

What Is “Turtles In the Classroom”?

As a part of our environmental science curriculum, SPFHS will be participating in a program to help raise hatchling Wood Turtles. These hatchlings are collected from [Great Swamp National Wildlife Refuge](#) by the [US Fish and Wildlife Service](#). These baby turtles face numerous challenges and likely would have struggled to survive on their own in the wild, so we are helping to give them a head-start before they are returned in June.

Turtles in the Classroom helps to connect students with their environment and serves as a gateway stewardship experience for students. Through the program, students learn to see connections between human impacts (including their own) and the natural world. It is an opportunity to help conserve an endangered species and protect biodiversity in our own backyards.

The hatchlings are hosted in our 20 gallon aquarium, complete with an underwater heater and filter and multiple basking platforms to help keep the young turtles comfortable. Over the course of the next few months, students develop a deep appreciation for the value of wildlife as they learn to take on the role of environmental stewards. The program culminates with a field trip to the Great Swamp National Wildlife Refuge, where students return their turtles to a state-approved location. The funding for our Turtles in the Classroom program was provided by a generous grant from the EEF.

What Is A Wood Turtle?

Wood turtles are semi-aquatic freshwater turtles native to the northeastern United States and Canada uniquely adapted for cold climates and can grow to 9 inches in length.

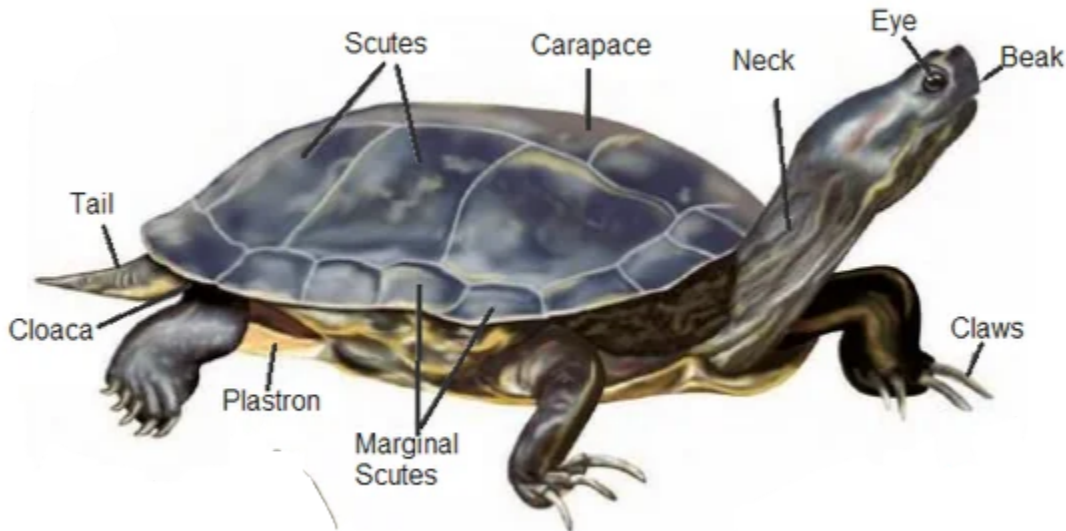
The wood turtle’s carapace, or upper shell, has a sculpted or grooved appearance, making it appear that their shells are carved from wood. Each season a new annulus, or ridge, is formed, giving each scute (a scale-like horny layer) a distinctive pyramid-shaped appearance. As the turtle ages, natural wear smooths the surface of the shell. While the scutes of the carapace are brown, the plastron, or underneath shell, consists of yellow scutes with brown or black blotches on each outer edge. The legs and throat are reddish-orange.

Wood turtles once ranged widely across eastern landscapes characterized by meandering cobble-bottom streams and their surrounding fields and forests. Neither strictly aquatic or terrestrial -- they live both on land and in water -- the wood turtle is vulnerable to loss of both types of habitat. Wood turtles are omnivorous and opportunistic. They are not picky eaters and will readily consume everything from slugs and algae to wild fruits, leaves and carrion. Once temperatures drop in autumn, the turtles retreat to rivers and large streams for hibernation. Dissolved oxygen is extracted from the water, allowing the turtle to remain submerged entirely until the arrival of spring.



