VERMONT

SPOTTED TURTLE

RECOVERY PLAN

July 2019

Vermont Fish and Wildlife Department (VFWD)
Agency of Natural Resources
111 West Street
Essex Junction, VT 05452
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Commissioner, Vermont Department of Fish and Wildlife — Date: 7/18/19

Secretary, Vermont Agency of Natural Resources — Date: 07/18/19

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I. Acknowledgements

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II. Executive Summary

The Vermont Endangered Species Law provides the authority for the protection and recovery of listed species. Authority and responsibility for the development and implementation of species recovery plans in Vermont rests with the Secretary of the Agency of Natural Resources and the Commissioner of the Fish and Wildlife Department. Ultimately, the goal of the State of Vermont is to recover species listed under the Vermont Endangered Species Law to a level that they can be delisted and maintain viable populations for the long-term.

The State of Vermont listed the Spotted Turtle (*Clemmys guttata*) as threatened in 1989 and endangered in 1999. At the time of listing, fewer than a dozen individual Spotted Turtles were known to live in Vermont and no breeding populations were known. Since that time, the list of known individuals has grown to over 50, but these are documented in three widely separated populations, two of which have fewer than 10 known individuals. Spotted Turtles are long-lived reptiles with low annual fecundity, and the reproductive status of Spotted Turtles in Vermont is unclear.

The Spotted Turtle is a small semi-aquatic turtle which lives in a variety of low-elevation wetland habitats including hardwood swamps, beaver (*Castor canadensis*) meadows, sphagnum bogs, emergent marshes, and fens. Spotted Turtles emerge from their hibernacula in late March to mid-April in Vermont, earlier than other turtle species. They forage for aquatic insects, tadpoles, amphibian eggs, small fish and crustaceans, and some plants. Mating peaks in late March and April in Pennsylvania and egg-laying peaks in early June. Adult females lay a single clutch of 2-5 eggs. Only clutches of four eggs have been observed in Vermont (n=3) (S. Parren, pers. obs.) Nesting sites have well-drained substrate with adequate sunlight. Eggs hatch in September. After nesting, and as summer temperatures increase, some Spotted Turtles may estivate (enter dormancy) in aquatic (Litzgus and Brooks 2000) or upland (Joyal et. al 2001,

Milam and Melvin 2001) thermal shelters such as muskrat (*Ondatra zibethicus*) burrows, moist hummocks, root wads, or a small form (depression) the turtle digs for itself. Estivation may last a few days or several weeks. Estivation habits for Spotted Turtles in Vermont are not well known. In September, Spotted Turtles move to their eventual hibernacula and daily activity decreases until they enter winter dormancy in October. Winter shelters include muskrat burrows, submerged rock caverns, sphagnum hummocks, and root wads.

The IUCN (International Union for Conservation of Nature) summarizes reasons for Spotted Turtle decline as:

> "*Clemmys guttata* apparently has population dynamics that particularly emphasize the long-term reproductive contributions of adult animals over time (Litzgus 2006); as a result, the species is particularly sensitive to removal of adults from a population, and impacts of even casual collection for pets, or traffic mortality, have significant impacts on a population. Collection for personal pets or trade, and mortality on roads and from agricultural machinery, have all been documented for the species.
>
> Invasive plant species affecting wetland vegetation structure are a contributing threat factor.
>
> *Clemmys guttata* is reasonably specialized in its habitat requirements and is not a good disperser/colonizer. As a result, habitat degradation, fragmentation and loss lead to disappearance of populations, while new opportunities, if any, are rarely colonized. Most populations are small to very small and thus sensitive to localized extinction. (Note: Literature and opinions vary on degree of specialization)
>
> Subsidized predators (i.e., unnaturally large populations of predators subsidized by easily available resources near human settlements) probably represent a further impact on eggs and juveniles, and likely reduce recruitment into existing populations.
>
> [Information taken from: Meylan 2006, Ernst and Lovich 2009]." (van Dijk 2013)

This document provides an overview of Spotted Turtle biology, population status, threats, research needs, and ongoing management efforts. It also provides a comprehensive list of actions identified as most likely to ensure the long-term persistence of the Spotted Turtle in Vermont. The goal is to recover the Spotted Turtle to a sustainable and secure level that will justify removing it from the Vermont list of endangered and threatened species. Management actions focus on protecting habitat from further loss and degradation, reducing adult mortality from collisions with vehicles, raising citizen awareness and reporting of Spotted Turtles, and protecting this sensitive species from collection for the pet trade.

For the purposes of this recovery plan, a known population is synonymous with a "local population". They are considered distinct from other populations if separated by >2 km of unsuitable habitat or >3 km of suitable habitat (Hammerson 2001). A Spotted Turtle occurrence linked by dispersal with other occurrences that are closer than the separation distances above would be considered an occurrence within a metapopulation.

III. Natural History and Ecology

Taxonomy and physical characteristics

The Spotted Turtle (*Clemmys guttata)* is in the Emydidae family, which is commonly referred to as the pond turtle or marsh turtle family. The Spotted Turtle is the sole member of the genus *Clemmys* although it once shared this name with Wood Turtles (*Glyptemys insculpta*), Bog Turtles (*Glyptemys muhlenbergii*), and Western Pond Turtles (*Actinemys marmorata*). In 2001 the Wood Turtle and Bog Turtle were moved to the genus *Glyptemys* and the Western Pond Turtle was moved to the genus *Actinemys* after a 1996 genetic analysis identified the Spotted Turtle as distinct from the other three species (Bickham et al. 1996).

Spotted Turtles are small (14.25 cm maximum carapace length; Ernst and Lovich 2009) semi-aquatic turtles that have a pattern of small, round yellow spots on their broad, smooth black carapace (top shell). However, deposits of yellow pigment, which give this turtle its spots, may fade with age so older turtles sometimes appear spotless. The plastron (bottom shell) is yellow or yellow-orange and has a large black blotch on each scute (bony segment of shell). This blotch can grow as melanism increases with age, possibly leading to an entirely black plastron in older individuals. A Vermont female found in 2017 had a completely black plastron (S. Parren, pers. obs,). The skin on the upper surface of the turtle is gray to black with scattered yellow spots and a broken yellow band near the tympanum (ear). The skin on the lower surface of the turtle can be orange, pink, or salmon-red (Ernst et al. 1994). Individuals can be identified by the unique set of spots and blotches on the carapace and plastron, respectively (Gray 2008).

Males and females can be distinguished in the field. Males have tan chins, brown eyes, a slightly concave plastron, and long, thick tails. Females have yellow chins, orange eyes, a flat or convex plastron, and shorter tails. Females, on average, are larger than males, although size alone is not enough to sex an individual. The sexual difference in coloring of the chin and eyes can be seen in hatchlings (Ernst et al. 1994).

Hatchling turtles are blue-black and usually bear a single yellow spot on each carapace scute except for the cervical scute (directly behind head, on margin of carapace), which has none. Sometimes hatchlings have no spots at all. The head is always spotted, and the neck may also have spots at the time of hatching. Hatchlings typically weigh an average of 4.7 g and are between 28 and 31.2 mm in carapace length and 28.5 to 33.1 mm in carapace width. Hatchling tails are proportionally longer than those of adults (Ernst et al. 1994).

Life History

Feeding habits

The Spotted Turtle is an omnivorous forager that actively seeks out food by foraging in shallow water and periodically probing with its snout into algae and other aquatic vegetation (Ernst 1976). Animals make up the bulk of the Spotted Turtle's diet and can be eaten live or as carrion. Spotted Turtles are known to consume aquatic insect larvae, small crustaceans (amphipods and isopods), snails, tadpoles (*Anaxyrus, Lithobates*), salamanders (*Ambystoma*), and fish (*Catostomus, Cyprinus, Ictalurus, Lepomis, Notropis*) (Ernst et al. 1994). In a study of the food habits of the Spotted Turtle the stomach contents of twenty-seven turtles were examined (Surface 1908). Identified prey included worms, slugs, snails, small crustaceans, crayfish, millipedes, spiders, and insects of the orders *Ephemeroptera*, *Plecoptera*, *Odonata*, *Hemiptera*, *Neuroptera*, *Lepidoptera*, *Coleoptera*, *Diptera*, and *Hymenoptera*. Many of the insects identified were non-aquatic species but it is unknown whether these insects fell into the water or were eaten on land (Joyal 1999). Plant foods are aquatic grasses and filamentous green algae (*Chlorophyta*) (Ernst 1976).

Population dynamics

Studies have differed on whether the observed sex ratio of adult Spotted Turtles is male-biased, female-biased, or even (Seburn 2003, Kaye et al. 2005, Reeves and Litzgus 2008). Differences could be due to sampling techniques (Breisch 2006) or behavioral differences between the sexes (Reeves and Litzgus 2008). True dominance of one sex could be due to nest temperatures during incubation (see Reproduction) or disproportionate adult mortality (Litzgus 2006, Beaudry et al. 2010). Enneson and Litzgus (2008) suggest that adults should make up 17% of a healthy population, juveniles 55% and hatchlings 28%. In most studied populations, juveniles make up a minority of individuals observed, but this may be due to the more cryptic nature of juveniles (Breisch 2006) or different habitat preferences from adults (Wilson 1994). Finally, estimates on Spotted Turtle population density have varied widely across studies (Table 1). Again, it is unclear whether these figures represent true differences in population density or reflect low capture success.

Reproduction

Both male and female Spotted Turtles reach sexual maturity when carapace length is about 8.0 cm (Ernst et al. 1994). In Pennsylvania, Ernst et al. (1994) estimated age at sexual maturity to be 7-10 years old. Joyal (1996) estimated maturity to be at 11-12 years in Maine, and a study in Ontario (Enneson and Litzgus 2008) used 12 years as the cutoff for a reproducing female. The peak period of Spotted Turtle courtship activity observed in southern Pennsylvania was during late March and April (Ernst 1976). Courtship consists of male turtles following females and/or biting at limbs. Forced copulation has been observed (Ernst 1976, Wilson 1994). The egg-laying season lasts from May to July, peaking in early June. Nests may be dug in well-drained areas exposed to sunlight. Nest sites also include grass tussocks, hummocks of moist sphagnum moss,

and loamy soil of marshy pastures (Ernst et al. 1994). Spotted Turtles usually lay 3-4 eggs, but there is a correlation between female size and number and size of eggs laid (Ernst 1970b, Joyal 1996, Litzgus and Brooks 1998).

Table 1. Estimated population density of Spotted Turtle (*Clemmys guttata*) populations.

