

A GUIDE TO
HABITAT MANAGEMENT
FOR THE
EASTERN BOX TURTLE
(Terrapene carolina carolina)



Photo: Jarren Uplinger

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BEST MANAGEMENT PRACTICES FOR EASTERN BOX TURTLE HABITAT IN THE NORTHEASTERN U.S.

SUMMARY

The eastern box turtle (*Terrepenne carolina carolina*) is an at-risk subspecies that is experiencing population declines throughout its range and in the Northeast. They inhabit forests, fields, ecotones, and early successional habitats, occasionally using ephemeral and shallow wetlands. In the Northeast, eastern box turtles spend the winter underground in forested habitat where they overwinter in deciduous or mixed forests, with an abundance of leaf litter. In the spring they emerge from their hibernacula and move toward ecotones where they thermoregulate and are active throughout the day. Nesting occurs in the late spring through the early summer and takes place in open canopy, upland areas with well-drained, loose soils. Once the nesting season is complete, turtles typically move to closed-canopy forests or wetland edges where they spend the rest of the summer. This species remains active until late fall and early winter when it begins to overwinter, thus restarting the annual activity cycle.

This species is threatened by numerous anthropogenic and natural pressures, which decrease the survivability of individuals and populations. Prescribed fires are known to cause mortality in eastern box turtle populations. Therefore, we recommend that prescribed fires occur during the eastern box turtles' inactive season from November 1 through March 31. Closed-canopy forests are important habitats for eastern box turtles and timber harvesting can cause direct mortality by crushing individuals. The mortality of eastern box turtles can be reduced during timber harvests by minimizing the frequency of motor vehicle use, minimizing the vehicle impact area, and only using vehicles during the inactive season when the ground is frozen. This species depends on early successional habitats such as fallow fields which can be improved by mowing, herbicide treatment, and/or grazing. Mower blades and vehicles can kill and injure turtles; therefore, we suggest that mowing takes place during the inactive season. Degraded nesting habitat may limit the reproductive output of this species and creating or enhancing nesting habitats may increase recruitment. Enhancing, creating, or managing the vegetation at a nest site should occur during the inactive season and nesting studies prior to management is recommended. The collection of individuals for the pet trade is a persistent threat to eastern box turtle populations. We recommend not sharing the location of eastern box turtle populations online or in publication and reporting suspicious behavior to state and federal wildlife agencies. Below we provide additional recommendations and details for minimizing the risk of injury and mortality to eastern box turtles during management activities. Sites may support other rare or vulnerable species with unique needs. Site managers will need to develop a management plan that considers the impacts to all species to avoid negative impacts.

BACKGROUND

The eastern box turtle (*Terrapene carolina*) in the northeast, also known as the woodland box turtle (*T. c. carolina*), is an at-risk subspecies that is experiencing population declines throughout most of its range (Fig. 1, Kiester and Willey 2015). They are a Species of Greatest Conservation Need (SGCN) in all the northeastern states and the District of Columbia, included in CITES Appendix II, and state-listed as Endangered, Threatened, or a Species of Special Concern in Connecticut, Maine, Massachusetts, New Hampshire, and New York. They face many threats, including habitat alteration and fragmentation from development, roadway traffic and ATV use in natural areas, agricultural activities, incidental and illegal collection, habitat management activities (e.g., mowing, prescribed fires), inflated level of predation, disease, climate change and natural disturbances (e.g., floods and fires). Populations are particularly vulnerable to adult mortality and very slow to recover (potentially many decades) from decline due to low reproductive output and juvenile survival. The purpose of this document is to provide guidelines aimed at sustaining and promoting healthy populations by reducing the potential for management activities to lead to mortalities or injuries.



Figure 1. Eastern Box Turtle Carapace (Left). Eastern Box Turtle Plastron (Right)

SEASONAL HABITAT USE AND HABITAT REQUIREMENTS

In the Northeast, eastern box turtles are typically an upland species that use a variety of habitat types seasonally (e.g., Madden 1975; Nazdrowicz et al. 2008; Quinn 2008; Willey 2010; Frederickson 2014).