What Is The Anatomy Of A Terrapin?

The scientific name of the wood turtle, *Glyptemys insculpta*, refers to the deeply sculptured or chiseled pattern found on the carapace (top shell), which makes it resemble carved wood. The carapace is dark brown or black and may have an array of faint yellow lines radiating from the center of each chiseled, pyramid-like segment due to tannins and minerals accumulating between ridges.



These segments of the carapace, as well as those of the plastron (bottom shell), are called scutes. The carapace also is keeled, with a noticeable ridge running from front to back. The plastron is yellow with large dark blotches in the outer corners of each scute. The black or dark brown head and upper limbs are contrasted by brighter pigments ranging from red and orange to a pale yellow on the throat and limb undersides. The hind feet are only slightly webbed, and the tail is long and thick at the base. Adults weigh approximately 1.5 to 2.5 pounds and reach a length of 5 to 9 inches.

Carapace	The upper shell of a turtle is known as the carapace and during embryonic development it is formed by the fusion of the spine with bones that would normally form the rib cage in other animals.
Plastron	The bottom shell of a turtle is known as the plastron and is composed of bone and is a structure unique to turtles. The plastron of wood turtles lacks a hinge and is immobile, meaning the head of the terrapin cannot be completely withdrawn into the shell like with a box turtle.
Scutes	The carapace and plastron are divided into bony plates called scutes that form a mosaic structure. • Vertebral scutes form along the midline of the back. • Costal scutes form along the sides of vertebral scutes. • Marginal scutes form an apron pattern along the edge of the carapace.
Keel	The main ridge along the midline of the carapace is the keel.
Bridge	The bridge is the bony segment that connects the two halves of the shell and serves as a brace/structural support that prevents the upper and lower shells from collapsing on each other following a heavy impact.

What Is The Wood Turtle Life Cycle?

During early March, wood turtles emerge from hibernation and bask along stream banks. Breeding activity begins as water temperatures warm to about 59°F. The turtles mate within streams during April and, by mid-May, move to dry land, where they will spend the next several months. Females nest primarily on sand and gravel bars on the banks of a valley stream, but if instream nesting habitat is limited, may travel into upland habitat to nest in lawns, gardens, roadsides, and sand or gravel pits. Eggs are laid in the mid to late spring through early summer, typically from late May into early July and nests are often excavated at depths of 3.5 – 4.5 inches.

Nests typically contain between 7 and 11 eggs, which hatch in about 70 days, usually between mid-August and mid-September. Unlike the vast majority of other turtles, which have temperature dependent sex determination, the sexes of Wood Turtles are determined genetically.

Hatchling wood turtles are 1.5 inches in length and are distinguished by their long tails, which can be nearly equal in length to the carapace. As soon as the young turtles hatch, they are on their own and receive no care from the adults. Turtle eggs and hatchlings are heavily preyed upon by a wide variety of predators including raccoons, skunks and birds. Hatchling mortality rates can fluctuate widely but 50% is a good rule of thumb. If the young turtles survive, they can live for more than 50 years, reaching sexual maturity in their 14th year.

During the summer months, adult wood turtles wander along stream corridors while foraging in open fields and woodlands. In New Jersey, marked wood turtles have been observed at locations up to 0.56 miles from their wintering streams. One turtle traversed nearly 1 mile within two months. The turtles are especially vulnerable to being struck and killed by automobiles while crossing roads during this nomadic period.

Wood turtles return to streams and creeks and begin hibernating by late November. They winter in muddy stream bottoms, within creek banks, or in abandoned muskrat holes. Individuals may overwinter in the same stream or embankment during successive years. Dissolved oxygen is extracted from the water, allowing the turtle to remain submerged entirely until the arrival of spring.