Source	State/ Province	Habitat	Population Density (indiv/ ha)
Breisch 2006	WV	riparian woodland/ beaver pond	19.6
Ernst 1976	PA	emergent marsh	39.7
Ernst 1976	PA	emergent marsh	72.8
Ernst 1976	PA	emergent marsh	69.4
Ernst 1976	PA	emergent marsh	80.6
Graham 1995	MA		6.7
Haxton and Berrill 1999	ON	emergent marsh/ sphagnum bog	0.4
Joyal 1996	ME	red maple swamp	1.4
Milam and Melvin 2001	MA	emergent marsh	0.2
Milam and Melvin 2001	MA	emergent marsh	1.4
Reeves and Litzgus 2008	ON	sphagnum bog/ rock pools	1.7
Ward et al. 1976	MD		3.5
Wilson 1994	IL	cattail marsh/ sedge meadow	2.2
Yagi and Litzgus 2012[1]	ON	peatland	1.6
Yagi and Litzgus 2012[2]	ON	beaver meadow	0.7

[1] before flooding by beaver activity (less available habitat)
[2] after flooding by beaver activity (more available habitat)

Incubation periods are estimated to range from 10-12 weeks. Young hatch in September, although they may overwinter in the nest (Ernst 1975, Ernst 1976, Ernst et al. 1994). Lovich et al. (2014) reported that 28% of Spotted Turtle hatchlings emerge the spring following hatching. There are only two observations in Vermont, and emergence has only been recorded in September (S. Parren, pers. obs.). Spotted Turtles have temperature-dependent sex determination. Eggs incubated at temperatures from 22.5 to 27ºC produced a predominance of males and eggs incubated at 30ºC produced females (Ewert and Nelson 1991).

Spotted Turtles have low annual reproductive potential due to their single, small clutch of eggs (Ernst and Zug 1994, Joyal 1996) and low survival rates for eggs and hatchlings (Joyal 1996, Litzgus and Brooks 1998, Wilson 1994). Spotted Turtles make up for low annual fecundity with high annual adult survivorship and long lives (Enneson and Litzgus 2008). Enneson and Litzgus (2008) estimated annual adult female survival to be about 92% and that adult females were 28 times more important to population continuity than hatchlings. Likewise, in a survival and population growth study, O'Bryan (2014) found that adult survival had a greater influence on the population growth rate than hatchlings or juveniles.

Physiology

Spotted Turtles, like all turtles, lizards, and snakes, are ectotherms (cold-blooded). This means that they cannot generate their own body heat and must bask in the sun during cold weather to increase metabolism and gain the energy needed for daily activity. However, Spotted Turtles prefer cooler temperatures than other turtles and are some of the first reptiles seen emerging from their overwintering sites (Ernst et al. 1994).

Spotted Turtles may spend late summer estivating (undergoing summer dormancy). Estivation sites can be aquatic and include muskrat burrows or the bottoms of pools of running water (Litzgus and Brooks 2000). Estivation sites can also be upland and include small burrows under vegetation, hummocks, and exposed roots (Joyal 1996, Joyal et al. 2001, Milam and Melvin 2001). Based on our review of the literature, there seemed to be a pattern of terrestrial estivation in northern locales and aquatic estivation in more southern locales, but it may simply vary by site and hydro period (Lori Erb, pers. comm.). Estivation can last a few days to many weeks (Beaudry et al. 2009). While estivation has generally been thought of as a means of avoiding high temperatures and desiccation, Litzgus (1996) suggested that avoidance of high temperatures was not the primary function of estivation. Other theories are that estivation is a response to food shortages occurring in late summer (Ward et al. 1976) or that it occurs after the turtles have met their dietary requirements for the season (Litzgus and Brooks 2000). Milam and Melvin (2001) observed that Spotted Turtles entered estivation when pools of water in the wetland dried up. Yagi and Litzgus (2012) monitored a Spotted Turtle population in a newly flooded peatland where the turtles ended their terrestrial estivation and instead stayed active in newly available aquatic habitat.

Over-wintering behavior

Spotted Turtles generally spend six months in their hibernacula. In Vermont, they usually enter hibernacula in early to mid-October and emerge in late March to mid-April (S. Parren, pers. obs.). Spotted Turtles are known to hibernate in groups as large as 12 individuals but can also hibernate alone (Ernst et al. 1994). Aquatic hibernation sites include muskrat burrows in stream banks, vernal pools and puddles, sphagnum swamps, cattail (*Typha spp.*) marshes, submerged rock caverns, and vegetative mats of alkaline fens (Litzgus et al. 1999). Joyal et al. (2001) observed hibernation in less aquatic sites in riparian meadows, shrub or forested swamps, and hummocks (Joyal 1996).

Home range and seasonal movements

Spotted Turtle activity patterns vary strongly with the season (Breisch 2006, Beaudry et al. 2009, Wilson 1994) (Figure 1). After emerging from hibernation, Spotted Turtles move to seasonal pools for basking and foraging (Litzgus and Brooks 2000, Milam and Melvin 2001). Since Spotted Turtles prefer cooler temperatures, they are most active during spring and early summer, and may estivate in late summer (Ernst et al. 1994). Activity levels peak in May and decline in June (Ernst et al. 1994). Ernst et al. (1994) suggested that decreased movements are indicative of a decrease in food availability.

Estimates of home range sizes of Spotted Turtles range from 0.2 to 34.4 ha (Yagi and Litzgus 2012) but studies from the northern latitudes average just over 2 ha (Joyal 1996, Anthonysamy 2012). Studies have differed on whether males or females have larger home ranges and longer daily movements (Table 2). The longest movements are during mating season (Beaudry et al. 2009), nesting season, and movement to and from hibernacula (Joyal 1996). It is likely that males are more active during mating and then females are more active as they seek nesting sites (Ernst 1976, Kaye et al. 2005). Joyal (1996) found males to be most active in March and April, and females were more active in May and June. Observations of turtle movement patterns in a linear wetland following a stream in Vermont may be influenced by the physical shape of the habitat (S. Parren, pers. comm.).

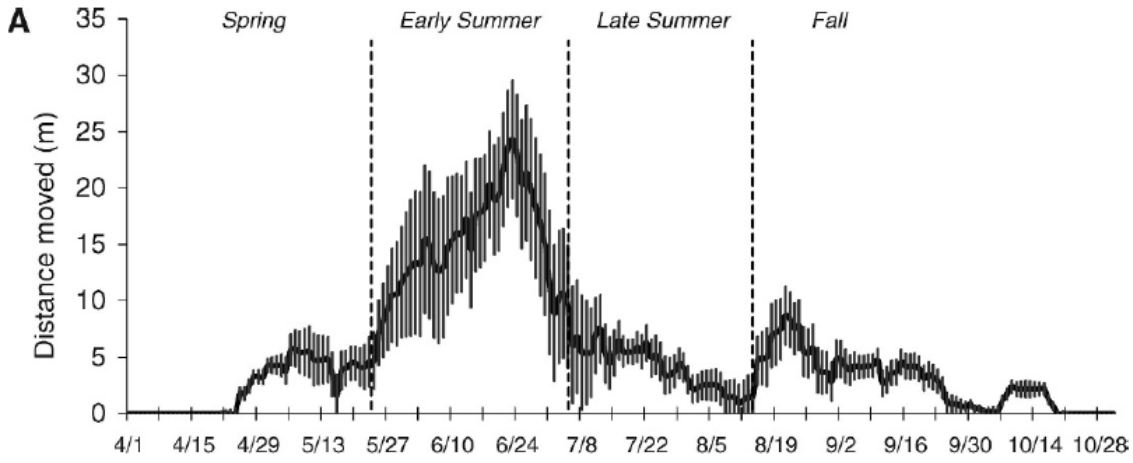

Figure 1. Mean (+/- SE) daily interwetland movement distances of Spotted Turtles (*Clemmys guttata*) during annual active season 2004-2006. Source: Beaudry et al. 2009.

Table 2. Mean (SE) for home range and movements of male and female Spotted Turtles (*Clemmys guttata*).

		Male				**Female**			
Source	State/ Province	Home range area [ha]	Daily movements [m]	Farthest movement [m]	Home range length [m]	Home range area [ha]	Daily movements [m]	Farthest movement [m]	Home range length [m]
Anthonysamy 2012	IL	2.2 (0.5)	12.2 (1.3)		261.7 (37.7)	3.0 (0.8)	14.7 (1.7)		328.8 (57.9)
Beaudry et al 2010	ME						148 (306)		
Breisch 2006	WV	0.39 (0.27)*	72.4 (40.8)*	288		0.39 (0.27)*	72.4 (40.8)*	160	
Ernst 1976	PA	1.3*				1.3*			
Haxton and Berrill 1999	ON	2				4.7			
Joyal et al. 2001	ME				1120*				1120*
Kaye et al 2005	MA	3.3				2.1			
Litzgus 1996	ON	3.6				3.2			
Litzgus and Mousseau 2004	SC	5.2				19.1			
Milam and Melvin 2001	MA	1.9 (0.5)		241 (34.7)	261 (102.8)	4.6 (2.0)		280 (34.9)	345 (59.0)
O'Bryan 2014	SC	37.3 (2.89)	32.6 (13.7)			12.2 (7.0)	26.9 (18.9)		
Seburn 2003	ON				327*				327*
Seburn 2012	ON	2.1			262	1.3			202
Wilson 1994	IL	0.72				1.75			
Yagi and Litzgus 2012[1]	ON	3.2 (0.01)*	6.0 (4.4)			3.2 (0.01)*	4.5 (1.7)		
Yagi and Litzgus 2012[2]	ON	7.1 (0.2)*	18.3 (4.3)			7.1 (0.2)*	16.5 (3.0)		

*study did not differentiate between males and females

[1] before flooding by beaver activity (less available habitat)
[2] after flooding by beaver activity (more available habitat)

Mortality factors

Spotted Turtle mortality is often reported to be low (Enneson and Litzgus 2008, Joyal 1996, O'Bryan 2014), but this may not be true of all populations, particularly those in urban areas (L. Erb, pers. comm.). Enneson and Litzgus (2008), cite collection for the pet trade (effective mortality), predation, habitat loss, and crossing roads as sources of adult mortality. In her study of Spotted Turtle ecology in southern Maine, Joyal (1996) located five dead adults over a period of three years. Two appeared to be predated, two had no obvious injury or disease, and one was an apparent roadkill. Juvenile survival rates are not well studied because of the difficulty of finding and tracking them, but it is reasonable to presume that hatchlings and small juveniles are more susceptible to predation than larger turtles.