They use a variety of habitat types such as forests, fields, and to a lesser degree, ephemeral wetlands, and shallow wetland edges of larger water bodies (Kaye et al. 2001; Donaldson and Echternacht 2005; Fredericksen 2014; Henriquez et al. 2017). Although they are considered a habitat generalist, they have specific requirements for nesting, overwintering, and thermoregulation (Dodd 2001; Ernst and Lovich 2009).

WINTER

Generally, eastern box turtles in the northeast spend the winter underground in forested habitats (Table 1; Fig. 2 and 4). They typically overwinter in deciduous or mixed forests, with ample leaf litter duff, which provides insulation and supports the retention of moisture (e.g., Nazdrowicz et al. 2008; Savva et al. 2010; Willey 2010). In late fall and early winter, they have been found just below the soil surface, but may burrow deeper as temperatures drop later in the season (Savva et al. 2010; Woodley 2013; Boucher et al. 2017). Activity usually ceases by the first frost of the season (Ernst and Lovich 2009; Boucher et al. 2017), but they may resurface during warm periods, particularly in early winter and early spring.



Figure 2. Eastern box turtle in partial form in preparation for brumation (left). Overwintering forest habitat example (right)

SPRING/NESTING

In spring (late March through early May) they emerge from their hibernacula and move toward ecotone habitats such as forest-field edges where they can move in and out of the sun throughout the day to thermoregulate (Adams et al. 1989; Iglay et al. 2007; Fredericksen 2014). They utilize ecotones and early successional habitats through the late spring when females nest (Wilson and Ernst 2005; Willey and Sievert 2012; Nicholson et al. 2020). For nesting, female eastern box turtles in the Northeast mainly use open canopy, upland areas with well-drained, loose soils (Fig. 3 and 4, Quinn 2008; Willey 2010). Substrate materials vary and may consist of sand, loam, gravel or mulch. Nesting sites in the Northeast require sun exposure throughout the day, such as open canopy sites with a south-facing aspect, to incubate the eggs in time for hatching before winter arrives (Congello 1978; Willey 2010). Nest sites also need to be above the floodplain to avoid being periodically submerged in water, which will kill the eggs (Duchak and Burke 2022). Sparsely vegetated sites are preferred since plant roots can destroy eggs, infiltrating and absorbing the egg's nutrients (Steggman et al. 1988; Willey and Sievert 2012).



Figure 3. Eastern box turtle female actively nesting in sand.

SUMMER

After the nesting season, most turtles move to closed-canopy forests or wetland edges where they spend the rest of the summer (Ernst and Lovich 2009; Fredericksen 2014). However, a smaller proportion of any population may stay within, or regularly use, early-successional (i.e. herbaceous or shrubby) communities during the summer (Dod 2001; Nazdrowicz et al. 2008). Individuals may use field-forest ecotones or open-canopy areas in the fall before heading deeper into the forest to overwinter again (Walden and Karraker 2018).

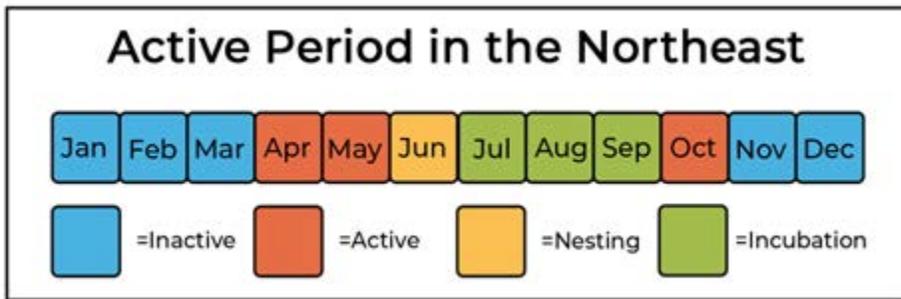


Figure 4. Active Period of Eastern Box Turtles in the Northeastern United States.

