



Department of Defense

Legacy Resource Management Program

Recommended Best Management Practices for the Blanding's Turtle (*Emydoidea blandingii*) on Department of Defense Installations

Department of Defense Partners in Amphibian and Reptile Conservation



March 2022

Introduction

The Blanding's Turtle (*Emydoidea blandingii*) is a species for which the U.S. Fish and Wildlife Service (USFWS) was petitioned to list under the U.S Endangered Species Act (ESA) in 2012. The USFWS conducted a status review (2015, 90-Day Substantial Petition Findings), which found that the petition action may be warranted. The Blanding's Turtle does not currently receive protection under the ESA, although it is informally considered a species "At-Risk." Blanding's Turtles occur in 3 Canadian provinces and 15 U.S. states. In Canada, the species is considered Threatened nationally; its range in Canada accounts for 20% of the global range of this turtle species. In addition, Blanding's Turtles are considered a species of concern in nearly every U.S. state in which it occurs.

In the course of our research for this document, we collected informational brochures produced by all 15 U.S. state wildlife agencies found within the range of the species. Many include management recommendations for Blanding's Turtles. In this document, we have distilled State agency recommendations to directly-applicable actions that can be performed by land managers, particularly on military bases, but also on park, wildlife management area, and private lands.

Numerous projects and studies are currently being undertaken to study the Blanding's Turtle throughout its range. Studies include those focusing on population biology and nesting ecology, head-starting, and population augmentation. A number of habitat restoration and protection projects include nesting habitat enhancements and road fencing. A wide array of collaborations are required to achieve such varied project goals, including partnerships with zoos and aquariums, state and provincial herpetologists, federal biologists, high school students, state park personnel, consultants, and highway department personnel, among others. The Northeast Blanding's Turtle Working Group, in partnership with the Partners in Amphibian and Reptile Conservation Northeast (NEPARC), has produced numerous informative documents, including status assessments and habitat management recommendations, all of which are available on the Internet (<http://www.blandingsturtle.org/>).

The Department of Defense (DoD), through its Partners in Amphibian and Reptile Conservation (PARC) network, and the USFWS seek to develop a Best Management Practices (BMPs) document for the Blanding's Turtle. The management practices described in this document heavily reference the extensive conservation and research efforts currently underway throughout the Blanding's Turtle's range. The management recommendations outlined in this document were developed specifically for DoD installations with known Blanding's Turtle occurrences, but are also applicable to off-DoD-installation occupied habitats. These are intended to be guidelines for DoD natural resource managers to help with planning, prioritizing, and implementing conservation and management actions that provide a conservation benefit to the turtle. This report also provides compliance guidance for regulatory processes such as the Sikes Act, and the Environmental Protection Agency's National Environmental Policy Act (NEPA) and its associated analyses (i.e., Categorical Exclusion, Environmental Assessments, and Environmental Impact Statements). Implementation of these BMPs should not impede military readiness activities, should be documented in installation Integrated Natural Resource

Management Plans (INRMPs), and should align with existing efforts among the DoD Military Services and Components, federal and state governmental agencies, and non-governmental organizations (NGOs)—with the goal to prevent continued decline of Blanding's Turtle populations and to preclude its listing under the ESA.

Species Profile

Description:

The Blanding's Turtle is a medium-sized freshwater turtle (adults up to 10 inches; 150-240 mm carapace length) with a domed black carapace (top shell) peppered with numerous white/yellow speckling. The plastron (bottom shell) is checkered with yellow and black blotches. Blanding's Turtles have a single plastral hinge; hinges are a trait found only in box (*Terrapene* spp.) and mud turtles (*Kinosternon* spp.) in North America. The top of the head is black or brownish with yellow speckling, but the most striking marking is the brilliantly bright yellow throat. An adult Blanding's Turtle with its head and yellow throat extended above a wetland's surface is often identifiable from a good distance away. Blanding's Turtles often bask, especially in the early Spring, as the ice melts, and they clearly stand out from the much smaller Painted Turtles (*Chrysemys picta*) with whom they share wetlands throughout much of their range. Hatchling Blanding's Turtles are much less colorful than the adults, usually with cream-colored throats and solid black carapaces. But the colors become more vibrant as they grow larger and older.



Left: An adult or subadult Blanding's Turtles cannot be confused with any other turtle based on their bright yellow throat. Right: Hatchling Blanding's Turtles have more muted coloration compared to the adults.



Left: a head-started Blanding's Turtle begins to show more color and pattern. Right: Blanding's Turtles have relatively long necks and feed heavily on aquatic insects, such as dragonfly larvae, and crayfish, that this juvenile will stealthily hunt.



Left: A young male Blanding's Turtles displays a concave plastron, a thick tail, and noticeable growth rings (annuli). Right: an old female Blanding's Turtle with a characteristic flat plastron and smaller tail. This female turtle is too old to age as the annuli are worn; also note the radio transmitter attached to the posterior right side of the carapace.

Note: Turtles are really only “ageable” by annuli counts only up until they reach maturity. Juvenile turtles display growth rings (similar to tree rings). However, once a Blanding's Turtle reaches maturity at approximately 18 years, growth slows and rings are difficult to discern. However, the male (above, left) has just reached maturity (note the straight center line on the plastron (head to tail), and may be 18 years old as its ring count indicates. The female (above, right)—although we can count 18 rings—is much older, and has been an adult for many years based on the jaggedness of the center plastral line.