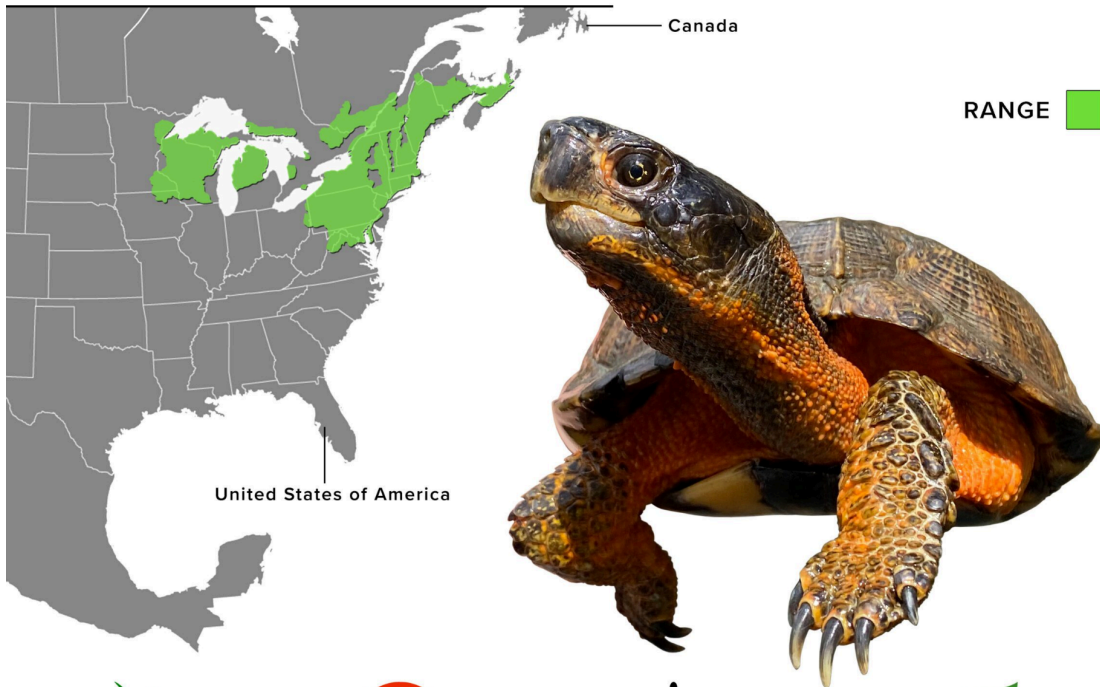
Comparison of mature male wood turtle (left) to mature female wood turtle (right). Males are slightly larger (this is the opposite of most turtle species) and have a concave plastron. Males also have larger, thicker tails, as well as larger scales and nails on the front legs.

Where Do Wood Turtles Live?



North American Wood Turtle

(*Glyptemys insculpta*)



HABITAT

- Riparian woodlands, moist meadows, swamps, floodplains, agricultural land, and upland hillsides, and their accompanying cool, clear streams, creeks, and rivers



THREATS

- Widespread habitat destruction, alteration, and fragmentation
- Collection for the pet trade
- Road and railroad mortality
- Increased predator populations
- Climate change



WILD POPULATION

- Decreasing
- Continuing range regression
- Dense populations localized
- Healthy populations often associated with state or federally protected lands



CONSERVATION

- Field surveys and population monitoring
- Habitat restoration and management
- Population augmentation
- Combating wildlife trafficking
- Protected throughout range
- CITES Appendix II

The wood turtle is found in eastern North America, ranging from Nova Scotia in the south to Virginia in the south and from the easternmost US states to Minnesota in the west. In New Jersey, the range is primarily limited to the northern and central portions of the state, although there have been a few occurrences within the Pine Barrens.

Wood turtles historically inhabited nearly all counties in northern and central New Jersey. However, habitat loss has restricted their distribution to disjunct populations associated with particular drainages. The largest populations in the state currently exist in Hunterdon, Morris, Sussex, Passaic, and Warren counties.

Unlike other turtle species that favor either land or water, the wood turtle resides in both aquatic and terrestrial environments. Aquatic habitats are required for mating, feeding, and hibernation, while terrestrial habitats are used for egg laying and foraging.

Freshwater streams, brooks, creeks, or rivers that are relatively remote provide the habitat needed by these turtles. Suitable tributaries are characteristically clean, free of litter, sediments and pollutants, and occur within undisturbed uplands such as fields, meadows, or forests. Such waterways also have a meandering form, with sharp twists and turns as they wind back and forth through valley floors. These rivers are also characterized by having prominent sand and gravel bars on the inside of sharp bends where wood turtles can nest. Adjacent floodplains provide suitable terrestrial habitat.