Egg survival is reported to be very low. Joyal (1996) observed hatching success of 26% (1.9 hatchlings per clutch), and O'Bryan (2014) and Wilson (1994) reported total nest failure (due to flooding). Litzgus and Brooks (1998) determined that red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), and ants were significant nest predators. Joyal (1996) and Beaudry et al. (2010) also reported ant infestations in nests, and some nests were overgrown with grass roots which penetrated the eggs. Ernst (1976) noted some nests completely dried out, killing the eggs. Ernst (1976) and Wilson (1994) also observed that many eggs failed to hatch for unknown reasons, so pre-hatching mortality appears to be high even for undisturbed nests.

IV. Habitat Requirements

Spotted Turtles use a variety of wetland types throughout their range. These vary from man-made ditches in North Carolina (O'Bryan 2014), to cattail marshes in Illinois (Wilson 1994), hardwood swamps in Pennsylvania (Ernst 1976), and peatlands in Ontario (Yagi and Litzgus 2012). Within New England, Spotted Turtles have been studied in red maple (*Acer rubrum*) swamps (Joyal et al. 2001), sphagnum bogs (Parren 2012), and wet meadows (Anthonysamy et al. 2014). In Massachusetts, Spotted Turtles have been found using vernal pools (M. Mandica, pers. comm., Milam and Melvin 2001). In Vermont, Spotted Turtles have been documented using red maple/black gum (*Nyssa sylvatica*) swamp, emergent marsh, and bog/fen habitats below 700 feet in elevation.

While Spotted Turtles are reported to spend a lot of time on land compared to other semi-aquatic turtles (Anthonysamy et al. 2014), Yagi and Litzgus (2012) found that when an occupied habitat that consisted of open peat and some wet ditches was flooded by beavers, turtles moved to an almost entirely aquatic lifestyle. In this new aquatic habitat, adult mortality declined by 57%, estivation decreased, home ranges and daily movements increased, and Spotted Turtles immigrated from nearby populations to exploit the new aquatic resource. Prior to flooding, the turtles were restricted to ditches. O'Bryan (2014) and Seburn (2003) also observed Spotted Turtles restricted to aquatic channels in ditched habitats. Additionally, in Massachusetts Milam and Melvin (2001) observed high use of seasonal pools, and that summer estivation begins around the time that seasonal pools dry out. O'Bryan (2014) found that water was the most

important habitat selection factor for Spotted Turtles, and that 85% of radio telemetry locations were in water. All of this suggests that permanent water, and thus feeding opportunities, may be limiting in many currently occupied Spotted Turtle habitats.

Feeding

Foraging needs of Spotted Turtles are not well studied. Spotted Turtles are omnivores and appear to do most of their foraging in water (Ernst 1976, Ernst et al. 1994). Captive hatchlings have been observed to consume food only when it is presented in water (S. Parren, pers. obs.). Beaudry et al. (2009) found that Spotted Turtles had a positive association with wetlands that hosted abundant Wood Frog (*Lithobates sylvaticus*) egg masses and hypothesized that this was an important source of food in early spring.

Nesting

Nesting occurs in the evening (Ernst 1976, Joyal 1996) and can take up to 12 hours (Wilson 1994), which is much longer than other aquatic turtles. During oviposition, Spotted Turtles can be disturbed by road traffic, human observers, and domestic dogs (Joyal 1996). Female turtles are known to abandon nesting attempts if disturbed but usually initiate a new nest the same evening (Joyal 1996). Some female Spotted Turtles exhibit nest site fidelity and/or nesting substrate fidelity (Joyal 1996).

Nest sites may include rock crevices filled with soil (Joyal 1996, Litzgus and Brooks 2000), sphagnum moss or hummocks (Beaudry et al. 2010), gravel road beds (Joyal 1996), cinder railroad beds (Parren 2010), and open fields and yards (Beaudry et al. 2010, Joyal 1996, Milam and Melvin 2001). Unfortunately, many of these nesting areas are anthropogenic in origin and thus are prone to human disturbance. Joyal (1996) found that 86% of known nests (n=14) were in human-altered sites. Likewise, Beaudry et al. (2010) found 64% of known nests (n=14) to be in human-altered sites, and Milam and Melvin (2001) tracked seven of eight nesting females to upland fields. Joyal (1996) suggests that anthropogenic sites may be more attractive to turtles than natural nesting areas because of better drainage and solar exposure. However, while these sites are appealing to nesting females, they may be hazardous to eggs and hatchlings. She noted such hazards as road graders, lawn mowers, grass roots, and domestic dogs.

Joyal (1996) found that female turtles traveled up to 570 m (mean 247 m) from their “home” wetland to nest. Beaudry et al. (2010) recorded median nesting forays as 148 m, with one female travelling more than 900 m. Milam and Melvin (2001) recorded female turtles moving up to 312 m (mean 249 m) to nest. Distances traveled to nesting sites is likely site specific (S. Parren, pers. comm.) and depends upon the layout of the habitat and proximity to suitable nesting sites.

Basking, estivation, and hibernacula

As with most ectotherms, Spotted Turtles must bask in the sun to raise their body temperature and increase their metabolism. Like other semi-aquatic turtles, Spotted Turtles bask on exposed logs and hummocks. In Maine, Joyal (1996) and Beaudry et al. (2009) observed that wetlands with more sun exposure were more likely to be occupied by Spotted Turtles than shadier wetlands. Conversely, O'Bryan (2014) found occupation of wetlands to be positively correlated with greater canopy cover, but his research was in North Carolina where air and water temperatures are warmer. In South Carolina, Lovich (1988) found that higher temperatures may be limiting to Spotted Turtles.

Estivation may occur in water (Wilson 1994) or on land (Joyal et al. 2001), but northern Spotted Turtles appear to migrate to forested uplands for summer estivation (Joyal 1996, Litzgus and Brooks 2000, Milam and Melvin 2001). It is thought that terrestrial estivation helps deter ectoparasites and prevents fungal infections (Milam and Melvin 2001). Dryer estivation sites include leaf litter, lichens, dried ephemeral pools, rock outcrops, and floating (unsaturated) sphagnum moss (Beaudry et al. 2009, Litzgus and Brooks 2000).

While Ernst (1976) and Litzgus et al. (1999) reported Spotted Turtles hibernating submerged in water, in Maine Joyal et al. (2001) reported that Spotted Turtles moved to less aquatic areas for hibernation in small burrows, under hummocks, and under exposed roots. They found that the probability of a wetland being occupied was positively correlated with wetland proximity to upland hibernation sites. Litzgus et al. (1999) found turtles hibernating only in sphagnum marshes either in sphagnum hummocks or rock caverns near the water edge. Some individuals exhibited fidelity to a particular hibernaculum for two or more years (Litzgus et al. 1999, Seburn 2003). In Vermont, hibernacula for three populations have all been in wetlands (S. Parren, pers. obs.)

Juvenile habitat

Very little is known about juvenile Spotted Turtle habitat preferences or requirements because very few are captured or observed during studies (Joyal 1996, O'Bryan 2014). Wilson (1994) observed that hatchlings were found in a graminoid fen whereas adults used a sedge meadow and cattail marsh. Breisch (2006) found juveniles most often in a seasonally flooded sedge meadow. Adults used a wider variety of habitat within the wetland complex including ponds, old fields, and a vernal pool. It is thought that juveniles have slightly different habitat needs from adults (Wilson 1994) possibly due to being more vulnerable to predators or consuming smaller food items.

V. Distribution and Status

Range

Spotted Turtles are native to the United States and Canada and range from southern Ontario and Maine southward along the Atlantic Coastal Plain and Piedmont to northern Florida and westward through Ontario, New York, Pennsylvania, Ohio, Indiana, and Michigan to Illinois (Ernst et al. 1994) (Figure 2).

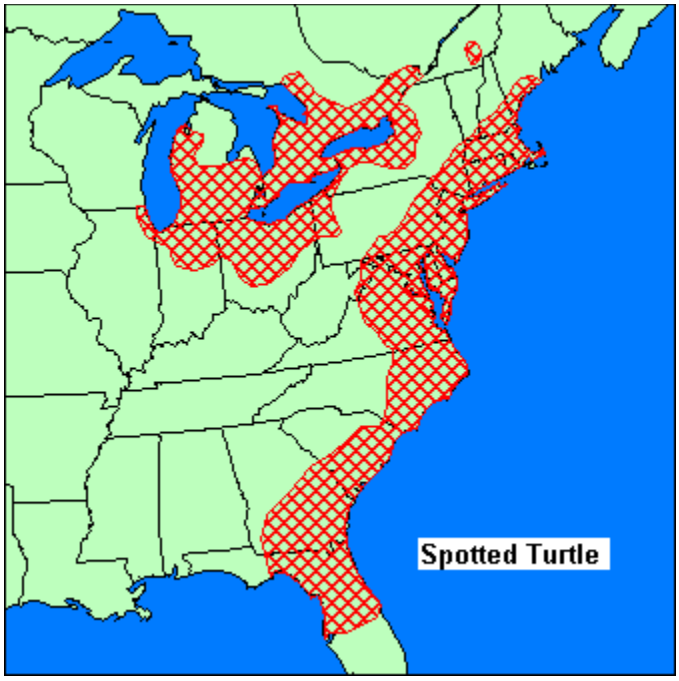

Figure 2. Range map of Spotted Turtles (*Clemmys guttata*). Map courtesy of New York Department of Environmental Conservation (Note: Does not include all Vermont sites).

Conservation status

While the Spotted Turtle is not federally listed as threatened or endangered in the United States, it is federally listed as endangered in Canada, and considered endangered by the International Union for Conservation of Nature (IUCN). In 2013, the Spotted Turtle was proposed for addition to Appendix II of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). In response to a petition to list the Spotted Turtle as a federally endangered species, the U.S. Fish and Wildlife Service came to a "substantial finding" in 2015. This means there is compelling evidence that the species warrants further review. In addition to these federal and international listings, the Spotted Turtle is listed as endangered in Vermont (S1) and Quebec (S1), threatened in New Hampshire (S2) and Maine (S3), and as a species of special concern in

New York (S3). In Massachusetts (S4) it had been listed as a species of special concern but that status was removed in 2006.