Life History:

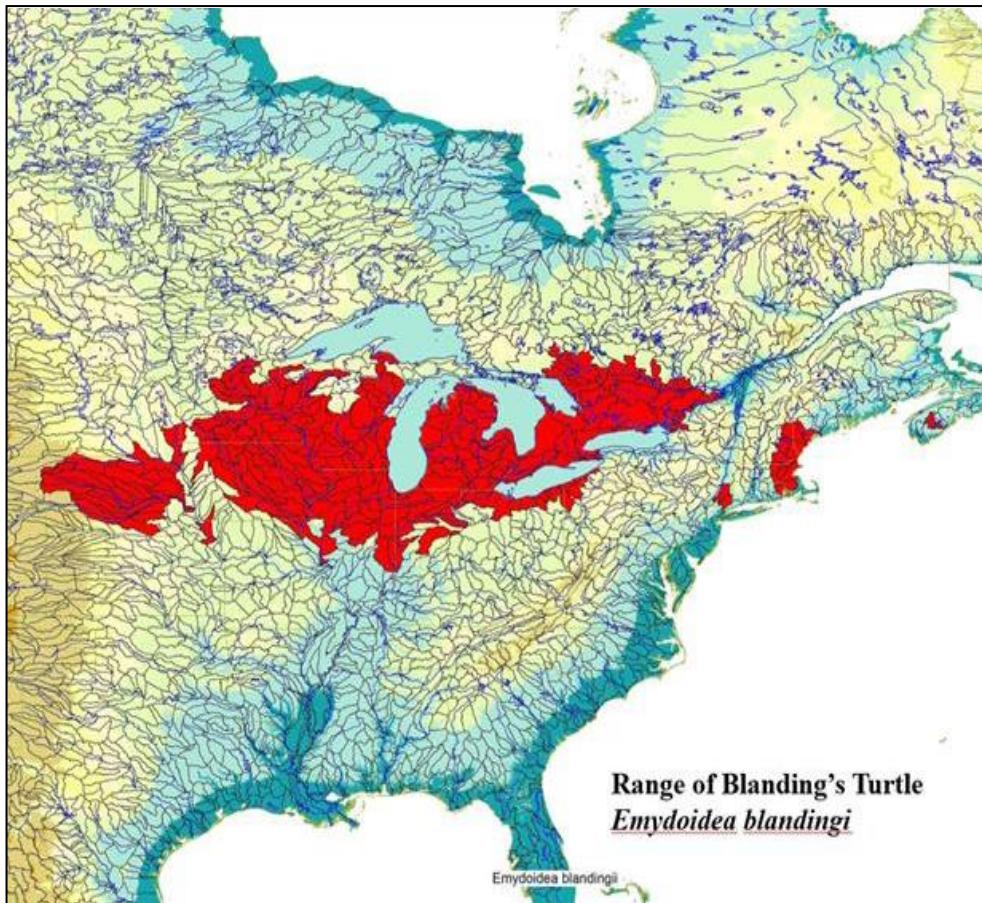
Blanding's Turtles display life history trait characteristics of long-lived species (Congdon et al., 2008), and may live 60 or more years. In fact, researchers in Michigan know of adult females that reached 84 years of age and were still reproductive, laying one clutch of eggs (average 7-12 eggs) most every year. Although adults Blanding's Turtles may have high annual survivorship under natural conditions, eggs, hatchlings, and young juvenile turtles are not as fortunate. Blanding's Turtle females nest in open sandy areas in June each year, and those clutches of perhaps 10 or more eggs each are often consumed by mesopredators including raccoons, foxes, and skunks. Hatchlings that emerge from nests that were not consumed by predators, have to travel overland—sometimes great distances—to reach the security of a wetland. There is evidence that Blanding's Turtles can orient towards water, but still many are eaten—even by chipmunks—or succumb to exposure if they are on land when frost arrives. Hatchlings that make it to the water have to escape predation from bullfrogs, herons, otters, and presumably large fish in some types of wetlands. Most importantly, turtles grow slowly and take between 14 and 20 years to reach a body size at which the females will begin producing eggs. Thus, as one might expect, few hatchlings make it to adulthood (which is sustainable if the adult population is large and stable). In theory, only two hatchlings need to make it to adulthood (to replace one male and one female) over the course of a female's 60 years of reproduction, in order for the population to remain stable. However, a problem with this type of life history, is that it requires high adult survival. In human-altered landscapes, additional deaths (additive mortality) of a few female Blanding's Turtles by automobiles on the road they cross between their wetland and the nesting area, means that in a relatively short time period, a Blanding's Turtle population may become extirpated. This scenario also holds true for most turtle species, hence the reason turtles are now one of the most endangered animal groups on the planet.

Therefore, it is the intent of this document to introduce natural resource managers, particularly on DoD facilities, to actions they can take to minimize or prevent these additive adult mortalities of Blanding's Turtles. In addition, we will provide some examples of habitat management that can improve Blanding's Turtle habitat, as well as population manipulation techniques, such as head-starting, that can be used to "boost" a diminished turtle population, especially if other actions to reduce adult mortality and improve habitat quality are being enacted concurrently.