On land, wood turtles are habitat generalists, but spend most of their time in a 25 to 50 acre home range within 300 feet of the streams where they overwinter. While foraging, they seem to favor early successional habitats such as meadows and farm fields, but they also venture into forested settings. Wood turtles will make use of a diversity of terrestrial habitats, especially edge habitat tending to stay close to transitional habitat between woods or shrublands and more open settings.

Regardless of habitat type, wood turtles seek out microhabitats where they can conceal themselves from predators. Dense vegetation, the branches of fallen trees, brambles, and leaf litter are some of the more common hiding places wood turtles will use when **basking** (a thermoregulatory behavior used to reduce metabolic needs and maintain overall health), making open fields and thickets of alder, greenbrier, or multiflora rose favored basking habitats. Wood turtles may also be found on abandoned railroad beds or agricultural fields and pastures.

Wood turtle habitats typically contain few roads and are often over one-half of a mile away from developed or populated areas. Individuals from relict or declining populations are also sighted in areas of formerly good habitat that have been fragmented by roads and development.

Why Do Wood Turtles Bask?

We provide our turtles with platforms where they can rest and bask in the light. [Basking is essential for the turtles' health.](#) To regulate their body temperature, turtles alternate between swimming and basking. Swimming cools their bodies and basking warms their bodies. Basking also allows the turtle to completely dry out, which makes it more difficult for fungal infections to develop because fungus needs moisture to grow.

In addition to thermoregulation, basking provides an opportunity for the wood turtles to absorb UVB light. Calcium is an essential mineral for turtles, and forms an important part of their diet. It helps them to maintain strong bones, keep their shell strong and healthy, and to carry out many important bodily functions. In order for turtles to process and utilize calcium, they need a vitamin called D3. When their skin absorbs UVB rays, turtles create Vitamin D and then convert it into Vitamin D3. Only once Vitamin D3 is present can a turtle begin to utilize the calcium they've taken in through food. Without absorbing UVB rays, turtles are unable to produce Vitamin D3 and utilize calcium.



How Do We Handle Our Wood Turtles?

Before handling any turtle, the handler must thoroughly wash their hands with soap and warm water. This prevents the spread of diseases from human to terrapin; hatchlings and wild wood turtles have a lower chance of transmitting diseases, but they can still catch certain diseases from humans. Do not use hand sanitizer prior to handling hatchlings as it can compromise the health of a hatchling. The area where the wood turtles will be handled should be cleaned in order to prevent the spread of disease to the terrapin. Too much handling may cause stress; therefore, terrapins should not be handled in excess.

While handling the turtles, they should be held firmly but gently from the side of the shell, right-side-up. Dropping a turtle may cause trauma; therefore, hatchlings should always be handled close to a surface. Handling hatchlings during sick seasons (i.e. flu season) is less desirable due to a high risk of passing the sickness on to the terrapins.

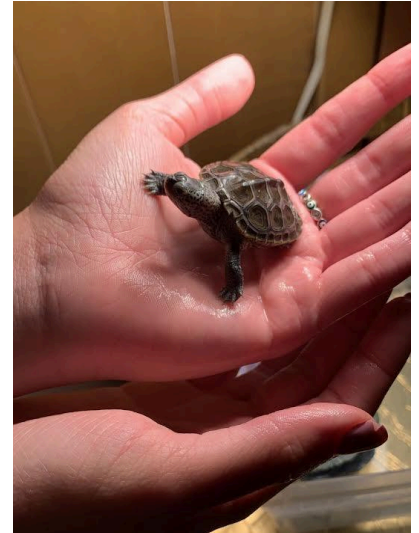
Thoroughly wash hands with soap and warm water after handling the turtles. Wood turtles are able to carry microorganisms, such as *Salmonella* sp., which can cause serious infections in humans. Hand sanitizer should be used as a last resort when cleaning hands.

What Is The Conservation Status of Wood Turtles in New Jersey?

Historically, the wood turtle was a fairly common species within suitable habitat in New Jersey. By the 1970s, however, declines were noted as wood turtles were absent from many historic sites due to habitat loss and stream degradation. Because of this, the wood turtle was listed as a threatened species in New Jersey in 1979.