Table 1. Eastern box turtle brumation period with periods when most turtles are underground in dark gray and periods when only part of the population is underground.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Source
<i>Massachusetts</i>									Willey 2010; Kaye et al 2001; Erb 2011
<i>Connecticut</i>									Quinn, D. 2008
<i>New York (LI*)</i>									Walden and Karraker 2018
<i>Delaware</i>									Nazdrowicz et al 2008
<i>Washington DC</i>									Allard 1935
<i>Maryland</i>									Quinlan, M. 2019 pers. comm.
<i>Virginia</i>									Fredericksen 2014
<i>West Virginia</i>									Oxenrider 2022

*LI = Long Island

MANAGING THREATS

The following guidelines are specific to eastern box turtles in the northeast, however many of these actions will benefit other herpetofauna (e.g., snakes and wood turtles) as well as other species and/or taxonomic groups (e.g., ground nesting birds, bats that brumate in leaf litter). Recommendations are grouped by management activity with a few general recommendations up front. By using as many of these recommendations as possible you will reduce the risk of injury and mortality to eastern box turtles.

GENERAL RECOMMENDATIONS FOR ALL MANAGEMENT ACTIVITIES

- **Coordinate interagency planning**
 - Develop strong coordination between agencies (i.e., the state's Forest Service and Natural Heritage Program) to identify areas containing populations of box turtles that are of conservation significance and/or at high risk of being impacted by a prescribed fire.
- **Understand habitat use**
 - Use visual surveys and/or radio-telemetry to understand seasonal habitat use and areas of high-density occupancy at managed sites. This will provide information needed to make informed decisions about the best timing of burns to avoid conflicts with box turtles and areas to avoid or where special considerations would be most useful.
- **Review NEPARC habitat management guidelines**
 - Review the Habitat Management Guidelines for Amphibians and Reptiles of the Northeastern U.S., developed by the Partners in Northeast Amphibian and Reptile Conservation (NEPARC). These guidelines provide recommendations to generally reduce the risk to herpetofauna while creating a diversity of habitats. The document can be downloaded from the NEPARC website (<http://northeastparc.org/habitat-management-guidelines/>)

PRESCRIBED FIRE

Prescribed fires are known to cause high mortality in eastern box turtle populations (Bigham et al. 1965; Frese 2003; Platt et al. 2010; Harris et al. 2020; Buchanan et al. 2021). Other studies indicate that fires can also result in long-term injuries and poor body condition (Howey and Roosenburg 2013; Harris et al. 2020). Fire can also be beneficial to eastern box turtles in some circumstances due to habitat changes resulting from fire (Markle et al. 2020). Those changes may create or improve existing nesting habitat and increase the diversity of vegetation density locally to provide a gradient of thermal conditions for thermoregulation and foraging (Robertson et al. 2022). However, given the importance of adult survivorship for population stability and the slow rate of recovery after decline, the habitat-related benefits of fire are quickly overshadowed if adult mortality results. Turtles that survive may also suffer scute loss (Fig. 5) and internal injuries that make them more susceptible to

disease, cold, heat, and drought (Dodd 2001; Albery et al. 2021.) Land managers should use as many of the following practices as feasible to help reduce eastern box turtle mortality while using prescribed fire to achieve habitat management goals. These recommendations are ordered by their likelihood to reduce eastern box turtle mortality with the most effective measures listed first.



Figure 5. Active burn in overwintering forest habitat with example photos of burn scars and scute deformities on eastern box turtle carapaces from prescribed fires.