Range:

The Blanding's Turtle inhabits wetland systems of the upper Midwestern (Ohio-Nebraska) United States and the Great Lakes region of the U.S. and Canada, and extends in isolated pockets into the northeastern U.S. and Canada. The Blanding's Turtle distribution is confined to a narrow range of northern latitudes, and more so than any other North American turtle. These turtles inhabit large glacial wetland complexes with permanent water, but also move terrestrially over landscapes where they seasonally inhabit isolated ponds and ephemeral wetlands. In general, Blanding's Turtles require large landscapes over which they will travel terrestrially between wetland complexes, to access seasonally available food (such as tadpoles in vernal pools), presumably for mates, and to access suitable nesting areas. Those behaviors quite obviously put

them at high risk from habitat loss resulting from the development of remaining large chunks of contiguous natural habitat, and road mortality. Although, the level of concern for all turtle species is increasing (Stanford et al 2020), for some species, it may be easier to maintain viable populations in smaller parcels of protected natural areas. This may not be true for the Blanding's Turtles, which require larger landscapes. Therefore, some of the greatest opportunities for protection of the species may therefore exist on large DoD military installations, in addition to larger parks and wildlife refuges.



The global range of the Blanding's Turtle consists of a core Midwestern/Great Lakes range, with a smaller, more fragmented, northeastern distribution, that includes the Hudson River Valley, NY, and eastern MA, se. NH, se. ME and Nova Scotia. It is in this northeastern range that Blanding's Turtles are uniformly considered an “At-Risk” species. Blanding’s Turtle Range Map modified from Buhlmann et al (2009) and based on known occurrences in hydrologic units.

Distribution on Military Sites:

The Blanding's Turtle is confirmed present on the following 10 military sites (Petersen et al. 2018).

- Air Force: New Boston Air Force Station (NH)
- Army/Air Force: Camp Grayling Joint Maneuver Center (MI)
- Army: Devens Reserve Forces Training Area (MA); Fort Drum (NY); Fort McCoy (WI);
- Army National Guard: Fort Custer Training Center (MI); Arden Hills Army Training Site (MN); Camp Ripley (MN); New Hampshire Army National Guard Training Site (NH)
- Marine Corps: Marine Corps Reserve Center Battle Creek (MI)

Of these 10 confirmed military sites, 3 are in the northeastern range of the Blanding's Turtle where conservation concern is the greatest. Of those, New Boston AFS, has a long standing Blanding's Turtle research and monitoring program; and Devens Reserve Forces Training Area is adjacent to Oxbow National Wildlife Refuge (USFWS) which is actively managed for Blanding's Turtles. Thus, some substantial opportunities for conservation and partnerships exist. Blanding's Turtles were recently confirmed (2017) at the New Hampshire Army National Guard Training Site.

Seven military sites are in the Midwestern (core) portion of the Blanding's Turtle range. These sites include Fort Drum, NY (which is the easternmost portion of the Midwestern/Great Lakes range of Blanding's Turtles). The Minnesota DoD sites have had active nest protection programs and the Wisconsin DoD site has Blanding's Turtles managed in their INRMP. Both are peripheral to a large population at Weaver Dunes Natural Area (Pappas et al., 2000). Several of the Michigan DoD sites are near long-term Blanding's turtle research sites (Gibbons, 1968; Congdon et al., 1993).

The Blanding's Turtle is unconfirmed and potentially present on the following 10 military sites; specimens have been found in the same county as these sites, but not within the boundaries of the installation itself (Petersen et al. 2018).

- Air Force: Hanscom Air Force Base (MA); Westover Air Reserve Base (MA); Offutt Air Force Base (NE)
- Army: Iowa Army Ammunition Plant (IA)
- Army National Guard: Bog Brook Training Site (ME); Hollis Training Site (ME); Camp Curtis Guild (MA); Camp Perry Training Site (OH); Otis Air National Guard (MA)
- Navy: Naval Station Great Lakes (IL)

Given that 6 of these 10 potential sites are in the Northeastern portion of range, it may be important to prioritize surveys, if that has not been done already. Also, Hanscom Air Force Base

is 9 miles east of Assabet River National Wildlife Refuge (NWR), which has been the site of a Blanding's Turtle reintroduction project using head-starts (Buhlmann et al., 2015).

Habitat:

Blanding's Turtles inhabit a variety of wetland habitats that include glacial wetlands whose characteristics range from shrub swamps, fens and bogs, open emergent grassy marshes, beaver ponds, seasonal (vernal) woodland ponds, and the margins of lakes. Prairie wetlands are also commonly used in the western portion of their range, such as at Valentine NWR, Nebraska. Many of their aquatic habitats have dark, tannin-stained, but clear waters. Blanding's Turtles do not prefer waters heavy with sediment. The muck layers are soft and deep, and often seem to have no solid bottom, especially as perceived by a human biologist in waders.

Although Blanding's Turtles are not hesitant to move long distances overland, the landscape in which they inhabit requires some wetlands that contain permanent water, with deep sections, and preferably non-fluctuating in levels. Within that landscape, however, Blanding's Turtles will travel through hardwood forest, prairies, and savannas and frequent shallow marshes, and seasonally flooded vernal woodland ponds, where their visitations may coincide with the hatching of Wood Frog (*Rana sylvatica*) and Spotted Salamander (*Ambystoma maculatum*) egg masses. Thus, Blanding's Turtles traverse terrestrial habitats and need to be protected on these overland journeys.



Left: An emergent wetland with grasses and sedges in Massachusetts favored by Blanding's Turtles. Right: a Leatherleaf (*Chamaedaphne calyculata*) dominated shrub swamp favored by Blanding's Turtles.



Above: Vernal pools may be full with water in Spring months, are fish-free, and provide foraging Blanding's Turtles with a rich supply of food in the form of frog tadpoles, salamander larvae, and aquatic insects.