[According to the New Jersey Department of Environmental Protection](#), “threatened species are those who may become endangered if conditions surrounding them begin to or continue to deteriorate.” This status highlights the precarious future of wood turtles and underscores the importance of conservation projects like the Head Start program we are participating in.

Facing substantial declines over the last century, wood turtles have been petitioned for listing under the Endangered Species Act. The U.S. Fish and Wildlife Service will review the species status by 2023 to make a listing determination. The wood turtle is designated as a Species of Greatest Conservation Need (SGCN) in the State Wildlife Action Plans of all 17 states in which they occur, and is considered endangered by the International Union for Conservation of Nature.



What Are The Threats to Wood Turtles?

Wood turtles are hearty creatures with remarkably long lifespans (>50 years) and the ability to survive the range of threats that existed before humans were present on the landscape. However, due to delayed sexual maturity (12–20 years of age) and naturally high nest predation and juvenile mortality rates, wood turtle populations grow very slowly even without humans present. As a result, any additional pressures, small or large, that have the potential to negatively influence wood turtle survival or reproduction, can have detrimental impacts and even cause local populations to go extinct.

As the most densely populated state in the nation, New Jersey's wood turtle population faces a number of challenges nearly all of which are directly or indirectly caused by humans. [Major threats posed to the species include:](#)

Habitat loss and fragmentation by development	• Habitat degradation, fragmentation and destruction are widespread in wood turtles' areas of occupancy, from residential and recreational developments (particularly second homes/cabins) and associated infrastructure, as well as forestry practices in the public lands where the main populations are located. • Road ways fragment wood turtle habitat and the terrestrial habits of wood turtles in summer lead to fatal encounters with recreational vehicles and agricultural machinery. • Dams alter sedimentation of rivers, streams and other waterways, reducing aquatic habitat quality as well as providing further fragmentation of habitat.
Poaching and wildlife trafficking (commercial and incidental)	• Wood Turtles are valued as pets, and continued collection of animals for the (illegal) pet trade represents a threat to some populations • Between June 2017 and December 2018, a U.S. Fish and Wildlife Service investigation discovered that at least 1,500 native turtles — including wood turtles, spotted turtles, and eastern box turtles — traveled more than 8,000 miles from the woods and wetlands of the U.S. to Asia.
Predation by human-adapted (subsidized) mammals (e.g. raccoons)	• Predation by (subsidized) raccoons is significant, and believed to result in no recruitment. Subsidized predators may become a more significant issue as residential and recreational developments penetrate further into wood turtle habitat. • Adult wood turtles are unlikely to be killed but predators, but about 12% of adults are missing limbs due to predation.
Other threats	• Pollution • Invasive plants, especially Japanese knotweed, can degrade the nesting habitat of Wood Turtles by overrunning sand and gravel bars, forcing females to travel greater distances to find a suitable place to lay eggs. Invasive plants also stabilize stream banks, which reduces the quality of aquatic habitat.

What Can You Do to Help Wood Turtles?

Humans have altered wood turtle habitats throughout nearly the entire species range. These alterations vary in degree of severity, but in most cases the negative impacts of humans on wood turtle populations are unlikely to subside. Without direct intervention, many populations that exist today may disappear in the coming years or decades or decline to the point that they are unable to rebound.