Recommendations

- **Prescribed burns should be restricted to November 1 through March 31⁴**
 - November 1 through March 31 is the eastern box turtle's inactive season.
 - Choosing a cooler (below 13 °C), overcast day² is best particularly during November and March to assure most individuals are underground.
 - When these dates will not work, the second-best burn window is April³. Turtles are usually active and above ground but less sluggish than when they first emerge from their hibernacula.
- **Use single front fires⁵**
 - Single front fires (instead of ring fires that burn inward) allow turtles to escape to fire breaks and other refuge. This is generally good for all wildlife.
- **Burn in smaller rotational units⁶**

- This provides shorter distances for turtles to get to fire breaks. Leaving unburned units interspersed within the larger burn area, until adjacent areas recover, will also provide a refuge for turtles during the burn and in later months.
- Pollinators, rare invertebrates and snakes will also benefit from burning smaller rotational units no more than every 3 years.
- **Use slow-moving low intensity and severity fire⁴**
 - Increased fire intensity and severity increases the risk to turtles in the burn area.
- **Maintain refugia with woody debris, undergrowth, and leaf litter**
 - Areas characterized by cool, moist microhabitats provide microrefugia for turtles, as well as snakes and amphibians, both during and after burns⁷.
 - Avoid performing burn clean ups. When reducing some woody debris and undergrowth is necessary, prior to burning consider the following⁷:
 - Use hand tools to clear undergrowth or, if using heavy equipment, use machinery during the inactive season to avoid crushing turtles.
 - Use grazers (i.e., goats) to reduce undergrowth prior to burns.
 - Leave some woody debris and other refuge for turtles to hide under during a fire, such as downed tree limbs and tree stumps.
 - Avoid going back to burn/reignite areas that were missed in the original burn.
- **Exclude a 30m (~100 ft) forest-field edge from fire⁸**
 - This is particularly important for forests adjacent to known nesting sites. Egg-laying snakes will also benefit.
- **Perform turtle sweeps prior to a prescribed burn**
 - Coordinate with your state's natural heritage program and/or wildlife agency to conduct visual surveys, for eastern box turtles, of the burn area within 24 hrs of ignition to remove as many turtles as possible until the fire is extinguished.

Justification

1. Eastern box turtle mortality, during fire events, is lower during the turtle inactive season (Table 1), when turtles are still underground for the winter (e.g, Frese 2003; Harris et al. 2020; Buchanan et al. 2021). Being underground helps to protect turtles from being exposed to extreme temperatures. Roe and Bayles (2021) found that subsurface temperatures during fire events did not exceed 23° C, while ground temperatures were 350-600° C.
2. During the eastern box turtle's inactive season, individual turtles and other herpetofauna may become active on warm days (Bigam et al. 1965; Frese, 2003) and are less likely to be above ground during cooler/overcast days. This is more likely to occur during late fall (November) and early spring (March-April).
3. When burning during the active season, April is likely the best timeframe. Buchanan et al. (2021) found that the risk of injury or mortality increased May through June.

4. Fire intensity increases the risk of mortality of eastern box turtles during natural and prescribed fires (Buchanan et al. 2021; Harris et al. 2020; Jones et al. 2021). In some cases increased frequency of prescribed burns may help lower fire intensity by reducing debris/fuel load present, but also increases exposure to fire risk to turtles (Howey and Roosenburg 2013; Harris 2019). Slower moving fires allow time for turtles to escape (Cross et al. 2021; Harris et al. 2020; Platt et al. 2010).
5. The use of single front fires allows turtles to move in the opposite direction to escape or find refuge (Harris et al. 2020), although Harris et al. (2020) observed that not all turtles will move out of the fire's path. Multiple fire fronts within a burn unit (i.e., fire rings) are sometimes used to complete burns faster, but this can entrap eastern box turtles and other wildlife and prevent them from reaching fire breaks and other refuge (Melvin 2017; Harris 2019).
6. Smaller rotational units provide refuge areas (burn breaks and unburned units) for box turtles to access during a fire and provide unburned areas nearby for use after the fire (Robertson et al. 2022; Roe and Bayles 2021). Refuges are important to increase survivorship by providing areas to escape the fire and habitat to use after fire events to support individuals and the population (Robinson et al. 2013). In addition, leaf litter is a very important habitat feature for eastern box turtles (e.g., Dodd 2001; Gibson 2009; Weiss 2009; Willey 2010). It provides cover on hot dry summer days and is preferred at sites selected for overwintering (e.g., Luensmann 2006; Willey 2010).
7. Removal of some shrubs and woody debris before fires could reduce fuel loads and thereby fire intensity (Jones et al. 2021). However, it is important to both minimize potential mortality due to heavy equipment and leave some woody debris for turtles to use as refuge during a fire (Roe et al. 2019; Harris et al. 2020; Buchanan et al. 2021; Roe and Bayles 2021).
8. Excluding forest-field edge habitat from prescribed fire plans will reduce eastern box turtle mortality, because box turtles heavily use these habitats (Laarman et al. 2018).
9. Burning less frequently can decrease the possibility of fire-related turtle mortalities and maintain greater leaf litter (Melvin 2017; Laarman et al. 2018; Platt et al. 2010). Longer fire-return intervals allow woody debris to collect between fire events, thus providing refuge structures for turtles to use during subsequent fire events (Roe and Bayles 2021).