Seasonal wetlands often dry in summer and are not suitable winter hibernacula, as turtles would freeze or risk exposure in shallow or drying water. Thus, an optimal Blanding's Turtle landscape has permanent and seasonal wetlands in a landscape of forest, and field, and open nesting areas, that is not fragmented and made hazardous with roads and automobiles.



Blanding's Turtles in shrub swamp habitat dominated by Leatherleaf (*Chamaedaphne calyculata*) where juveniles seem to have high survivorship.



Left: Ditches on a wildlife refuge in Michigan contained old Blanding's Turtles, but no juveniles were found. Right: Open water marshes with cattails are used by Blanding's Turtles but are not their favorite habitats.

Behavior:

Basking: Blanding's Turtles do bask and are often seen in early spring months basking on logs before concealing vegetation has fully leafed out. At this time, they are easily distinguished from fellow basking turtles, most notably the Painted Turtles (*Chrysemys picta*), which are distinctly smaller than Blanding's Turtle adults. Spring is a good time to conduct low-effort basking surveys to attempt to detect the presence of Blanding's Turtles. Survey and detection (inventory), and monitoring projects involving trapping should be in coordination with State biologists, and protocols are available from the Northeast Blanding's Turtle Working Group (blandingsturtle.org).

Foods:

Blanding's Turtles appear to be strongly carnivorous, with tadpoles, snails, and aquatic insects frequently consumed. Travels to vernal ponds may be in search of amphibian egg masses.

Nesting:

Adult female Blanding's Turtles are most often encountered on land during the nesting season. Females choose to nest in open canopy sites, including agricultural fields and the edges of roads, which can lead to mortalities. Nests are constructed in sandy soil. Blanding's Turtles also may dig nests in lawns, but nest hatching success is lower than in open sandy areas. Nesting typically begins during evening hours but the female may not complete the process until after dark. Nests are constructed in Spring, most likely to be observed in late-May to late-June depending on the location within the species range.

Managing Blanding's Turtle nesting can be perceived as a challenge because the turtles are reported to move long distances to nest, and sometimes spend multiple nights out of the water. However, do they really need to walk that far? The best nesting habitat associated with the most stable populations are typically 50-200 m from the adult wetland source location.

Eggs in nests incubate by the heat of the sun and hatch in late-August to early-October, after approximately 84 days, varying with summer temperatures and latitude. Clutch size varies with the size and age of the female, but averages 7-12 eggs.

Hatchlings all emerge from the nest and enter the wetlands in autumn; they do not have the ability to overwinter in the nest. Some hatchlings have been tracked to the basins of dry vernal pools (Butler and Graham, 1995), but their survival was unknown.



Blanding's Turtles may seek to nest on road shoulders or even dig in hard-packed dirt roads, if they do not have access to appropriate nesting sites.

Threats:

The lists of threats to Blanding's Turtles include those common to most other turtles and wildlife: loss of habitat (whether by pollution, destruction via development, or isolation of habitats in increasingly humanized landscapes), collection for the pet trade (especially for illegal commercial trade to Asia), consumption of eggs and hatchlings by predators, and mortality associated with automobile collisions. Specific threats and potential conservation ameliorations are given in the following sections.

Conservation Status

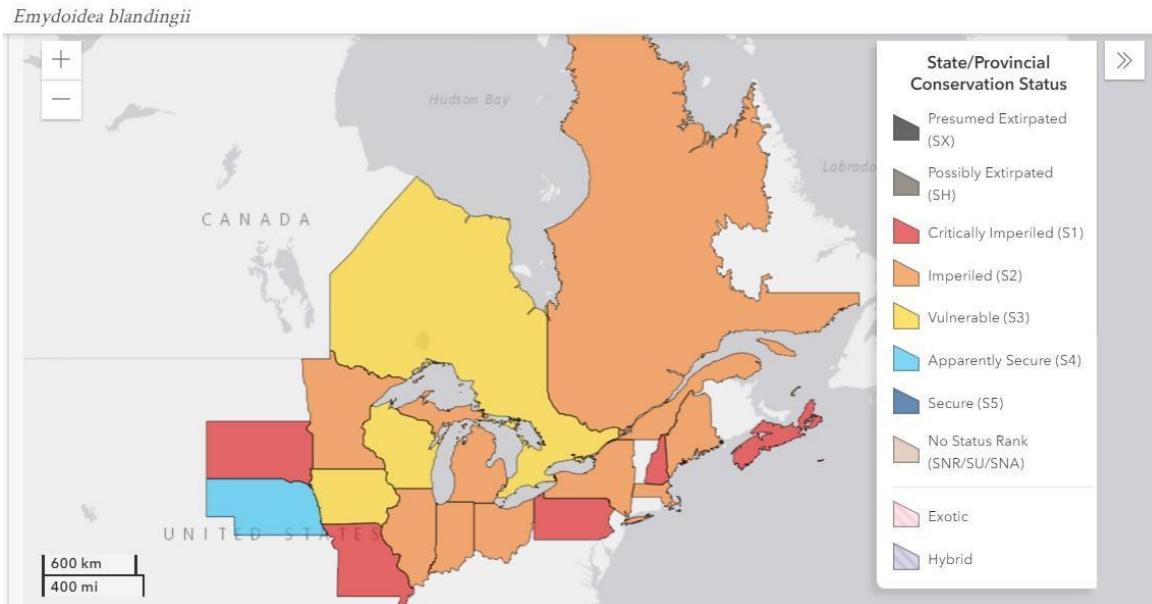
At the U.S. federal level, Blanding's Turtles range-wide have been petitioned for listing, but do not receive protection at present. In Canada, the species is listed as Federally Threatened (COSEWIC, 2018). The Blanding's Turtle is considered Endangered on the IUCN Red List (van Dijk and Rhodin, 2011) and has a NatureServe Global Rank of G4-Apparently Secure.