The Spotted Turtle was listed as threatened in 1989 and then endangered in 1999 by the State of Vermont, as recommended by the Endangered Species Committee to the Agency of Natural Resources. The criteria for listing a species as endangered is: a species that "normally occurs in the State and whose continued existence as a sustainable component of the State's wildlife or wild plants is in jeopardy, or a species determined to be an endangered species under the Federal Endangered Species Act" (*10 V.S.A. Chapter 123 §5401*). The justifications for listing the Spotted Turtle in Vermont include:

- There are estimated to be three or fewer viable, reproducing populations separated by unfavorable habitat in Vermont.
- There are estimated to be fewer than 100 reproducing individuals in Vermont.
- The species has declined overall or non-cyclically throughout a significant portion of its global range.
- Special factors cause this species to be vulnerable to extirpation: the species is in danger of exploitation or is threatened with disturbance; the species occurs in specialized habitat that is vulnerable to loss, modification, or variations in quality; the species has low reproductive potential or is experiencing reduced reproductive success.
- Other factors that render the species vulnerable to extirpation: collection for the pet trade.

Distribution in Vermont

There are three known Spotted Turtle populations in Vermont. Exact locations will not be described to protect turtles from collection for the pet trade (*10 V.S.A. Chapter 123 §5410*). The populations are referenced by their geographic location: the southeast population, the southwest population, and the west central population.

Southeast

The first confirmed record of a Spotted Turtle associated with a wild population in Vermont came from southeastern Vermont in 1981. To date, eight adults have been identified in this population. The habitat can largely be described as red maple swamp and blueberry (*Vaccinium spp.*) bog. There is standing water throughout in pools and channels. The swamp has a deep, mucky substrate with a stream running through the middle. Red maple, winterberry (*Ilex verticillata*), highbush blueberry, and cinnamon fern (*Osmundastrum cinnamomeum*) are dominant species.

This location is bisected by a railroad track which partially acts as a barrier to the Spotted Turtles' movement between two wetlands and poses a mortality hazard. Twenty underpasses were installed underneath a section of the railroad tracks in 2011 to assist the turtles with crossing. Spotted Turtle nesting has been confirmed at this site. In 2001, two dead eggs, two sets

of eggshells and two 30 mm hatchlings were found in a nest. In 2006, a Spotted Turtle nest was found containing a dead hatchling half out of the egg as well as three eggshells indicating that three young had successfully emerged. Thirteen sand nesting pits were created along this railroad in 2006 to provide replacement nesting sites after the old cinder bed was covered by crushed stone as part of railroad maintenance. Turtle eggshells have been found at the pits, but it is uncertain if these were Spotted Turtles or Painted Turtles (*Chrysemys picta*), which also use the area. Adult turtles were actively monitored until 2010. This site is visited annually by VFWD staff for invasive plant removal and maintenance of nesting pits and under-rail passages.

Southwest

The southwestern population was discovered in 2001 and has three known individuals (all adult females). While no adult males or juveniles have been found, females have been observed during the nesting season along a road that borders a portion of the wetland, suggesting they were nesting (Parren 2009). The habitat is a stream frequently dammed along its course by beavers. It consists of emergent and shrub marsh characterized by cattails, speckled alder (*Alnus incana*), and willows (*Salix sp.*).

West Central

The west central population was discovered in 2010. Currently there are nearly 50 identified individuals in this population, but the number is likely much higher because recapture rates are very low (Parren 2013). Juvenile turtles and one hatchling have been observed, indicating reproduction in this population. The habitat is intermediate fen interspersed with "islands" of dwarf shrub bog along with patches of larch (*Larix laricina*) and black spruce (*Picea mariana*) which are part of a large wetland complex. The size and relative isolation of this wetland provides some protection for this population. In 2013, survey efforts were suspended because of concerns that VFWD presence would draw attention to the turtles and lead to collection.

VI. Threats and other factors limiting the population in Vermont

Spotted Turtles face some significant threats. Lewis et al. (2004) summarized the primary threats as development, habitat fragmentation, isolation, and invasive species. Enneson and Litzgus (2008) cited habitat loss, predation, collection, and roads.

Habitat loss and fragmentation

Wetland complexes are among the most threatened habitat types in Vermont (VT Wildlife Action Plan 2015). Destruction of the beaver population in the 18th century would have led to the collapse of what likely was an extensive matrix of beaver-created wetlands in the state (Vermont Fish and Wildlife Department 2009). Wooded lowland forests and remnant beaver meadows were likely first to be cleared and drained for agriculture, housing, commerce, and transportation. It is estimated that less than 4% of Vermont is currently wetland and that nearly 35% of

Vermont's historic wetland areas have been lost or severely impaired (Vermont Wetlands Program 2016).

Extant wetlands are threatened by encroaching development and fragmentation from roads and railroads, resulting in Spotted Turtles navigating fragmented habitats where they are more vulnerable to predation, collection, and road mortality. Currently, regulations protecting wetlands in Vermont apply to the wetland and a small buffer, not the surrounding landscape. Mandatory buffers range from 50 feet (~15 m) for a Class II wetland to 100 feet (~30 m) from the wetland edge for a Class I wetland. This may be insufficient to protect nesting females, which regularly venture further than these buffer distances from the wetland to nest and can venture over 100 m (Beaudry et al. 2010, Joyal 1996, Milam and Melvin 2001).

Predation

Spotted Turtle adults are sometimes killed by raccoons and fox (L. Erb, pers. comm.). Eggs and hatchlings are likely extremely vulnerable. Known predators of both turtle eggs and hatchlings in Vermont include raccoons, red fox, and striped skunks (*Mephitis mephitis*), which are generalist species (Chapman and Feldhamer 1982, Hamilton and Whitaker 1979, Novak et al. 1987). Generalist species have a varied diet and can thrive in many habitat types, making them common and successful, especially in human-dominated landscapes (McKinney 2002). Populations of generalist predators are thought to be on the rise in New England due to human activity (Oehler and Litvaitis 1996).

Collection

Spotted Turtles are highly valued in the pet trade for their brightly colored spots and small size. One description of the turtle found on a pet shop's website says: "Spotted Turtles are very special turtles with unique 'polka-dot' markings that you won't find in any other turtle species. Every Spotted Turtle is unique because the yellow and orange markings on every turtle are different. Their markings make them very unique, but these turtles have great personalities, too!" (myturtlestore.com 2017). Hatchling Spotted Turtles can sell for $295 and adults as much as $595 (theturtlesource.com 2017), making them very valuable to collectors.

In 2003, VFWD wardens investigated a case of collection and sale of turtles as pets. Native and non-native turtles were seized, including four Spotted Turtles likely collected out of state (Parren 2003). This case resulted in a conviction and fine. In 2012, there was a report of someone in Vermont selling a Spotted Turtle on craigslist, which is illegal. The post stated "captive-hatched" (Parren 2012). It is common practice among Spotted Turtle researchers not to reveal exact locations of study sites to protect turtles against collection for the pet trade (e.g., Litzgus and Brooks 2000, Joyal et al. 2001, Breisch 2006). While there is no documented case of anyone collecting wild Spotted Turtles in Vermont, collection is regarded as a serious threat.

Invasive species

Invasive plant species may alter the habitat used by Spotted Turtles in Vermont. Japanese knotweed (*Fallopia japonica*) is documented growing in the southeastern location. This plant has been pulled annually since 2008 to keep it under control and to prevent it from invading the wetland edge, including potential nesting substrate. While this invasive plant appears to be under control in this location, it will require regular pulling for the foreseeable future. Invasive plants such as common reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*) could devastate wetland habitats on which turtles rely (van Dijk 2013). For example, Bolton and Brooks (2010) investigated the effect of fast-growing *Phragmites* on hatching success of Spiny Softshell Turtles (*Apalone spinifera*). They found that during the incubation period, *Phragmites* shoots could grow and shade nests that had been completely exposed to sun during the egg-laying period. Shaded nests were significantly cooler than unshaded nests and incubation times were significantly longer. These differences could be critical for turtle species at the northern end of their range, possibly extending development time and skewing sex ratios. It is important to prevent invasive plants from spreading to new habitats. *Phragmites* is found along a railroad track in one section of the Spotted Turtle wetland in southeastern Vermont. It is located on private land and does not appear to be spreading, but monitoring should continue. The wetland immediately adjacent to the knotweed in southeastern Vermont contained purple loosestrife intermingled with native plants (S. Parren, pers. obs.).

Diseases and parasites

Ossiboff et al. (2015a) sampled turtles across the eastern United States for Emydid herpesvirus which can infect turtles in the Emydidae family. He notes that fatal systemic disease with characteristic herpesviral-like inclusions has been observed in Painted Turtles and Map Turtles (*Graptemys spp.*) and was a contributing factor in the death of a Box Turtle (*Terrapene carolina*). Emydid herpesvirus was found only in Bog Turtles and one Spotted Turtle collected in New Jersey. While Emydid herpesvirus was rare, they speculated that it could be a significant pathogen because it can be shared amongst members of the Emydidae family, which in New England also includes Painted Turtles, Box Turtles, and Wood Turtles.

In another study, Ossiboff et al. (2015b) sampled Emydid turtles in New Jersey, Pennsylvania, and Delaware for *Mycoplasma* infection. *Mycoplasma* infections can cause acute or fatal respiratory disease in reptiles. They found the bacterium in 70% of Bog Turtles (n=83), 100% of Box Turtles (n=3), and 18% of Spotted Turtles (n=11). All Snapping Turtles (*Chelydra serpentina*) and Wood Turtles sampled tested negative (n=7 and 4, respectively). Despite the presence of *Mycoplasma sp*., none of the turtles sampled showed signs of clinical disease, leading the authors to conclude the bacterium is commensal in Emydid turtles.

Ranavirus, known for affecting frogs, has been documented in wild turtles and tortoises (Johnson et al. 2008). In wild Box Turtles, which seem especially susceptible, the progression of the

disease was rapid (Belzer and Seibert 2011) and always fatal once symptoms were exhibited (De Voe et al. 2004). Ranavirus is concerning in that it appears to be transmissible among amphibians and reptiles and has been found in Wood Frogs in New York and New England (Crespi et al. 2015). The VFWD Wildlife Health Surveillance Plan calls for the necropsy of any dead or sick Spotted, Spiny Softshell, or Wood Turtle with signs of respiratory disease or skin lesions.

Rausch (1947) examined turtle specimens from Ohio for parasitic helminths (worms). He reported the common trematode *Telorchis robustus* and the intestinal nematode *Spironoura affine* in Spotted Turtles.

Several researchers have observed leeches on Spotted Turtles (Breisch 2006, Ernst 1976), but noted that they did not seem to cause much harm and didn't stay attached for long once the turtle emerged from water.