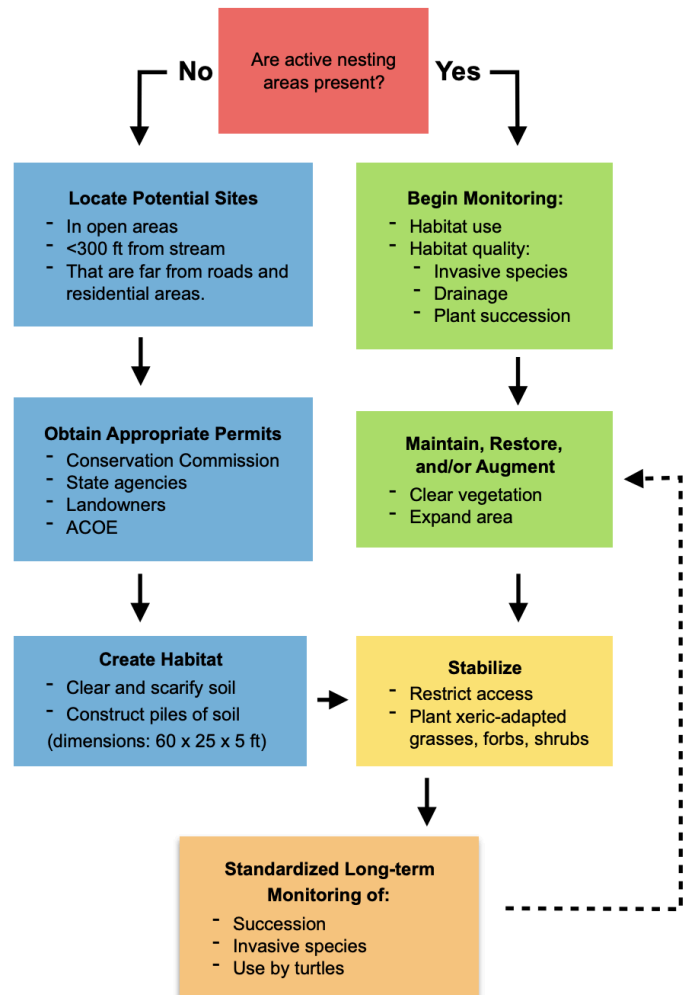
The most effective way to support wood turtle populations is to protect existing habitat and generate new, suitable habitat through land management efforts. Especially important are nesting sites which can be improved or created by clearing land to expose mixed poorly-graded sand and gravel or by depositing piles of soil. Restoring hydrology and controlling invasive plant species (e.g. knotweed) are crucial as well.

Additionally, it is extremely important to not take turtles from the wild: in New Jersey, it is illegal to take wood turtles from the wild as they are a non-game, endangered species.

Finally, intensive agriculture places adult wood turtles at higher risk of mortality and injuries from mowers, combines, tractors, plows, harrows, and other farm machinery. Under certain landscape configurations and times of years, repeated mortalities and even mass mortality events can occur in the same field. Below are methods that can be used to help prevent wood turtle mortalities in agricultural operations:

1. **TIMING:** The most effective way to avoid causing wood turtle mortalities is through timing of land management/machine use. If possible, any land management (e.g. logging, mowing, etc.) should be conducted during the colder months of the year when wood turtles are inactive and primarily restricted to streams.
2. **BLADE HEIGHT:** Raising mower blades ≥ 6 inches is often recommended when managing wood turtles.
3. **GRAZING INSTEAD OF MOWING:** Animals typically used for grazing (cows or goats) are capable of clearing large areas of land and do not pose a threat to wood turtles especially compared to blade mowers.
4. **BUFFER HABITAT:** Creating buffer habitat between streams/rivers and agricultural fields provides cover/refuge for wood turtles.

Major considerations and actions for managing Wood Turtle nesting habitats:



What is the Research Area?

To protect the safety of the wood turtles (for whom there is an illegal pet trade), the name of our research site is privileged information and cannot be shared. We will simply refer to it as the “Research Area”. According to Professor Duchack, the wood turtle population in this area was observed to have a hatch rate of only 25%, significantly lower than the 80% hatch rates of the snapping and painted turtles also living in the Research Area and for wood turtle populations at other sites.

This meant that there was clearly something happening to the wood turtles, but not impacting the other turtle species. At first, predation was considered the most likely culprit. However, this was determined to not be a factor as the wood turtle nests were covered in canvas tarps to prevent predator access over multiple seasons with no change in hatching rate.

Furthermore, incubating wood turtle eggs in captivity did not improve the hatching rate, implying some kind of an environmental contaminant. And the fact that only the wood turtles are being impacted implies that the source of contamination is terrestrial rather than aquatic. This is because wood turtles spend equal time in the water and on land, while snapping and painted turtles primarily remain in the water.

The Research Area has been used for hunting woodcocks and pheasants for decades. This led Professor Duchack to question if lead poisoning could explain the reduced hatch rate in the wood turtles. Lead is a heavy metal that can be toxic to humans and wildlife and is also used in shotgun shells. Could the leftover shells be introducing lead to the soils, which is then picked up by the vegetation (e.g. phytoremediation), earthworms and insects, all of which are sources of food for wood turtles?