State Conservation Status:

State NatureServe Rankings (S) follow the same definitions as Global (G) and are as follows: S5 (Secure), S4 (Apparently Secure), S3 (Vulnerable), S2 (Imperiled), S1 (Critically Imperiled), SH (Possibly Extirpated), SX (Presumed Extirpated).

Current Provincial and State natural heritage rankings (rarity status) are given below, as well as State and Provincial T&E listings (protection level).

Nova Scotia:	S1	Endangered
Ontario:	S3	Threatened
Quebec:	S2S3	Endangered
Illinois:	S2S3	Endangered
Indiana:	S2	Endangered
Iowa:	S3	Threatened
Maine:	S2	Endangered
Massachusetts:	S2	Threatened
Michigan:	S2S3	Special Concern, not listed
Minnesota:	S2	Threatened
Missouri:	S1	Endangered
Nebraska:	S4	N/A
New Hampshire:	S1	Endangered
New York:	S2S3	Threatened
Ohio:	S2	Threatened
Pennsylvania:	S1	considered Threatened, no protection status
South Dakota:	S1	Special Concern, no protection, SH possible
Wisconsin:	S3S4	Special Concern, no protection



Natural heritage rankings for Blanding's Turtles by State and Province (Explorer.NatureServe.org, 2021). The various colors on the map represent the conservation status of Blanding's Turtles in each State and Province (see map legend). No conservation status of Presumed Extirpated (SX), Possibly Extirpated (SH), Secure (S5), No Status Rank, Exotic or Hybrid are present on the map. Surprisingly, Blanding's Turtles are presumed most secure at the farthest western edge of their range (e.g., Nebraska).

Recommended Conservation Implementation Strategies and Best Management Practices for Blanding's Turtles on Military Sites

In general, implementation of the specific BMPs listed below should not be performed if those practices would negatively impact an existing Blanding's Turtle population. Habitat management practices, while serving long-term benefits, should be carefully planned prior to their implementation to minimize potentially adverse impacts to turtle activity periods and locations. Make sure to document performance of any of the following BMPs, whether current or future, in your installation's INRMP. The USFWS may consider these proactive conservation actions prior to making a listing determination for this species.

Specific to Military Bases:

- 1. Review Internet Literature From Your State Wildlife Agency.** During the course of this document preparation we found informational brochures, management recommendations, status surveys, photographs of techniques, and monitoring techniques on the state wildlife agency websites for Blanding's Turtles in virtually every state (and Canadian province) in which they occur. Therefore, resources specific to your state, as well as contacts of individual biologists who can assist are accessible, and many are listed at the end of this document.

- 2. Identify Blanding's Turtle Habitats.** Documenting occurrence or continued presence of Blanding's Turtles on the DoD installations mentioned in this document can be achieved by conducting visual surveys of basking turtles in installation wetlands, ponds, and lakes. It is recommended that military bases in the Northeastern range prioritize inventories.
- 3. Protect Blanding's Turtle Habitats.** Once aquatic habitats inhabited by Blanding's Turtles are identified, efforts should be made to identify potential pollution inputs (i.e., road runoff, outfalls) that may be degrading water quality. Correct pollution issues, as applicable.
- 4. Remove Human Subsidies for Turtle Predators.** Policing cleanup of bivouac and recreation litter such as discarded Meals, Ready-to-Eat (MRE) materials, as well as removal of any trash cans or dumpsters from nesting areas will decrease the amount of predation by subsidized species such as raccoons, coyotes, and other carnivores. Regular removal of trash from roadsides and other turtle travel corridors will also decrease predation. This can be done through regulation, volunteer cleanup efforts, and unit education. Not only will these areas attract less predators when clean, but artificially high population densities of predators will be reduced.
- 5. Restoration and Creation of Blanding's Turtle Nesting Habitats.** Open canopy nesting areas must be maintained and not allowed to become shrub dominated. Creating openings for nesting adjacent or near to existing Blanding's Turtle wetlands can restore nesting habitat lost to forest succession and invasive plants (e.g., multiflora rose [*Rosa multiflora*], autumn olive [*Elaeagnus umbellata*], glossy buckthorn [*Rhamnus frangula*]). Optimal nesting sites should not be large barren areas, but should include microhabitat structure, which can be provided by intermittently planted bunch grasses, such as Little Bluestem (*Schizachyrium scoparium*). Those grass clumps help a Blanding's Turtle be less detectable in the nesting landscape. However, a lawn habitat is not appropriate, as nesting turtles need bare soil in which to dig. Creation or restoration of nesting areas may also help prevent long distance searching by females and avoid conflicts with roads. Hatchling turtles may more successfully access near rather than far wetlands. As per recommendations in the Northeast Blanding's Turtle Working Group's BMP (2021) it could be beneficial to have nesting areas located adjacent to or within 200 m (approx. 650 ft) of wetlands inhabited by Blanding's Turtles. Understanding that seasonal turtle movements occur between wetland and nesting habitats and that turtles need connecting habitat corridors where human impacts such as logging, movement of heavy equipment, and vehicle traffic are minimized, will help reduce mortality of both nesting females and hatchlings returning to the wetland. It is recommended that you consult with installation planners and range officials to assess the potential impact to military training prior to conducting any clearing of habitat.