Release of turtles from the pet trade is a potential threat for native turtles. Due to stress and increased exposure to disease in captivity (capture, handling, transport, inappropriate housing and feeding, crowding, and contact with other species including exotic turtles), captive turtles that end up in the wild may infect native populations (Aiello et al. 2014). Spotted Turtles seized during a Vermont law enforcement action in 2003 showed signs of respiratory infection common to turtles in the pet trade (S. Parren, pers. obs.). They were treated and appeared healthy before being given to the Zoo Ecomuseum on the island of Montreal. Native turtles used as part of permitted research in Vermont have been prohibited from release into the wild due to disease concerns (S. Parren, pers. comm.). There is a similar risk that rehabilitation activities could result in introduction of disease or parasites into wild populations if proper husbandry practices are not followed. For this reason, the risks of rehabilitation may outweigh the benefits. Vermont has joined the Northeast Wildlife Disease Cooperative and these issues are being discussed.

Diseases and parasites of pond turtles in the northeastern U.S. are poorly studied overall. Because of our lack of knowledge, care must be taken not to spread potential pathogens among populations during conservation activities such as assisted migration, headstarting, or reintroduction.

VII. Monitoring, research, and management

Monitoring

Spotted Turtles are reclusive and are hard to detect when they occur in small numbers. Much more research is needed to understand the size and demographics of the populations in Vermont. Intensive surveys have not occurred regularly because of limited staff resources and concerns about attracting attention to the sites.

The three known Spotted Turtle populations have been surveyed (Table 3), but limited staff resources and concerns about impacts to the populations have kept these efforts modest. Monitoring has included visual searches, trapping, and radio telemetry. The intensity of monitoring has varied with staff and other resource availability and has utilized volunteers. Monitoring began with a statewide assessment in 1988-89 (DesMeules 1989). Annual monitoring by VFWD began in 1998 and annual summary reports date back to 2000.

Visual searches

Visual searches might occur from a roadside or wetland edge with the use of binoculars, but this method is unlikely to detect Spotted Turtles unless they are basking in a prominent place or have moved to the open to nest. Staff or volunteers have also traversed the wetlands looking for turtles. The noise and vibration of humans moving through a shrubby wetland provides warning for turtles to hide so turtles may still be overlooked. Studies using this survey method tend to detect more adult females (Ernst 1970, Ernst 1976, Reeves and Litzgus 2008, Seburn 2003). Juveniles and males appear to be harder to detect this way (Breisch 2006, Reeves and Litzgus 2008). If surveys are timed for when turtles are just emerging from hibernation and are lethargic while basking, they can yield better results (S. Parren, pers. obs.). Breisch (2006) caught more juveniles by trap than by hand. Hand captures partly rely on turtles being exposed. If juveniles avoid exposure, hand captures are unlikely.

Trapping

Turtle traps are placed in channels and tunnels which turtles use to move around the habitat (Figure 3). Wing-like appendages funnel the turtles into the mouth of the trap. The trap door yields as they enter but closes behind them (Figure 4). During times when traps are set someone must be available to check the traps every day and record what is caught. Studies using trapping have generally had low success (Breisch 2006, DesMeules 1989, Parren 2003), but trapping has proved to be very helpful in Vermont. At one site, considerable effort was put into trapping over a 45-day period and our success rate was 3.46 turtles/trap night with 26 captures logged (S. Parren, unpublished data).

Table 3. Monitoring efforts for Spotted Turtles in Vermont

Year	Geographic location	Survey type	Survey effort	Result	Conclusion	Source
1970	northwest	incidental observation	road crossing	1st record in VT	likely released/ escaped pet	DesMeules 1989
1981	southeast	incidental observation	road crossing		species present in VT	
1983	southeast	incidental observation	road crossing			
1988	southeast	baited traps	9 days	1 capture	present	
	west central	baited traps	5 days	no captures		
	unknown	unknown	8 sites	no observations		
1989	statewide	foot search	17 sites	no observations		
	southeast	baited traps	18 trap nights	no captures		
		foot search	5 days	no observations		
1997	southeast	visual search	1 individual	1 unknown Spotted Turtle	verified occurrence	Parren photo 1997
1998	southeast	visual search	1 individual	1 capture	adult female missing leg	Parren field notes
1999	southeast	visual search	1 individual	1 recapture	adult female missing leg	Parren field notes
2000	southeast	interception traps	420 trap nights	2 captures, 3 incidental observations, 2 recaptures	5 adults	Parren 2000
		radio telemetry	2 individuals	movement data obtained, hibernacula discovered	turtles cross railroad tracks	
2001	southeast	visual search		1 new capture, 2 hatchlings recovered	breeding	Parren 2001
		interception traps		no captures		
		radio telemetry	2 individuals	movement data obtained, possible estivation sites discovered		
2002	southeast	visual search	2 days	1 nesting attempt		Parren 2002
	southwest	visual search		no observations		
		interception traps	372 trap nights	no captures		

2003	southeast	visual search	3 days	no observations		Parren 2003
	southwest	interception traps	900 trap nights	no captures		
2004	southeast	visual search	3 days	no observations	nest site disturbed by railroad work and ATV use	Parren 2004
	southwest	visual search		no observations		
2005	southeast	visual search		no observations		Parren 2005
	southwest	visual search		no observations		
2006	southeast	visual search		1 nest with emergence	breeding	Parren 2006
	southwest	visual search		no observations		
2007	southeast	incidental observation	road crossing	1 observation		Parren 2007
2008	southeast	interception traps		1 capture	present	Parren 2008
	southwest	radio telemetry	1 individual			
		visual search		1 observation	present	
2009	southeast	radio telemetry	1 individual			Parren 2009
		interception traps		1 capture		
	southwest	incidental observation		1 observation		
		radio telemetry	1 individual			
		visual search		1 observation		
2010	southeast	visual search		1 observation		Parren 2010
	southwest	interception traps		no captures		
	west central	radio telemetry	3 individuals			
		interception traps		9 turtles marked	population confirmed	
2011	southeast	visual search		no observations		Parren 2011
	southwest	visual search		no observations		
		incidental observation		1 observation		

	west central	interception traps		38 turtles now identified	hatchling found (breeding)	
2012	southeast	visual search			8 known individuals	Parren 2012
	southwest	visual search		no observations		
	west central	interception traps		44 turtles now identified	robust population	
2013	southeast	visual search	1 day	no observations		Parren 2013
	southwest	interception traps	~168 trap nights	no captures		
	west central	radio telemetry	1 individual			
		visual search		46 known individuals	robust population	
2014	southeast	visual search	1 day	no observations		Parren 2014
	southwest	visual search		no observations		
	west central	no survey				
2015	southeast	visual search	2 days	1 unconfirmed observation		Parren 2015
	southwest	visual search		no observations		
	west central	no survey				
2016	southeast	visual search		no observations		Parren 2016
	southwest	visual search		no observations		
	west central	no survey				
2017	southeast	visual search		no observations		Parren 2017
	southwest	visual search	2 days	1 observation	3 known individuals	
		radio telemetry	1 individual		know from this site	
	west central	no survey				
2018	southeast	visual search		no observations		Parren 2018
	southwest	visual search radio telemetry	1 days 1 individual	1 observation same female as 2017	new hibernacula confirmed	
	west central	no survey			1 female reported by public	

Figure 3. A deployed turtle trap. Photo credit: A. Breisch.

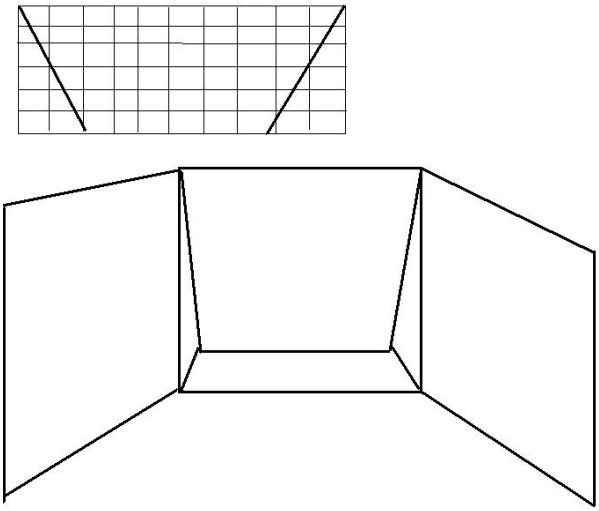

Figure 4. Side and front view of traps used to capture Spotted Turtles.

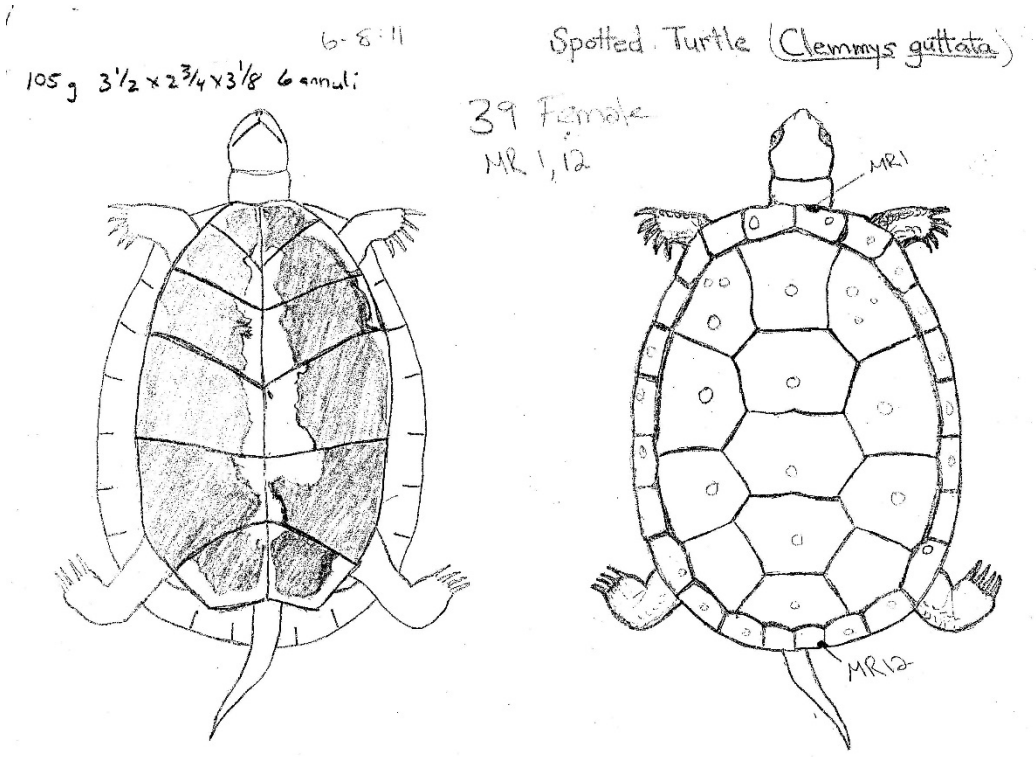

Figure 5. Example of sketches which show the unique spotting and blotching pattern of an individual, and notches to identify individual captured.

