height of 3-5 ft. (0.9-1.5 m). The pinnae (fern equivalent of leaflets) are a forking stalk, each stalk ending in a palmately lobed yellow-green blade about 2 in (3-6 cm) across. The fertile blades are tiny, palmate, and produce spores on the underside. The gross morphology of this fern distinguishes it from any other species in Massachusetts.

HABITAT IN MASSACHUSETTS: Climbing Fern grows in moist pine-oak-maple woods with an open understory, in moist thickets, and along stream margins. This plant prefers acidic soils that are sandy and rich in humus, but nutrient-poor. Regenerating woodlands and powerline corridors also provide habitat for this species in Massachusetts.

RANGE: Climbing Fern occurs from southern New Hampshire and northwestern Vermont west to Michigan, and south to Georgia and Alabama.

Holmgren, Noel H. 1998. *The Illustrated Companion to Gleason and Cronquist's Manual.* New York Botanical Garden.

Distribution in Massachusetts
1984-2009
Based on records in Natural Heritage Database

POPULATION STATUS: Climbing Fern is a Species of Special Concern in Massachusetts. It is considered rare in New Hampshire, Vermont, Rhode Island, Connecticut, New York, New Jersey, Maryland, West Virginia, Virginia, North and South Carolina, Alabama, Georgia, Indiana, and Michigan. It was known historically from Delaware and Washington, DC. There are 34 current sites (since 1984) in Massachusetts for Climbing Fern, and 27 additional historical (before 1984) locations.

In the 1800's, when Climbing Fern was much more common, it was very popular as a decoration and commercial collection contributed to its decline. The first plant protection law was passed in Connecticut in 1869 specifically to protect this species. Legal protection helped alleviate the collection problem. However, loss of habitat through expansion of agriculture and development continued as the major factor contributing to the species decline.

Although Climbing Fern may be abundant where it is found, populations are rare and localized. Climbing Fern continues to decline in Massachusetts due to loss of habitat through draining and filling of wetlands, land development projects, and the maturation of woodlands. Seemingly appropriate habitat for Climbing Fern is fairly common in Massachusetts; however, for unknown reasons, Climbing Fern occurs in only a very few of these areas.

Updated 12 February 2009

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Eastern Box Turtle

Terrapene carolina

State Status: **Species of Special Concern**
Federal Status: None

Photo by Liz Willey

DESCRIPTION: The Eastern Box Turtle is a small, terrestrial turtle ranging from 11.4–16.5 cm (4.5–6.6 in.) in length. It is so named because a hinge on the lower shell (plastron) allows it to enclose head, legs, and tail completely within the upper (carapace) and lower shells. The adult box turtle has an oval, high-domed shell with variable coloration and markings. The carapace is usually dark brown or black with numerous irregular yellow, orange, or reddish blotches. The plastron typically has a light and dark variable pattern, but some may be completely tan, brown, or black. The head, neck, and legs also vary in color and markings, but are generally dark with orange or yellow mottling. The Eastern Box Turtle has a short tail and an upper jaw ending in a down-turned beak. The male box turtle almost always has red eyes, and females have yellowish-brown or some times dark red eyes. Males have a moderately concave plastron (female's are flat), the claws on the hind legs are longer and the tail is both longer and thicker than the females. Hatchlings have brownish-gray carapace with a yellow spot on each scute (scale or plate), and a distinct light colored mid-dorsal keel (ridge). The plastron is yellow with a black central blotch, and the hinge is poorly developed.

SIMILAR SPECIES: The Blanding's Turtle (*Emydoidea blandingii*) may be confused with the Eastern Box Turtle. Often referred to as the "semi-box turtle," the Blanding's Turtle has a hinged plastron enabling the turtle to pull into its shell but with less closure than in the Eastern Box Turtle. Both may have yellow markings on the carapace; however, the marking on a Blanding's Turtle are spots or flecks rather than blotches. An adult Blanding's Turtle is larger than the box turtle (15-23 cm; 6-9 in. in shell length). While both will be found nesting in similar habitat, the Blanding's Turtle is essentially aquatic whereas the Eastern Box Turtle is terrestrial. Eastern Box Turtle hatchlings could be confused with Spotted Turtle hatchlings, because both have spots on each scute. However, the Spotted Turtle lacks a mid-dorsal keel.

RANGE: The range of the Eastern Box Turtle is from southeastern Maine; south to northern Florida; and west to Michigan, Illinois, and Tennessee. Although Eastern Box Turtles occur in many towns in Massachusetts, they are more heavily concentrated in the southeastern section of the state.

HABITAT IN MASSACHUSETTS: The Eastern Box Turtle is a terrestrial turtle, inhabiting many types of habitats. It is found in both dry and moist woodlands, brushy fields, thickets, marsh edges, bogs, swales, fens, stream banks, and well-drained bottomland.