Environmental contaminants including heavy metals like lead tend to concentrate in bones, but there is no way to test that on live animals. Luckily, keratin, a primary ingredient of turtle shells and the same molecule that makes up our hair and nails, also tends to store these kinds of compounds, meaning Professor Duchack could collect shavings of the wood turtles' scutes for analysis. This would not harm the turtles, but allow us to determine if heavy metal pollution was the root cause of the low hatch rates. Mass spectrometry of soil samples from the Research Area will also be necessary to test the lead poisoning hypothesis.

SPFHS has a fantastic opportunity to participate in an authentic scientific experience to better steward our environmental resources. A head-start program at SPFHS would help boost the survivorship of the hatchlings, helping the population to recover. And students would be on the front lines of scientific exploration, helping to figure out the root cause of the low hatch rate at the Research Area.

What is the GSNWR Wood Turtle Head-Start Program?

In May of 2006, a female wood turtle was found dead on a road within Great Swamp National Wildlife Refuge (GSNWR). Prior to that, over a decade had passed since one had been confirmed there and the status of wood turtles in GSNWR was uncertain. But shortly thereafter, a newly-acquired property containing an abundance of suitable habitat led to the discovery of a small population that had been able to persist, in part due to its secretive location where it was likely able to go undetected by poachers and illegal collectors. The population that was present consisted almost entirely of old adults; specifically, 8 males and 18 females.



With almost no younger age classes documented (sub-adults or juveniles), there were basically no prospects to take the places of those “founder” individuals when they inevitably passed on. This meant that the GSNWR wood turtles were a “ghost population”. In conservation ecology, ghost or “relic” populations are composed primarily of old adults and give the false perception that all is fine, because these individuals may be observed on the landscape for many years.

When initial efforts to revitalize the GSNWR wood turtle population such as protecting nests and existing habitat proved ineffective, GSNWR staff turned to a head-start program. A **head-start program** (aka. “headstarting”) is a conservation technique for endangered species, in which young animals are raised in captivity and subsequently released into the wild. On their own, the hatchlings would face heavy predation and would grow more slowly. After being raised and fed indoors for nine months, hatchlings can attain the size of a four year-old wild turtle. The larger size reduces the suite of predators that can prey upon them such as northern water snakes, bullfrogs, largemouth bass, crows,

and others. This gives them a head-start over their wild counterparts and enables researchers to attach tracking devices to the turtles to collect data.

Table 3. Known-fate survival (survived/total released) of 3 age classes (2yHS, headstarted for 2 years; 1yHS, headstarted for 1 year; and 0yHS, direct release hatchlings) of wood turtles 1 month after release, over winter, and 1 year after release studied in 2016–2018 in Ontario, Canada. Cohort year refers to year of release.

Age class	Time period								
	1 month after release			Overwinter			1 year after release		
	2016 Cohort	2017 Cohort	Total	2016 Cohort	2017 Cohort	Total	2016 Cohort	2017 Cohort	Total
2yHS	87% 13/15		87% 13/15	92% 12/13		92% 12/13	67% 10/15		67% 10/15
1yHS	93% 14/15	93% 14/15	93% 28/30	85% 11/13	93% 13/14	89% 24/27	47% 7/15	47% 7/15	47% 14/30
0yHS	87% 13/15	53% 8/15	70% 21/30	30.8% 4/13	0% 0/8	19% 4/21	13% 2/15	0% 0/15	7% 2/30

Headstarting is highly effective for turtles and has been shown to increase the survival rate of hatchlings by **25-70%** depending on the species and how long the individuals were headstarted for.

What is Turtle Release Day?

Release Day is graduation day for our wood turtle hatchling and the culmination of the Turtles in the Classroom experience. After 8 months of hard work, we collect our turtles and travel to the Great Swamp National Wildlife Refuge (GSNWR) for a health inspection before releasing them back into the refuge. When we arrive at GSNWR, our turtles will be marked by staff for tracking and data collection purposes following their release.

Thanks to the Head-Start Program, our wood turtle hatchlings have a greater chance of surviving their first year. In a few more years they will reach adulthood and start having offspring of their own. In this way, our school has directly contributed to the survival of the species, helping to ensure wood turtles will populate New Jersey for many years to come! Together, we have helped to conserve biodiversity in our own backyard.

Works Cited Page