Once caught by trap or by hand, a turtle is photographed. Sketches of the individual's unique spot pattern are derived from the photographs or drawn from life in the field (Figure 5). A notch is put in one or more of the marginal scutes using a small file (Cagle 1939). Notches quickly distinguish it as a previously caught individual and the location of the notch provides a unique identifier.

Radio telemetry

Radio-telemetry tracking has been conducted at all three Vermont Spotted Turtle sites. These studies have been based on one or two individuals at a time and were intended to provide a better understanding of how the wetlands were being used (especially distribution within a wetland complex) and where other turtles might be found. Signals indicated that Spotted Turtles were crossing the railroad tracks at the southeast site regularly. Previously, these tracks were thought to be a barrier to movement (Parren 2000). Radio telemetry has also led to the discovery of hibernacula. A summary of radio telemetry efforts is in Table 4.

Table 4. Dates and locations of radio-tracked Spotted Turtles (*Clemmys guttata*) and knowledge gained.

Year	Geographic location	Age/ sex*	Date tagged	Tag removed	Knowledge gained
2000	southeast	AF	5/7/2000	11/21/2000	>1/4 mile north/south movement; hibernaculum discovered
2000	southeast	AF	5/29/2000	11/3/2000	crossed railroad tracks
2001	southeast	AM	4/14/2001	9/14/2001	crossed railroad tracks; possible estivation site discovered
2001	southeast	AM	4/14/2001	9/14/2001	crossed railroad tracks; possible estivation site discovered
2008	southwest	AF	5/30/2008	6/2/2009	area of wetland used
2008	southeast	AF	6/25/2008	5/27/2009	area of wetland used
2009	southeast	AF	5/28/2009	10/11/2009	likely gravid when captured
2009	southwest	AF	6/5/2009	10/11/2009	crossed railroad tracks; hibernaculum discovered
2010	west central	AF	5/4/2010	6/8/2010	area of wetland used
2010	west central	AM	5/13/2010	6/22/2010	area of wetland used
2010	west central	JF	5/15/2010	6/23/2010	area of wetland used
2013	west central	AF	4/4/2013	10/3/2013	possible hibernaculum discovered
2017	southwest	AF	4/10/2017	4/2/2018	hibernaculum discovered

*A=adult, J= juvenile, F=female, M=male

Research needs

Distribution and abundance

Our knowledge of Spotted Turtle populations in Vermont is limited to the three known populations and it is possible other populations have gone undetected. The Vermont Reptile and Amphibian Atlas (Atlas) has collected reports of species from citizens, scientists, and volunteers since 1995, including two that are believed to have been escaped pets, and there has been one targeted survey of selected sites for Spotted Turtles in Vermont (DesMeules 1989). Despite considerable effort, the survey yielded only one individual. The three known populations were all discovered by chance encounters. The two southern populations are believed to be small because few individuals have been found and recapture rates are high. In the west central population, almost 50 individuals have been identified. Few recaptures may indicate a much larger population, but active trapping of turtles in this population ended in 2013. Past surveys provided information about where the population appeared to be concentrated within a much larger wetland complex. The risks and benefits of researcher intrusions into Spotted Turtle habitat should always be considered due to the very real risk of collection by those in the pet trade.

Given that the largest known population of Spotted Turtles in Vermont was discovered as recently as 2010, it is possible that there are additional, undiscovered populations in the state. A more complete understanding of Spotted Turtle distribution in Vermont would help inform

habitat protection and land acquisition efforts. The costs and risks must be weighed against the benefits of turtle surveys.

Population change

It would be helpful to monitor population size as well as age and sex distribution over time to evaluate recruitment and to detect possible population declines quickly. Better knowledge of demographics might allow determination of short and long-term viability of a population, but this needs to be weighed against the risk of drawing the attention of collectors and predators that follow human scent (e.g., raccoon). A detected decline in adult population, recruitment, or nesting attempts might trigger management actions, but collecting the necessary data would require a concentrated effort that might be intrusive and still not provide the needed details for this long-lived and cryptic species. Much of the current monitoring could be characterized as threat monitoring of the known occurrences in Vermont.

Habitat requirements

Knowledge of Spotted Turtle critical habitat is limited to those areas surveyed in Vermont. Hibernacula, estivation sites, and nesting sites are known to a limited extent. Dispersal corridors are not known and may not exist. A couple of young male Spotted Turtles were detected moving away from the core of one population and it is uncertain how such dispersal ends. When critical areas are identified, efforts should be made to protect them. The VFWD has acquired two parcels specifically for Spotted Turtle conservation and owns another site.

Threats

It is likely that Vermont Spotted Turtles face threats similar to those known from other areas and other turtle species such as habitat loss, nest predation and disturbance, adult mortality from crossing roads, entrapment between railroad rails, and collection for the pet trade. We have not found dead adult Spotted Turtles in Vermont and although a suspected Spotted Turtle nest was discovered depredated, it could not be determined with certainty that it was a Spotted Turtle nest. The three known local populations of Spotted Turtles are widely separated with no known nearby populations in Vermont, although a nearby population in an adjacent state is suspected at one location. In the event of habitat impacts, possibly due to human activity or climate change, dispersal to new habitats would be challenging. Two of the local populations of Spotted Turtles in Vermont appear to be modest in size and stochastic events in such small populations might threaten their persistence. The likelihood of recolonization from a nearby population is very low. The small size and isolation of Spotted Turtle populations is a threat to their survival.

Management

To date, active habitat management for Spotted Turtles has only occurred at the southeastern site (Table 5). Other measures consist of guarding locations of known populations against public disclosure and attempting to secure habitats and adjacent lands for conservation through fee

ownership or easements. While necessary, these steps alone likely will not secure or enhance existing populations.

Table 5. Management history of a Spotted Turtle (*Clemmys guttata*) population in southeastern Vermont.

Year	Management action
2005	nesting substrate added to nesting site along railroad
2006	nesting substrate added to nesting site along railroad
2007	vegetation cleared from nesting site additional habitat conserved
2008	Japanese knotweed pulled 13 nesting pits created along railroad
2009	vegetation cleared from nesting site Japanese knotweed pulled
2010	Japanese knotweed pulled
2011	Japanese knotweed pulled 15 railroad crossings installed
2012	Japanese knotweed pulled, nesting pits checked 5 additional railroad crossings installed
2013	Japanese knotweed pulled nesting pits checked/vegetation cleared
2014	Japanese knotweed pulled nesting pits checked/vegetation cleared
2015	Japanese knotweed pulled nesting pits checked/vegetation cleared
2016	Japanese knotweed pulled nesting pits checked/vegetation cleared
2017	Japanese knotweed pulled nesting pits checked/vegetation cleared
2018	Japanese knotweed pulled nesting pits checked/vegetation cleared

VIII. Goals, Objectives, and Strategies for Recovery

Successful management and conservation programs for long-lived organisms, such as turtles, must recognize that protection of all life stages is necessary. For instance, programs that protect nests and headstart hatchling turtles are only one part of a broad-based conservation program that must include conservation and protection of adult and older juvenile turtles to achieve a viable, self-sustaining population (Congdon et al. 1994, Heppell et al. 1996). Globally, declines in turtle populations are being attributed to low annual reproductive success, delayed sexual maturity, overexploitation, and habitat alteration and degradation (Dodd 1990, Congdon et al. 1993, LaClaire 1995, Lovich 1995 *as cited in* DonnerWright et al. 1999).

Goal

The Vermont Fish and Wildlife Department and Agency of Natural Resources' goal is to protect and enhance Spotted Turtle populations to the extent that the species may be removed from the Vermont list of endangered and threatened species.

To achieve delisting, the long-term viability of the three known Spotted Turtle populations must be assured. Occupied and nearby unoccupied habitats, as well as landscape connections, should be protected from disturbance and development so that dispersal to new habitats and establishment of new populations is possible.

Objectives

Downlist from current endangered status to threatened if:

1. There is evidence that there is a minimum of 375 females of breeding age in Vermont or surrounding jurisdictions that share a metapopulation with Vermont; and

2. There are at least three stand-alone populations or metapopulations with a minimum of 38 adult females each.

(Note: Occurrences within a metapopulation are separated by <2 km of unsuitable habitat or <3 km of suitable habitat (Hammerson 2001) and the minimum of 38 adult females is simply 75% of the minimum of 50 used for delisting.)

Delisting from threatened status if:

1. There is evidence that there is a minimum of 500 females of breeding age in Vermont or surrounding jurisdictions that share a metapopulation with Vermont; and

2. There are at least three stand-alone populations or metapopulations with a minimum of 50 adult females each, or five stand-alone populations or metapopulations with a minimum of 38 adult females each.

Justification

Spotted Turtles are at risk of loss in Vermont due to the following factors:

1. Female Spotted Turtles do not attain sexual maturity until approximately 11 years of age (range from seven to 14 years, at a carapace length of about 8 cm, with northern animals likely taking longer to mature than those living farther south (Ernst 1970b, Harding and Mifsud 2017). Only four eggs per clutch has been documented in Vermont, and the rate of nesting failure may be high due to nest depredation which has been documented for other turtle species in Vermont. As with most turtles, the proportion of hatchlings that survive to breeding age is likely low;

2. Documented occurrences are few, widely separated, and gene flow between our known populations is likely nonexistent, so there may not be any natural population rescue potential without human intervention. One young male was found at a road edge and was likely dispersing, but with no known nearby populations this was likely a dead end;

3. Two of our three known populations are in limited wetland areas surrounded by human infrastructure and activity. They are vulnerable to catastrophic occurrences such as a change in hydrology, disease outbreaks and other stochastic events, as well as pollution such as a chemical spill. One site has a railroad line that bisects the wetland, which is also a threat;

4. Due to illegal harvest for the pet trade, public knowledge of Spotted Turtle locations is a serious potential threat.

Spotted Turtles are experiencing range-wide population declines largely due to wetland habitat loss and fragmentation, roadkill, and nest depredation by over-abundant generalist predators such as skunks and raccoons (Harding 2017, van Dijk 2013). Because of their sensitivity to habitat fragmentation and given that Vermont's wetlands have already faced extensive losses, it is unlikely that Spotted Turtles can be reestablished to their historic distribution throughout the state. Indeed, their historic distribution is unknown since no records exist prior to 1970. Instead, recovery will focus on preserving the extant populations and their surrounding habitats so that new populations may someday be established through natural or human-assisted dispersal.