Distribution in Massachusetts
1980 - 2006
Based on records in Natural Heritage Database

LIFE CYCLE & BEHAVIOR: The Eastern Box Turtle hibernates in the northern parts of its range from late October or November until mid-March or April depending on the weather. Box Turtles overwinter in upland forest, a few inches under the soil surface, typically covered by leaf litter or woody debris. As soil temperatures drop, the turtles burrow into soft ground. Overwintering is usually not communal, although several may overwinter within close proximity of one another. Some individuals may emerge prematurely during warm spells in winter and early spring. When this occurs they may perish from exposure if there's a sudden cold snap. During the spring, Box Turtles start to forage and mate in the forest and fields.

In summer, adult Box Turtles are most active in the morning and evening, particularly after a rainfall. To avoid the heat of the day, they often seek shelter under rotting logs or masses of decaying leaves, in mammal burrows, or in mud. They often scoop out a "form" (a small domelike space) in leaf litter, grasses, ferns, or mosses where they spend the night. These forms may be used on more than one occasion over a period of weeks. Though known as "land turtles", in hottest weather they frequently enter shaded shallow pools and puddles and remain there for periods varying from a few hours to a few days. In the cooler temperatures of spring and fall, Box Turtles forage at any daylight hour.

The Eastern Box Turtle is omnivorous, feeding on animal matter such as: slugs, insects, earthworms, snails, and even carrion. Box Turtles also have a fondness for mushrooms, berries, fruits, leafy vegetables, roots, leaves, and seeds.

Females reach sexual maturity at approximately 13 years of age. Mating is opportunistic and may take place anytime between April and October. Courtship begins with the male circling, biting, and shoving the female. After which the premounting and copulatory phases take place. Females can store sperm and lay fertile eggs up to four years after mating.

Females nest in June or early July and can travel great distances to find appropriate nesting habitat. They may travel up to approximately 1600 m (1 mile), many crossing roads during their journey. Nesting areas may be in early successional fields, meadows, utility right of ways, woodland openings, roadsides, cultivated gardens, residential lawns, mulch piles, beach dunes, and abandoned gravel pits. Females sometimes exhibit nest site fidelity, laying eggs in close proximity to the previous years' nest. Females typically start nesting in the late afternoon-early evening and continue for up to five hours. Typically four or five white, elliptical eggs are deposited at intervals of one to six minutes, with the incubation period depending on soil temperature. Hatchlings emerge approximately 87–89 days after laying, usually in September. Juvenile Box Turtles are rarely seen, which is true of other turtle species as well.

During the first four or five years of life, box turtles may grow at a rate of half an inch to about three-quarters of an inch a year. The average life expectancy of a Box Turtle is 40 to 50 years, but it may live to be about 100.

ACTIVE PERIOD

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

THREATS: There are several reasons the Eastern Box Turtle is threatened in Massachusetts: habitat destruction resulting from residential and industrial development; road mortality; collection by individuals for pets; mowing of fields and early successional habitat during the active season; unnaturally inflated rates of predation in suburban and urban areas; disturbance of nest sites by ATVs; and genetic degradation due to the release of non-native (pet store) turtles. The release of non-native species could also transmit disease, which may become an issue in Massachusetts, but is not currently a problem.

MANAGEMENT RECOMMENDATIONS:
Using NHESP records, Eastern Box Turtle habitat needs to be assessed and prioritized for protection based on the extent, quality, and juxtaposition of habitats and their predicted ability to support self-sustaining populations of Box Turtles. Other considerations should include the size and lack of fragmentation of habitat and proximity and connectivity to other relatively unfragmented habitats, especially within existing protected open space.

Given limited conservation funds, alternatives to outright purchase of conservation land is an important component to the conservation strategy. These can include Conservation Restrictions (CRs) and Agricultural Preservation Restrictions (APRs).

Habitat management and restoration guidelines should be developed and implemented in order to create and/or maintain consistent access to nesting habitat at key sites. This is most practical on state-owned conservation lands (i.e. DFW, DCR). However, educational materials should be made available to guide private land-owners on the best management practices for Box Turtle habitat.

Alternative wildlife corridor structures should be considered at strategic sites on existing roads. In particular, appropriate wildlife corridor structures should be considered for bridge and culvert upgrade and road-widening projects within Box Turtle habitat. Efforts should be made to inform local regulatory agencies of key locations where these measures would be most effective for turtle conservation.

Educational materials need to be developed and distributed to the public in reference to the detrimental effects of keeping our native Box Turtles as pets (an illegal activity that slows reproduction in the population), releasing pet store turtles (which could spread disease), leaving cats and dogs outdoors unattended (particularly during the nesting season), mowing of fields and shrubby areas, feeding suburban wildlife (which increases numbers of natural predators to turtles), and driving ATVs in nesting areas from June-October. People should be encouraged, when safe to do so, to help Box Turtles cross roads (always in the direction the animal was heading); however, turtles should never be transported to "better" locations. They will naturally want to return to their original location and likely need to traverse roads to do so.