Above: Examples of overgrown nesting areas that were restored to open conditions for use by nesting Blanding's Turtles.



Left: Open dune areas and sparse grass presence are preferred nesting habitat by Blanding's Turtles. Right: Areas that were cleared of brush to provide nesting habitat for Blanding's Turtles.

- 6. Identify Nesting Locations and Protect Nests.** During May-July, seek information on observations of large freshwater turtles walking across roads, parking lots, lawns, and golf courses. Blanding's Turtles nest most commonly from late-May to mid-June. These turtles are likely females in search of suitable nesting sites. Several actions/alternatives can be taken once female turtles are observed digging a nest and depositing eggs. First, observe the process without disturbing the female, note the location of the nest, and protect it with signage or fencing. Second, should permitting, resources and priorities allow, cover the nest with wire mesh to protect the egg contents from predation. To be most effective, this must be done as soon as the nest is discovered, as turtle nests are typically depredated by mammalian predators (mostly raccoons) the first night after the eggs are deposited.



A wire mesh covering made of half-inch hardware wire cloth and with a size of 3 ft x 3ft can be placed over the area where a turtle has nested. In this case the exact location of the nest was marked with an outline of small stones, and flagging. The edges of the wire mesh were secured with large nails to prevent raccoons, dogs, and coyotes from digging up the eggs. This method is highly effective at preventing predation if the cover is placed on

the nest immediately after the female turtle finishes nesting. Most turtle nests are predated within the first few nights. However, this cover needs to be removed prior to hatching (we suggest by the first of August), so that the baby turtles can escape, otherwise they will die from exposure under the mesh. Nests can take 70-100 days to hatch depending on summer temperatures. Nests can be temporarily covered with plywood—but only for a few days—as the plywood will shade the nest and prevent proper egg development.



The nest covers above have small square exits so that hatchlings can escape on their own once they hatch. Photos obtained from: <https://blog.cwf-fcf.org/index.php/en/build-it-and-they-will-hatch/>

7. **Identify Invasive Species Threats to the Aquatic Habitat.** Identify and control invasive plants (i.e., *Phragmites*, *Eurasian milfoil*) that degrade the habitat quality for Blanding's Turtles. This may include Water Chestnut (*Trapa natans*) and require technical assistance. Several species of invasive plants spread and cover bankside basking and nesting habitat. These include Multiflora Rose, Glossy Buckthorn, and Autumn Olive—which may destroy nesting habitat. Avoid stocking predatory fish in DoD wetlands, such as Leatherleaf shrub swamps. The fish may not survive well, and they may eat hatchling Blanding's Turtles.

- 8. Be Alert for Poaching Activity.** Some aquatic water bodies on DoD facilities are open to legal fishing and recreation. Be aware that collection of turtles by individuals, especially commercial collection for food or the pet trade, would represent a serious threat to maintaining stable, viable populations of Blanding's Turtles. Blanding's Turtles are unlikely to be captured unless illegal baited turtle traps are set, but females and eggs could be poached during nesting season. The illegal commercial pet trade involves Blanding's Turtles so vigilance is required and suspicious human behavior should be noticed. Some wildlife refuges have installed cameras on turtle nesting areas to monitor both human and predator poaching of turtle nests. Report any known or suspected poaching to state and federal wildlife law enforcement.
- 9. Prevent Turtle Roadway Mortality.** It is becoming understood that additive (above normal) levels of mortality suffered by female turtles as they encounter roads and automobiles is leading to long term extirpations of turtle populations. A female Blanding's Turtle requires 18 or more years to mature, after which they may produce a clutch of eggs each year for up to 60 more years. In addition, nest mortality is high, and a female must nest many times for just a few hatchlings to make it to maturity. Once Blanding's Turtles reach adulthood, it has few enemies besides automobiles. A female turtle killed on the roadway while going to nest represents not only the loss of a breeding female and that clutch of eggs, but also the loss of every clutch she would have produced in subsequent years.
- 10. Consider Installation of Road Signage.** Roadway signage that alerts drivers to the presence of turtles on roads can be effective. Reducing speeds and the use of rubberized (temporary, movable) speed bumps may also be effective. Signage should also be used seasonally. Motorists become accustomed to signs. However, if the signs appear each year at the beginning of turtle nesting season (such as early May), and are only up for the duration of the nesting period, (through early July), then motorists are more likely to pay attention.





Above: Signage can be funny, as this example from Mobile Bay, Alabama to protect endangered Alabama Red-bellied Turtles. Consider installing turtle crossing signage and potentially reducing speed limits during the nesting season along roads with high turtle activity.

11. Consider Installation of Road Fencing. The use of turtle fencing is becoming more common (see pictures below) to prevent turtles from accessing roads. Fence materials include plastic sheeting, silt fence, galvanized wire, and chain link. Some may be more effective in areas where winter snow cover will be an issue. Turtle fencing is not always about blocking passage, but providing access to, or direction to, safe nesting habitat. Opaque fencing is best to keep turtles moving along a fence or to direct them to a specific location. Turtles will try to push through large-hole fencing such as chain link. There are experts who can assist with design of turtle fencing to prevent road mortality and divert females to alternate nesting areas. Additional studies like radio telemetry can help determine movement patterns, especially over land between aquatic habitats, and thus help managers identify barriers to successful turtle movement.