TIMBER HARVESTING

Closed-canopy deciduous and mixed forests are critically important for the eastern box turtle in the northeastern U.S. The turtles rely heavily on forest habitat for overwintering and summer refuge from the heat (e.g., Quinn 2008; Willey 2010). Heavy equipment used in timber harvesting can cause direct mortality of eastern box turtles by crushing during any time of the year (Fig. 6). Timber harvesting can also positively or negatively change thermal conditions on the ground. Thinning and small canopy openings can create gradients in thermal conditions that provide thermoregulatory opportunities as well as habitat for juveniles and basking areas for adults in spring and fall (Felix et al. 2008; Currylow et al. 2012). Conversely, harvesting with intensive removal of woody debris eliminates cooler more humid microhabitats within the harvest area and can result in unfavorable

conditions for a box turtle, in some cases affecting growth rates and thereby the ability of a population to recover (Dodd and Dreslik 2008; Heaton et al. 2022). Large-scale clearcuts (>5 ha) will result in more extreme thermal conditions (hotter in the summer and colder in the winter; Currylow et al. 2012), reducing available habitat during these times of the year, as well as increasing their vulnerability to predators while moving through these areas due to the lack of vegetative cover. The guidelines that follow are designed to outline measures that can reduce the risk of injury to turtles and increase the likelihood that a harvest will be compatible with box turtle conservation.



Figure 6. Image of timber harvesting.

Recommendations

- **Reduce the effect of motorized vehicles**
 - Minimize the frequency¹⁰ that motorized vehicles are used. This is also generally good for all ground nesting or dwelling animals.
 - Minimize the vehicle impact area¹⁰ to < 25% of the total area.
 - Clearly mark vehicle use areas (skid roads, wood roads, and staging areas and landings) to minimize the impact area.
 - Only use motorized vehicles November 1 through March 31 and preferably when the ground is frozen¹¹.
 - Use rubber-tracked vehicles¹¹ to distribute the weight of the equipment weight over a

- larger surface area and thereby decrease soil compaction.
- Discontinue use of logging roads once the harvest is completed.
- Conduct soil scarification by hand to reduce the risk of turtle-vehicle interactions and avoid soil compaction.
- Create designated vehicle use areas that reach as many trees as possible within the management area.
- **Leave microhabitat refugia**
 - Leave fallen logs, tops of trees, snags, and leaf litter¹². This is also good for snakes, amphibians, and forest birds.
 - Retain small patches of uncut trees around snags to reduce possible safety concerns for workers related to falling snags¹².
- **Maintain vegetated wetland buffers**
 - Clearly mark boundaries of filter strips surrounding vernal pools, streams, ponds, and other water bodies to maintain unaltered wetland buffers¹³.
- **Only use landings for wood chip piles**
 - Avoid creating and leaving wood chip piles anywhere outside the landing area¹⁴. Wood chip piles attract many other species which will also benefit from this action.
- **Avoid clear cuts if the forest patch is <1 ha**
 - Forest habitat is critically important for overwintering success for the eastern box turtle in the northeast¹. This will benefit any forest species occupying the sites.
- **Limit clear cuts to 0.5-5.0 ha in large intact forests¹⁵**
- **Plan longer intervals between cuts**
 - Heavier cuts with longer intervals between cuts are favored over lighter, more frequent cuts, provided sufficient forest habitat remains¹⁰.
- **Install turtle exclusion fencing around log piles**
 - If log piles are necessary and will be manipulated during the active season, use silt fencing to exclude turtles from using the log pile as a site of refuge.