Increased law enforcement is needed to protect our wild populations, particularly during the nesting season when poaching is most frequent and ATV use is common and most damaging.

Forestry Conservation Management Practices should be applied on state and private lands to avoid direct turtle mortality. Motorized vehicle access to timber harvesting sites in Box Turtle habitat is restricted to the times when the Box Turtle is inactive during the winter, preferably when the ground is frozen. Motorized vehicles should not be used for soil scarification.

Finally, a statewide monitoring program is needed to track long-term population trends in Eastern Box Turtles.

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Updated: 2007

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Wood Turtle

Glyptemys insculpta

State Status: **Species of Special Concern**
Federal Status: None

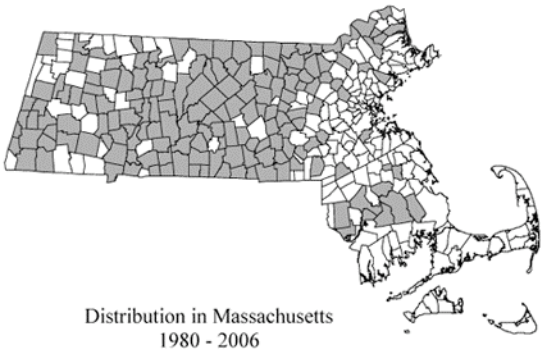
Photo by Mike Jones

DESCRIPTION: The Wood Turtle is a medium-sized turtle (14-20 cm; 5.5-8 in) that can be recognized by its sculpted shell and orange coloration on the legs and neck. The carapace (upper shell) is rough and each scale (scute) rises upwards in an irregularly shaped pyramid of grooves and ridges. The carapace is tan, grayish-brown or brown, has a mid-line ridge (keel) and often has a pattern of black or yellow lines on the larger scutes. The plastron (lower shell) is yellow with oblong dark patches on the outer, posterior corner of each scute. The head is black, but may be speckled with faint yellow spots. The legs, neck, and chin can have orange to reddish coloration. Males have a concave plastron, thick tail, long front claws, and a wider and more robust head than females. Hatchlings have a dull-colored shell that is broad and low, a tail that is almost as long as their carapace and they lack orange coloration on the neck and legs.

SIMILAR SPECIES: The habitat of the Eastern Box Turtle (*Terrapene carolina*) and the Blanding's Turtle (*Emydoidea blandingii*) may overlap that of the Wood Turtle, but neither has the Wood Turtle's pyramidal shell segments. Unlike the Wood Turtle, the Box and Blanding's Turtle have hinged plastrons into which they can withdraw or partially withdraw if threatened. The Northern Diamond-backed Terrapin (*Malaclemys terrapin*) has a shell similar to that of the Wood Turtle. However, its skin is grey and it lives only near brackish water, which the Wood Turtle avoids.

RANGE: The Wood Turtle can be found throughout New England, north to Nova Scotia, west to eastern Minnesota, and south to northern Virginia. The Wood Turtle appears to be widespread in Massachusetts. However, it should be kept in mind that little is known about the status of local populations associated with the majority of these sightings. Most of the towns have fewer than 5 known occurrences.

HABITAT IN MASSACHUSETTS: The preferred habitat of the Wood Turtle is riparian areas. Slower moving mid-sized streams are favored, with sandy bottoms and heavily vegetated stream banks. The stream bottom and muddy banks provide hibernating sites for overwintering, and open areas with sand or gravel substrate near the streams edge are used for nesting. Wood Turtles spend most of the spring and summer in mixed or deciduous forests, fields, hay-fields, riparian wetlands including wet meadows, bogs, and beaver ponds. Then they return to the streams in late summer or early fall to their favored overwintering location.



Distribution in Massachusetts
1980 - 2006
Based on records in Natural Heritage Database

LIFE CYCLE & BEHAVIOR: The Wood Turtle typically spends the winter in flowing rivers and perennial streams. Full-time submersion in the water begins in November, once freezing occurs regularly overnight, and continues until temperatures begin to increase in spring. It may hibernate alone or in large groups in community burrows in muddy banks, stream bottoms, deep pools, instream woody debris, and abandoned muskrat burrows. The Wood Turtle may make underwater movements in the stream during the winter; however, extended periods of activity and emergence from the water do not occur until mid-March or early April.

In spring, Wood Turtles are active during the day and are usually encountered within a few hundred meters from the stream banks. They have relatively linear home ranges that can be ½ a mile in length in Massachusetts (M. Jones, unpubl data). They will use emergent logs or grassy, sandy, and muddy banks to soak up the spring sun. During the summer months they feed in early successional fields, hayfields, and forests.