In a demographic study of a Spotted Turtle metapopulation in Canada, Enneson and Litzgus (2009) determined that a population of approximately 70 adults was relatively safe from extinction in the near term. They also found that:

- populations increased, and total extinction was unlikely when dispersal was possible
- barriers to dispersal led to local extinctions

- more populations meant a lower chance of extinction for the metapopulation

All of this suggests that a well-connected network of wetlands is necessary for a functioning metapopulation, which will reduce the likelihood of extinction.

The known Spotted Turtle populations in Vermont are too widely separated to allow immigration of individuals through natural dispersal. It is possible that unknown populations exist, including in neighboring states, and some could be close enough for exchange of individuals. Until we learn if such populations exist, our known populations should not be considered a metapopulation but rather remnant and isolated populations with no known opportunities for recolonization from neighboring populations. Under these circumstances, the risk of local extinction may be extremely high, particularly for the two small southern populations. The existing populations need to be protected and maintained to allow time for enhancement actions that might allow establishment of adjacent networks of metapopulations or population augmentation through captive breeding and/or assisted migration/translocation.

Strategies

Keep locations confidential

The Vermont Endangered Species Law provides limited authority to keep the locations of endangered and threatened species confidential (see *T.10, Chap 123, Section 5410*). Public disclosure is considered a significant risk for the Spotted Turtle due to the threat of illegal collection. Therefore, VFWD has been trying to prevent specific locational information from being presented. The Natural Heritage Database shows limited location information and the Atlas only displays locations at the county level. The annual VFWD summary report includes: "Collection of Spotted Turtles for the pet trade is a real concern and we have taken possession of Spotted Turtles in the past that were being traded in Vermont. We try not to share Spotted Turtle locations in Vermont due to our concern about collection and our Vermont Endangered Species Law has a 'Location Confidential' section that gives us the legal authority to restrict this spatial information." The populations are referred to only as southwestern, southeastern, and west central in case the report circulates, and we reinforce the need to keep locations confidential when discussing Spotted Turtles with landowners. (**high priority**)

While keeping location information from the public may seem counterproductive to conservation work, this is extremely important in the case of Spotted Turtles.

Monitor and secure existing populations

Additional monitoring of the Spotted Turtle populations in Vermont would be helpful to our understanding of this species. Demographic knowledge of known populations is limited. There are no robust population estimates for any of the populations, only indications of abundance based on capture rates and number of individuals handled. A sex ratio of 1.37 male:1 female was calculated for one population based on 45 adults that were captured (S. Parren, unpublished

data), but this may be biased by differences in behavior during the breeding season (traps set late April – early June). Only a few hatchlings and juveniles have been documented and adult turtles are not easily aged by scute annuli or wear. Breeding has been confirmed at two and suspected at the third population based on female movements during the nesting season. Recruitment rates are not known. Without additional information, it is challenging to know if existing populations are stable, declining, or increasing. Monitoring is needed for detecting problems that should be addressed in a timely manner (threat monitoring is a **high priority**) as well as population monitoring that might provide indices of abundance (moderate priority). This should be carefully planned so monitoring activities do not significantly impact the habitat, attract predators, or draw the attention of collectors.

Spotted Turtles are difficult to monitor in Vermont due to their relatively short annual activity period, secretive behavior, and rarity. Intensive monitoring of Spotted Turtle populations has occurred due to the need to document populations, but VFWD resources are limited and there are many competing needs. The VFWD should explore working with partners such as Antioch College, American Turtle Observatory, University of Vermont, or the Orianne Society to conduct surveys of Spotted Turtles. Discussions have occurred regarding the Competitive State Wildlife Grant (CSWG) Spotted Turtle Project and directing some CSWG resources to survey and monitor for Spotted Turtles in southern Vermont while CSWG project staff are working in adjacent states. There have also been discussions with The Orianne Society about cooperating on Spotted Turtle surveys.

Survey for possible unknown populations

The Spotted Turtle was listed as threatened in Vermont in 1989 and then as endangered in 1999 (*10 V.S.A. App. §10)*. Only three populations are known. While more populations may exist, they are not likely to be easily detected and limited resources would need to be redirected to such a search. If an incidental encounter was reported in an area that had potential habitat, we would try to verify if a population exists (**high priority**). If a partner was interested, or a funding source became available, we might attempt a dedicated search. (see CSWG discussion in previous section.) A habitat model developed for Maine was applied to Vermont and one wetland in southeastern Vermont was predicted to be Spotted Turtle habitat (T. Persons, pers. comm.).

Examine risk of inbreeding

Vermont's small southern populations may be at risk of inbreeding. Since the populations are widely separated there is no known opportunity for genetic rescue from dispersing individuals. In addition to further investigation of population size and distribution, genetic samples from Spotted Turtles within a population might provide useful information on the degree of relatedness among individuals. The CSWG proposal calls for collection and storage of genetic samples pending funding for a regional genetic analysis (CSWG Proposal 2017). If population genetics indicates a problem with relatedness among individuals within a population, this might prompt us to consider translocations among populations to introduce new genes (low priority action; CSWG funding and focus could change this).

Headstarting, captive breeding, and assisted migration/translocation

If local populations are determined to be at risk of extinction due to inbreeding, stochastic disasters, or continued decline, headstarting, captive breeding, and/or assisted migration of individuals among local populations may be considered to augment genetic diversity and reduce the risk of local extinction. Very few hatchlings have been encountered over the years so headstarting Vermont turtles would be a challenge. The more robust west central population might be the most likely Vermont source for captive breeding and juveniles because it seems more likely to be able to withstand the loss of a few individuals to supplement the smaller southern populations. Nearby populations in adjacent states may also be a possible source of new genes, as Spotted Turtles are more secure in other states and some of their populations are closer geographically to our southern populations. We would need to know more about the genetics of both the source as well as the receiving populations. Genetics is not the only concern. If populations become very small, the opportunities for mating might be limited or cease to exist (e.g., remnant population of females only).

Disease is also a concern when moving turtles. A discussion of the costs and benefits of captive breeding and moving turtles would need to occur before such actions were attempted. (low priority until we better understand the circumstances). While we may learn more about existing populations and their possible connections to other populations, including those in surrounding states, having some hidden populations may be helpful to the survival of this species that is vulnerable to collection. We have continued to explore the extent of current populations and have reached out to partners about enlisting their help with further survey work.

Protect occupied, adjacent, and potential habitats

Acquiring areas important to Spotted Turtles through fee or easements is desirable. Some biologists believe habitat loss and fragmentation to be leading causes of Spotted Turtle declines throughout their range (Lewis et al. 2004, Enneson and Litzgus 2008). An interconnected wetlands complex that allows linking populations and occurrences would be helpful for protection of the Spotted Turtle in Vermont. When compared to Painted Turtles, Musk Turtles (*Sternotherus odoratus*), and Snapping Turtles, with which Spotted Turtles sometimes share habitat, Anthonysamy et al. (2014) found Spotted Turtles to be the most sensitive to habitat fragmentation. Lewis et al. (2004) found that state-owned lands in Ohio were as likely as private lands to be fragmented, but less likely to have encroaching development. He found that while ownership did not impact habitat quality, it did impact habitat longevity. Suitable habitat had been completely lost from 17% of historically occupied lands that were privately owned.

Seburn (2012) found that Spotted Turtles in a large complex habitat did not cross a two-lane road to utilize habitat on the other side. He theorized that turtles could avoid crossing the road because their requirements were met by the wetland they occupied. This would seem to apply to our west central population located in a large wetland complex, but Spotted Turtles have occasionally been found on the road edge. Identification and protection of large, high-quality wetlands could

reduce adult road mortality by lessening the need to cross the road. The challenge in Vermont is that most large wetlands are not known to contain Spotted Turtles.

Current buffers for wetlands in Vermont are 50 feet for Class II wetlands and 100 feet for Class I wetlands (Vermont Wetland Rules, Vt Code R. 12 004 056 Section 4.2) although these can be adjusted based on topography and other factors. All of the known occupied wetlands are designated Class II wetlands. The required buffer may not be sufficient to protect Spotted Turtles which are known to move between wetlands and upland areas in Maine (Joyal et al. 2001). We have never found a radio-tagged Spotted Turtle far from a wetland in Vermont, but one young, untagged male was found further away along a road edge. (Parren, unpublished data). These wetlands may be eligible for Class I designation due to their harboring a critically endangered species (Vermont Wetland Rules, Vt Code R. 12 004 056 Section 5.4), but the increased buffer still might not be enough. We have considered this but decided not to push for Class I designations because the risk of collection is believed to be a greater threat and we have not wanted to risk drawing more attention to occupied habitat. Milam and Melvin (2001) recommended a wetland buffer of 400 meters. While ideal, it may not be realistic.

Immediate focus should be on the known occupied habitats. The west central wetland is large and a good portion of it is owned by VFWD. It seems that a large number of Spotted Turtles are concentrated in this state-owned area. A large portion of the wetland complex remains in private ownership, but that habitat is variable and perhaps not as suitable for Spotted Turtles. The southeast wetlands are known to support a small population of Spotted Turtles and two sections used by Spotted Turtles are owned by VFWD. A more remote section of the VFWD ownership has not been well surveyed and perhaps more turtles will be found there. The southwest wetland known to harbor Spotted Turtles has multiple owners who have been amenable to turtle surveys on their properties. Only three adult females have been found but we suspect more turtles use this wetland. Human development, mostly residential, surround the two southern populations, but there are sections of both wetlands that are more remote and harder to access. There have been discussions with NRCS and how their Working Lands For Wildlife Program might benefit easements to protect Spotted Turtle habitat.

The following actions could be considered to protect known and potential habitats.

1. Prioritize parcels for acquisition or easement based on likelihood of turtle occupation, threat of habitat loss, and landowner receptiveness. (**high ongoing priority**).
2. Continue to acquire lands in and around known populations, including upland areas (Joyal et al. 2001). VFWD has already acquired two parcels specifically for Spotted Turtle conservation (**high priority** if core wetland, moderate priority if on the margins).
3. Acquire lands around occupied wetlands even if the buffer distance is smaller than the 400 m recommended by Milam and Melvin (2001). (moderate priority but could vary depending on site specific need and circumstances).
4. Continue invasive plant removal and monitoring. More could be done if we think the habitat is at risk. (moderate priority; site specific evaluations are needed).
5. Consider protection of suitable unoccupied habitat within 2 km of occupied habitat if a dispersal corridor connects it to occupied habitat. (low priority…we have not identified dispersal corridors in Vermont).
6. Reclassify occupied wetlands as Class I wetlands only after a discussion of the costs and benefits of this designation (low priority due to risk of collection).
7. Designate Spotted Turtle wetlands and buffer habitats as critical habitat only after a discussion of the costs and benefits of this designation (not a priority due to risk of collection).