Justification

- ¹⁰. Reducing the frequency of use and area of impact will reduce the likelihood of turtle-vehicle interactions.
- ¹¹. Working in winter when the turtles are inactive and underground, the ground is frozen, and using a rubber-tracked vehicle will increase the chance that a turtle could survive a turtle-vehicle interaction (e.g., Nazdrowicz et al. 2008; Currylow et al. 2012).
- ¹². Woody debris, leaf litter, and small patches of uncut trees provide microhabitat refuges for turtles (MacNeil et al. 2013). They provide overwintering sites and cool, moist microhabitat important for thermoregulation throughout the turtles' active season.
- ¹³. Leaving wetland buffers provides turtle refuge areas and reduces impacts to wetlands, which are important to box turtles and other species (MacNeil et al. 2013).

14. Large wood chip piles alter the microhabitat and if not removed potentially entrap turtles underneath.
15. Clear cuts of this size will allow most box turtles with a home range that includes the harvest area to move to intact forest within their home range or within a reasonable movement distance. It's important to maintain at least 1 ha of intact forest habitat to provide overwintering habitat for the eastern box turtle. South and southeastern slopes are particularly important.

MOWING

The eastern box turtle depends on early-successional habitats (Fig. 7) such as fallow fields for thermoregulation, foraging, and nesting (e.g., Dodd 2001; Nazdrowicz et al. 2008). Maintenance of these habitats with use of mowing, herbicide treatment, and/or grazing can be important for long term persistence of the species. However, mower blades and tires can also cause mortality (Nazdrowicz et al. 2008; Tingley et al. 2009; Erb and Jones 2011). The following recommendations are provided to help minimize the risk to eastern box turtles while managing open canopy habitats. These measures are generally ordered with the most effective measures listed first.



Figure 7. Examples of habitats mowed to control woody and invasive species.

Recommendations

- **Restrict mowing to the turtles' inactive season**¹⁶
 - Mowing is best done November 1 through March 31, the inactive season of the eastern box turtle. Although, keep in mind that dates may vary a bit by state and annually.
 - If mowing must occur during the growing season, mow during mid-July through August, when conditions are hotter and drier. Turtles will be less likely to use field habitats under these conditions.
- **Leave a 5 m (~15 ft) unmowed edge until after 15 October**¹⁷
- **Provide longer time intervals between mowing events**¹⁸
 - Mow once every 2-3 years instead of every year. This will also benefit snakes and ground nesting birds.
- **Use other tools to maintain field habitat**
 - Consider management tools such as use of grazing and/or chemical control of woody and invasive plant species.
- **Mow only a portion (25%-50%) of large fields in any given year**⁸
- **Avoid using flail mowers**¹⁹
 - Flail and other mowers with heavy guide bars that roll along the ground increase the surface area where turtles could be crushed.
- **Raise the mower blade height to >18 cm (7 in)**²⁰
 - For areas that need to be mowed lower, only mow during the inactive season or mow frequently to discourage turtles from hiding in the grass and so mower operators can see turtles. This will also benefit snakes, amphibians, and ground nesting birds.
- **Mow fields from near the center of the field outward**¹⁷
 - Leaving the outer edges for last provides time and a route for turtles to escape into the forest edge. This will also benefit snakes.
 - Edges are best left for midday on sunny days, when the field edges are hottest and when turtles are less likely to be using them.
- **Mow at a slower speed**²¹
 - Lower speed may provide time for the driver to see turtles in the mower's path and turtles a chance to escape.