Wood Turtles are opportunistic omnivores; their diet consists of both plant and animal matter that is consumed on land and in the water. The Wood Turtle occasionally exhibits an unusual feeding behavior referred to as "stomping." In its search for food, this species will stomp on the ground alternating its front feet, creating vibrations in the ground resembling rainfall. Earthworms respond, rising to the ground's surface to keep from drowning. Instead of rain, the earthworm is met by the Wood Turtle, and is promptly devoured.

Although the peaks in mating activity occur in the spring and fall, Wood Turtles are known to mate opportunistically throughout their activity period. Males have been observed exhibiting aggressive behavior such as chasing, biting, and butting both during the mating season and at other times. A courtship ritual "dance" typically takes place at the edge of a stream or brook for several hours prior to mating. The dance involves the male and female approaching each other slowly with necks extended and their heads up. Before they actually touch noses, they lower their heads, and swing them from side to side. Copulation usually takes place within the water. Courting adults may produce a very subdued whistle that is rarely heard by observers. A female may mate with multiple individuals over the course of the active season.

In Massachusetts, most nesting occurs over a four-week period, primarily in June. Nesting sites may be a limited resource for Wood Turtles. Females are known to travel long distances in search of appropriate nesting habitat (average straight line distance of 244 m; 800 ft). Once they have arrived at a suitable nesting area, there may be multiple nesting attempts or false nests that occur over the course of several days, prior to laying eggs. They abort attempts when disturbed (e.g. by human activities) early in the process or hit a large rock while digging. Female Wood Turtles lay one clutch a year and often congregate in a good nesting area. Clutch size in Massachusetts averages 7 eggs (Jones, 2004, pers. comm.). Hatchling emergence occurs from August through September. The life span of the adult Wood Turtle is easily 46 years and may reach as much as 100 years.

ACTIVE PERIOD

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

THREATS: Hatchling and juvenile survival is very low and the time to sexual maturity is long. These characteristics are compensated by adults living a long time and reproducing for many years. Adult survivorship must be very high to sustain a viable population. These characteristics make Wood Turtles vulnerable to human disturbances. Population declines of Wood Turtles has likely been caused by hay-mowing operations, development of wooded stream banks, roadway casualties, incidental collection of specimens for pets, unnaturally inflated rates of predation in suburban and urban areas, forestry and agricultural activities and pollution of streams.

MANAGEMENT RECOMMENDATIONS: Using a turtle habitat model developed by UMass and NHESP records, Wood Turtle habitat needs to be assessed and prioritized for protection based on the extent, quality, and juxtaposition of habitats and their predicted ability to support self-sustaining populations of Wood Turtles. Other considerations should include the size and lack of fragmentation of both riverine and upland habitats and proximity and connectivity to other relatively unfragmented habitats, especially within existing protected open space. This information will be used to direct land acquisition and to target areas for Conservation Restrictions (CRs), Agricultural Preservation Restrictions (APRs) and Landowner Incentive Program (LIP) projects.

Mowing and nest site creation guidelines developed by NHESP should be followed on properties managed for Wood Turtles. These practices will be most practical on state-owned conservation lands. However, these materials are available to town land managers and private landowners.

Alternative wildlife corridor structures should be considered at strategic sites on existing roads. In particular, appropriate wildlife corridor structures should be considered for bridge and culvert upgrade and road-widening projects within or near Wood Turtle habitat. Efforts should be made to inform local regulatory agencies of key locations where these measures would be most effective for Wood Turtle conservation.

Educational materials are being developed and distributed to the public in reference to the detrimental effects of keeping our native Wood Turtles as pets (an illegal activity that reduces reproduction in the population), releasing pet store turtles (which could spread disease), leaving cats and dogs outdoors unattended (particularly during the nesting season), mowing of fields and shrubby areas, feeding suburban wildlife (which increases the number of natural predators to turtles), and driving ATVs in nesting areas from June-October. People should be encouraged, when safe to do so, to help Wood Turtles cross roads (always in the direction the animal was heading); however, turtles should never be transported to "better" locations. They will naturally want to return to their original location and likely need to traverse roads to do so.

Increased law enforcement is needed to protect our wild turtles, particularly during the nesting season when poaching is most frequent and ATV use is common and most damaging.

Forestry Conservation Management Practices should be applied on state and private lands to avoid direct turtle mortality. Seasonal timber harvesting restrictions apply to Wood Turtle habitat and to upland habitat that occurs up to 600 ft (183 m) beyond the stream edge. Motorized vehicle access to timber harvesting sites in Wood Turtle habitat is restricted to times when the Wood Turtle is overwintering. Bridges should be laid down across streams prior to any motorized equipment crossing the stream in order to maintain the structural integrity of overwintering sites.

Finally, a statewide monitoring program is needed to track long-term population trends in Wood Turtles.

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