Left: photo from: https://s3-eu-west-1.amazonaws.com/assets-animexfencing-com/images-c3/Animex-Fencing/Projects/_md1x1/Ausable-Fencing-along-guardrail.jpg. Right: photo from: https://www.algonquinpark.on.ca/images/turtle_fencing3.jpg



Left: photo from: <https://blog.cwf-fcf.org/wp-content/uploads/2020/04/Turtle-fencing-1-1100x640.jpg>. Right: photo by KA. Buhlmann.

12. Consider Installation of Road Culverts. In some cases, turtles can be directed through safe passage under roads, as just preventing their crossing does not address their nesting or movement needs. Consider the installation of road culverts at locations where high turtle mortality has been documented. Road culverts will benefit not only Blanding's Turtles, but also a variety of other wildlife species.



Different types of culvert designs to consider. Left: <https://s3-eu-west-1.amazonaws.com/assets-animexfencing-com/images/New-photos/Underpassage-Grate.JPG>; Right: <https://dandelionsandconcrete.blogspot.com/2013/04/mto-turtle-crossing-nesting.html>

13. Monitor Population Trends. If desired, herpetological experts can help design monitoring protocols for Blanding's Turtles. Coordinate with state wildlife agency and USFWS biologists to make sure studies are useful and meet the needs of advancing turtle conservation. The Northeast Blanding's Turtle Working Group, working with PARC, has developed standardized monitoring protocols (<http://www.blandingsturtle.org/>). Basking

surveys can provide insight into population numbers, but a mark-recapture program can provide measures of true population size, sex ratios, demography (*i.e.*, representation of different age classes, and reproduction), growth, and survivorship. Share observations of sick or diseased turtles with reptile/wildlife-focused veterinarians. Emerging diseases affect not only humans, but wildlife as well.

- 14. Consider Population Manipulations That Aid Recovery.** Techniques for manipulating populations include nest protection and head-starting of hatchling turtles (*i.e.*, raising hatchling turtles in captivity for their early vulnerable periods of life to quickly increase their size, thus increasing survivorship of the turtles upon release). Since 2007, the USFWS, in collaboration with a Massachusetts high school and a university, have been head-starting Blanding's Turtles to reintroduce and establish a new Massachusetts population. Their 1000th head-start was released in 2021. If increasing the numbers of Blanding's Turtles in a population is a goal, seek advice from conservation ecologists associated with DoD who have experience with these methods.
- 15. Seek Opportunities to Collaborate on Species Conservation.** Working with researchers, such as those within Northeast and Mid-west PARC, DoD PARC, state agencies, federal agencies, or universities, can benefit conservation efforts. These partnerships lead to discussions, brainstorming, and efficient methods to help DoD natural resource managers obtain the information they need to manage and recover at-risk and endangered and threatened species, minimize conflicts with the military mission, and maintain military readiness.

Inventory and Monitoring Techniques for Blanding's Turtles

Basking Surveys

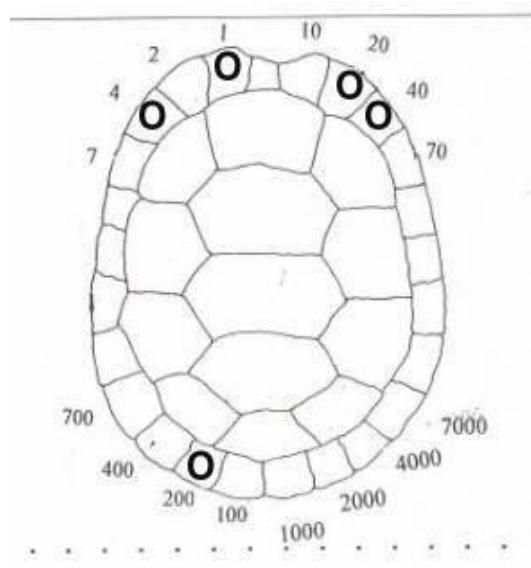
Visual surveys of artificial or natural basking sites (*i.e.* logs, banks and sandbars, etc.) can be conducted with speed, efficiency, and take less time than other ground survey methods. Basking surveys require binoculars or a spotting scope, and can be conducted on foot or via boat in larger bodies of water. This method is not ideal for estimating population size, but it requires much less effort than other survey methods such as mark-recapture. Optimum survey periods are early spring through early summer and must be conducted when environmental conditions are suitable for turtle basking activity (*i.e.*, sunny days with air temperatures above 70 F). Surveys conducted in the morning might have a better chance of spotting turtles.

Nesting Surveys

Wildlife cameras can be used to detect Blanding's Turtle nesting activity, detect the presence of nest and egg predators, as well as to monitor human disturbance. Detection of nesting areas via wildlife cameras could also help identify those areas where heavy foot traffic and therefore nest trampling is a concern.

Mark-recapture

Mark-recapture is still the most widely-used method to census turtle populations. This technique involves making permanent marks on the shell, such as notching or drilling the lateral scutes to provide long-term, distinctive visual indicators of individual turtles. It is recommended that you check with your respective state agency to determine permit requirements before starting a mark-recapture study. In addition, some states may already have a specific marking protocol established for this species.