Justification

- ^{16.} Simply driving a mower through a field has the potential to cause up to 46% mortality of turtles using the field from tractor tires alone (Erb and Jones 2011). In Massachusetts, the peak season for use of early successional habitats was 1 May through 15 September (Willey 2010). Based on the similarity in the active season across the Northeast (Table 1), we expect these dates to work throughout the region. Avoiding mowing field habitats during the time

when box turtles are most likely to be using these habitats will greatly reduce the risk to turtles.

17. Eastern box turtles and similar species like the wood turtle are more often found close to the forest-field edge (Tingley et al 2009; Willey 2010), and some individual turtles will try to escape perceived danger (such as mowers), so mowing the edge last and/or leaving an unmowed edge until late in the season will reduce the chance that turtles will be in the area being mowed. In addition, mowing from the center of the field towards the outer edge will allow some turtles to escape.
18. Mowing less frequently and mowing only portions of larger fields reduces the likelihood that a turtle will be hit by a mower blade or crushed by mower tires.
19. Some mower styles pose a higher risk of woodland box turtle mortality (Erb and Jones 2011). When comparing flail, rotary, and sickle bar mowers, the flail mower crushed almost everything in its path due to the heavy guide bar that rolls along the ground, whereas the sickle bar mowers had the least likelihood of killing a turtle.
20. Raising the mower blade height to ≥ 18 cm (7 inches) reduced the likelihood of injury or mortality to eastern box turtles in the mower's path (Erb and Jones 2011). Raising the blade height can also reduce wear on the blade (Rider and Barr 1987) and increase crop yield in subsequent harvests, because the remaining vegetation helps to maintain soil moisture (Smith 1978; Sharp et al. 1995). Mowing at a slower speed can give turtles an opportunity to escape and the mower operator a greater chance to see a turtle in the mower's path.

EXPANDING, IMPROVING, AND/OR CREATING NESTING HABITAT

Eastern box turtles primarily use open-canopy, upland habitat with well-drained soil for nesting (Fig. 8, Dodd 2001; Ernst and Lovich 2009). Nesting habitat may be lacking in quantity or quality at box turtle sites, limiting the ability for a population to remain sustainable or recover from any perturbations, such as a flood or disease outbreak, that decrease the local population size or abundance. Created and enhanced nesting sites have proven successful in attracting female box turtles and producing successful broods (e.g., Willey 2010).



Figure 8. Sand-loam access road with mounds for nesting (left) Sand dominated powerline access with open canopy for nesting (right).

Recommendations

- **Survey the site**
 - Survey known and/or potential nesting sites to determine what is needed and delineate the work area.
- **Determine nest site location(s)**
 - Within 300m of, or within, forest habitat²³, preferably within 600m of where box turtles have been observed.
 - No roads nearby²⁴ or between the forest and nesting site.
 - Level ground or southern facing slope to provide sun exposure of the nests throughout the day.
 - Above the spring/summer floodplain²⁵.
 - Multiple or larger nest sites will reduce the likelihood of depredation²⁶.
 - Away from human activity areas such as picnic areas, boat landings, ball fields, and other recreational areas²⁷.
- **Obtain appropriate permits**
 - Permits may be required from ACOE, state agencies, the local conservation commission, county, or township, and landowner.
- **Restrict vegetation clearing with heavy machinery (if needed) to November 1 through March 31**, the box turtle's inactive season²⁸.

- **Expose sand-gravel substrate or create mounds (during inactive period)** of sand-gravel (<5% clay and <25% gravel)
 - If soil is brought in, use washed soil to reduce the risk of introducing invasive plant species.
 - Pile introduced soil to at least 10-12 inches in depth.
- **Retain or provide 5-25% native vegetation cover**²⁹ such as sedges, grasses, and short shrubs. This is also great for snakes.
- **Monitor vegetation growth**
 - Vegetation removal and management will likely be required every 2-5 years
 - Inspect the habitat every 2-3 years to determine if any management is needed.
 - Remove non-native plants.
 - Reduce woody and herbaceous plants if they cover >50% of the site.
 - Remove shrubs taller than 24" in height.
- **Monitor turtle use of the nesting sites**
 - Consider performing visual surveys or setting up surveillance cameras to evaluate turtle use and predator activity, which can inform management needs.

Justification

21. Female eastern box turtles in the Northeast primarily overwinter in forest habitats and often move to open canopy-forest edge habitat in the spring to bask and nest (e.g., Quinn 2008; Willey 2010).
22. Roads, even if infrequently traveled, are a source of potential mortality.
23. Eggs can drown if the nest is submerged in water for an extended period.
24. Nest depredation can be higher at sites with more concentrated nesting habitat (Marchand and Litvaitis 2004). Creating multiple nest sites or larger ones may reduce depredation of nests.
25. Areas of human recreation often have sources of food waste that can attract and subsidize predator populations. These areas also increase the likelihood of human-turtle interaction, potentially resulting in incidental collection.
26. Doing work during the turtle's inactive season, when they are underground in the forest, will reduce the likelihood of injury to turtles from heavy equipment or even electric hand tools.
27. Sparsely distributed vegetation provides turtles with cover from predators. Females often arrive at the nesting sites early and remain there until they are ready to lay their eggs.

LIMITING INCIDENTAL COLLECTION AND POACHING

Eastern box turtles can live a century or more in intact habitat with few threats. In the Northeast, females reach sexual maturity and lay their first nest by approximately 10-13 years of age depending on the latitude, with shorter time to maturation in more southern climates where the growing season is longer. Nest predation varies considerably but can be as high as 100% in areas with subsidized predator populations. With late age of maturation and high nest predation, many turtles have to

reach 30-40 years in age before replacing themselves in the population. Even without other threats, collection of turtles from the wild can quickly result in population decline. Every turtle counts and is important to the local population.

Recommendations

- **Discourage recreational use of known nesting areas**²⁹
- **Become informed and spread the word**
 - Collecting wild box turtles is illegal in all of the northeast states with the exception of two states (Delaware and Maryland), which allow the collection of one eastern box turtle³⁰.
 - Removing or moving even a few individuals can result in local extinction. For more information go to #EveryTurtleCounts.
 - Turtles do not make good pets. Turtles are a long-term commitment with some turtles living for over 50 years, have specialized care and habitat requirements which can be costly, and can be carriers of salmonella.
 - Sharing turtle location information on social media sites can be detrimental. Poachers use these sites to find sites to target for collecting turtles.
 - Releasing pet store turtles into the wild can introduce new diseases into wild turtle populations. Re-homing them is much safer for both the captive and wild turtles.
- **Watch for and report suspicious activities**
 - If you suspect someone is involved in the illegal collection of wild turtles, report it to the U.S. Fish and Wildlife Service's tip line (1/844/FWS-TIPS) or consult <https://wildlifecrimestoppers.org/report-a-poacher/> to find your state wildlife agency's law enforcement phone number. Learn more about [what to look for](#) and always keep your safety in mind.
 - Poachers may try to gain access to both public or private properties with a good turtle population. Ask questions and be vigilant.

Justification

- ^{28.} Turtle populations have been found to decline once an area was opened up to human recreation, with two populations crashing within a 10-year period (Garber and Burger 1995). Nesting turtles are the most important in the population, are very vulnerable when nesting, and the nesting season coincides with the start of the peak recreational season.
- ^{29.} A summary of collection and possession regulations for eastern box turtles for each northeastern state and for all freshwater turtles can be found on the Partners in Amphibian and Reptile Conservation website.

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