A scute marking system, such as the one illustrated, can be used to mark a unique code to identify individual turtles. The 1-2-4-7 system allows for any number between 1 and 9 by marking or drilling. No more than two scutes on any of the four “corners” of the turtle are marked. The identification code for this turtle is 265. Up to 9999 different turtles can be identified with this method. The marks on turtle shells can be made as notches from a knife or file, or as holes drilled through the marginals (illustrated here). Hatchlings can be marked with small scissors or fingernail clippers. Marks on the shells of terrestrial and freshwater turtles do not damage the turtle but are permanent—being identifiable for as many as 30 years after initial marking.

Genetics

Collection of genetic material can be obtained by minimally invasive specimen sampling such as shell filings, nail clippings, blood draws, or carcass tissue and can provide information on the unique genetic markers for turtle populations. These markers can be used in a wider context with regional partners such as state biologists and researchers to determine population characteristics (isolation and dispersal), and support law enforcement functions such as preventing poaching, prosecution, and return of seized turtles. It is recommended that you check with your respective state wildlife agency to determine if state or regional genetic studies are already underway and if a permit is required for collecting genetic material.

Benefits of Blanding's Turtles Best Management Practices to Military Training Operation

1. Aquatic turtles on military bases should have little or no impact on military training activities.
2. Blanding's Turtles that are protected from human poaching due to their presence on secure, limited access bases, contribute to overall species stability.

3. Maintaining viable populations of species of concern on military bases, may reduce the long term likelihood of their listing under the Endangered Species Act.
4. Turtles are of interest to most people especially those who appreciate the outdoors, as well as children. Overall, they help enhance the living environment on military bases.
5. The same open and diverse habitats that serve the turtles well also benefit military training.
6. Blanding's Turtles co-occur with two other mission-sensitive species (Spotted Turtle [*Clemmys guttata*] and Wood Turtle [*Glyptemys insculpta*]) that will co-benefit from implementation of this BMP.

DoD PARC Points of Contact

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For additional experts on turtles, in general, search the Partners in Amphibian and Reptile Conservation (PARC) Expert Partner Database <https://parcplace.org/network/parc-partners/>

Acknowledgements

DoD PARC would like to thank Kurt Buhlmann for taking the lead on writing this document. Comments and review were provided by Lori Erb (Mid-Atlantic Center of Herpetology and Conservation), and Eliese Dykstra, Wende Mahaney, and Noelle Rayman-Metcalf of the USFWS. We also thank Matt Hinderliter for coordinating the USFWS review of this document.

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State and Provincial Blanding's Turtle Resources on the Internet

U.S. State Wildlife Agencies

Illinois: <https://www2.illinois.gov/dnr/education/Pages/WATBlandingsTurtle.aspx>; <https://www.lcfpd.org/what-we-do/projects/blandings-turtle-recovery-program/#:~:text=The%20Blanding%20is%20long-lived%2C,have%20been%20documented%20from%2017%20localities%20since%201907>.

Indiana: <https://www.in.gov/dnr/fish-and-wildlife/wildlife-resources/animals/blandings-turtle/>

Iowa: <https://www.iowadnr.gov/Portals/idnr/uploads/education/Species/turtle/bturtle.pdf>; <https://dickinsoncountyconservationboard.com/2021/03/16/blandings-turtle-in-iowa/>

Massachusetts: <https://www.mass.gov/doc/blandings-turtle-conservation-management-practices/download>

Maine: https://www.maine.gov/ifw/wildlife/endangered/pdfs/blandingsturtle_72_73.pdf

Michigan: <https://mnfi.anr.msu.edu/species/description/11490/Emydoidea-blandingii>; https://mnfi.anr.msu.edu/abstracts/zoology/Emydoidea_blandingii.pdf

Minnesota:

<https://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=ARAAD04010>

--Weaver Dunes-- <https://www.nature.org/en-us/get-involved/how-to-help/places-we-protect/weaver-dunes-scientific-and-natural-area/>

Missouri: <https://mdc.mo.gov/discover-nature/field-guide/blandings-turtle>
https://files.dnr.state.mn.us/natural_resources/animals/reptiles_amphibians/turtles/blandings_turtle/nest_factsheet.pdf

Nebraska: <https://herpneb.unl.edu/blandings-turtle>

New Hampshire: <https://www.wildlife.state.nh.us/wildlife/profiles/blandings-turtle.html>

New York: <https://www.dec.ny.gov/animals/7166.html>; <https://guides.nynhp.org/blandings-turtle/>

--Water Chestnut-- https://www.dec.ny.gov/docs/lands_forests_pdf/aiswatercfs.pdf

Ohio: <https://www.clevelandmetroparks.com/about/conservation/current-issues/blanding-s-turtle-1>; <https://www.nature.org/en-us/get-involved/how-to-help/animals-we-protect/blanding-s-turtle/>

Pennsylvania: <http://archive.allegenyfront.org/story/blanding%20%99s-turtles-threatened-pa-not-yet-endangered.html>;

<https://www.fishandboat.com/Resource AmphibiansandReptiles/Documents/08blandings.pdf>

South Dakota: https://www.sdherps.org/species/emydoidea_blandingii

Wisconsin:

<https://dnr.wi.gov/topic/EndangeredResources/Animals.asp?mode=detail&SpecCode=ARAAD04010>

Canada:

<https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/recovery-strategies/blandings-turtle-2018.html>

Nova Scotia:

https://novascotia.ca/natr/wildlife/biodiversity/pdf/recoveryplans/Blandings_Turtle_Recovery_Plan_Jan2003.pdf

Ontario: <https://www.ontario.ca/page/blandings-turtle>

Quebec: <https://naturecanada.ca/discover-nature/endangered-species/blandings-turtle/>