We are fortunate that the VFWD owns important portions of two Spotted Turtle habitats and we have so far enjoyed good landowner relations concerning privately owned areas. We have discussed acquisition with the owner of one important wetland area. Protecting the core wetland for Spotted Turtles is a higher priority than protecting buffer areas and small house lots along the margins of occupied wetlands. Even low priority actions listed above are important, but we should be thoughtful and strategic about spending limited time and funds.

Improve nesting success and hatchling/juvenile survival

Appropriate nesting substrate is crucial for turtle reproduction. Successful incubation requires nesting areas that are free from human and domestic animal disturbance. Female turtles are attracted to disturbed upland areas for nesting, but these sites might pose threats to developing eggs that more natural sites lack. For example, Beaudry et al. (2010) observed nests in pastures being trampled by horses and excavated by the landowner. In the southeastern population, the railroad bed had been attractive to several turtle species (Parren 2010). However, small rocks spread along the margins of the railroad have covered nesting substrate (Parren 2004) and may threaten the reproductive potential of the population. Artificial nesting pits have been provided at this site. Mammalian predators appear to have learned to search road edges for nesting turtles (S. Parren, pers. obs.). Alternative nesting areas may be needed which provide good nesting habitat for Spotted Turtles. Paterson et al. (2013) noted higher than expected use of artificial nesting mounds by Painted and Snapping Turtles. They also observed higher hatching success than eggs in natural nest sites. Artificial nesting sites may also be at risk of depredation unless protection

measures are put in place, and these typically require frequent monitoring and adjustments. At sites with modest populations of Spotted Turtles, dispersed nests may be more likely to escape predator detection than communal sites (Marchand and Litvaitis 2003). At one Vermont Spotted Turtle site, nesting is believed to be occurring on a large sphagnum mat in a floating bog and nest predation has not been documented.

Survival of freshwater turtle eggs and hatchlings is naturally low. In a meta-analysis of published turtle survival rates, Heppell (1998) determined the survival probabilities of age classes of freshwater turtles along with tortoises and sea turtles (Table 6).

Table 6. Survival probabilities from egg to reproductive age of freshwater turtles. Source: Heppell (1998).

Common name	**Scientific name**	**Probability of survival from egg to reproductive age**	**Source**
Painted Turtle	*Chrysemys picta*	2.43%	Wilbur 1975
Painted Turtle	*Chrysemys picta*	12.91%	Tinkle et al. 1981
Painted Turtle	*Chrysemys picta*	0.18%	Mitchell 1988
Blanding's Turtle	*Emydoidea blandingii*	1.09%	Congdon et al. 1993
Snapping Turtle	*Chelydra serpentina*	0.04%	Cunnington and Brooks 1996
Snapping Turtle	*Chelydra serpentina*	0.59%	Congdon et al. 1994

Due to naturally low survival rates, Enneson and Litzgus (2008) did not recommend management actions that focused on eggs or hatchlings. However, their study population was relatively large and slightly increasing. Protection of eggs in Vermont's southern populations, which are suspected to be very small, may be warranted. In a study of Bog Turtle demographics, Shoemaker (2011) determined that even in the absence of immigration/emigration, if adult mortality was low (<4%), yearly recruitment of 0.2 yearlings per adult was sufficient to sustain a population as small as 10-20 breeding adults for at least 100 years. While successful nesting by Spotted Turtles has been observed, it is possible that so few eggs are produced each year in the southern populations that recruitment may not be sufficient. Protection of eggs may consist of captive rearing, placing wire mesh over suspected nest sites, or fencing to deter predators. This requires knowing the location of nests and may not be feasible if nesting is dispersed.

The following actions could be taken to improve nesting success:

1. Maintain and monitor nesting pits along railroad tracks (**high priority**).
2. If necessary, protect nest sites from predation (priority set on a case by case basis).
3. Consider augmenting nesting substrate or providing alternative nesting sites (sand and gravel piles) away from roads and railroads (low priority unless we know where females go to nest). Once nesting is detected, monitoring and management is recommended.

Improve adult survival

Spotted Turtles are a long-lived species with low annual reproductive potential. This means that adults, particularly adult females, are the most crucial component of the population. In a study of Spotted Turtle demographics, Enneson and Litzgus (2008) determined that adult annual survivorship was by far the most important factor to the future viability of a population. Therefore, threats to adult survival are very serious.

Car strikes are a significant threat to adult turtles as they disperse to new habitats or search for nesting areas (Kaye et al. 2005). Kaye et al. (2005) studied the effectiveness of a large (6'x 6') box culvert at diverting turtles away from a busy road. They found direct and indirect evidence of extensive use of the culvert by Spotted Turtles.

In the southeastern population, 20 underpasses have been installed along a section of a railroad line that bisects the wetlands used by Spotted Turtles (Figure 6). At this site, a known Spotted Turtle nesting area was in the cinders along the railroad track, leaving female turtles vulnerable to injury or death from trains or track maintenance activities. The southwest population was discovered because female turtles were near the road, presumably to nest (Parren 2008). Additionally, roadkill is likely a principle cause of adult female mortality, both from turtles crossing roads searching for upland nest sites and from their attempting to nest in or next to the road itself (Joyal 1996).

Figure 6: Underpass installed on railroad track in southeastern location. Binoculars placed in crossing to give scale. (Photo credit: S. Parren)

The following actions will be taken to reduce adult turtle mortality.

1. Continue to maintain railroad crossings (**high priority**).
2. Locate actual or possible road crossing areas and take protective measures at road crossings such as installing wildlife culverts (low priority unless the opportunity presents itself).

Enforce laws

Vermont Game Wardens have been an important part of turtle conservation, including undercover operations. Advances in wildlife forensic genetics may aid Spotted Turtle protection in the future. The following actions are necessary to engage wardens and the public:

1. Maintain and enhance internal communications with law enforcement and biologists to build awareness and support for turtle protection (**high priority**).

Raise awareness through public outreach and education

Some private landowners are aware of the endangered species that they harbor on their property, but others are not. One Spotted Turtle was seen near a newly built home outside the west central population (S. Parren, pers. comm.). It is unlikely that the landowners were aware of the turtle's presence, but the individual was vulnerable to children, lawn mowers, vehicles, and dogs. The VFWD must balance educating abutting landowners with the need to keep turtle populations secret. Landowners should be approached carefully to gauge their openness and interest in turtle conservation. Interested and cooperative landowners can be crucial to monitoring efforts. In 2011, a new turtle was documented in the southwest population because the neighbors knew the VFWD was interested in sightings and reported one (Parren 2011). Some landowners have entered easements or even gifted parcels to the VFWD for other species (S. Parren, pers. comm.).

A few trusted volunteers have been instrumental in past monitoring efforts, but the need to keep Spotted Turtle locations secret foregoes larger volunteer events such as the beach cleaning activities that annually help support the Spiny Softshell Turtle. Nonetheless, an educated public can help support Spotted Turtle recovery. In addition to the new individual reported by neighbors in 2011, in 2012, a member of the public reported a Spotted Turtle for sale on craigslist.

Since 1995, members of the public have been able to report Spotted Turtle sightings to the Vermont Reptile and Amphibian Atlas. The Atlas's public outreach efforts have contributed to our knowledge of known populations. Dozens of Spotted Turtle observations have been reported to, discovered by, or catalogued through the Atlas. However, some historical reports are not associated with specific locations, some reports remain unverified, and some verified reports appear to be released pets. Only three populations have been verified. The majority of Vermont residents are likely unaware of the Atlas or the status of Spotted Turtles. One way to educate the public about Spotted Turtles and how to report sightings is to post short segments in VFWD publications and their website, advising Vermont residents to report any Spotted Turtles to the Atlas or to VFWD personnel. Programs on TV and radio would be another way to reach out to

the public. Additionally, readers can be urged to report any native turtles they see for sale in Vermont. The VFWD and the Atlas jointly provide news releases each year about reptile and amphibians and the value of reporting observations.

The ECHO Leahy Center for Lake Champlain legally acquired two confiscated adult Spotted Turtles that will be displayed at their Burlington facility with an interpretive display covering Spotted Turtle threats and conservation actions. VFWD is working with Steve Smith (Director of Animal Care and Facilities) and others at ECHO to develop conservation messages and encourage reporting.

The following actions could be taken to raise awareness within the public.

1. Encourage use of the Vermont Reptile and Amphibian Atlas by a wider array of Vermont citizens and highlight its importance in the identification, protection and survival of Spotted Turtles and other Species of Greatest Conservation Need (**high priority**).
2. Leverage relationships with The Orianne Society, ECHO Leahy Center, through the Reptile and Amphibian SAG, and with other partners to raise awareness and promote conservation of Spotted Turtles in a careful manner that does not put populations at risk (**high priority** if done carefully due to concern of collection).
3. Promote Spotted Turtle conservation awareness, including media stories, newsletter and enews, talks at key community organizations, and through the VFWD Facebook and other communications channels (moderate priority due to concern about collection).

Partnerships

Partnerships with other organizations may assist in the recovery of known Spotted Turtle populations and possible discovery of new populations, and opportunities for collaboration should be pursued.

Existing partners include:

- The American Turtle Observatory
- ECHO Leahy Center for Lake Champlain
- The Vermont River Conservancy
- Lake Champlain Land Trust
- The Nature Conservancy, Vermont Field Office
- The Orianne Society
- United States Department of Agriculture, Wildlife Services
- United States Fish & Wildlife Service, Lake Champlain Office
- Vermont Department of Fish and Wildlife
- Vermont Department of Forests, Parks, and Recreation
- Vermont Endangered Species Committee
- Vermont Reptile and Amphibian Atlas
- Vermont Scientific Advisory Group on Reptiles and Amphibians
- Vermont Wetlands Program
- NRCS Working Lands for Wildlife

1. Work with others to identify and protect important habitat areas.

- VFWD Land Acquisition Coordinator and ANR District Stewardship Teams
- Vermont River Conservancy
  A statewide, water-focused, nonprofit land trust supported by people who believe that the protection of exceptional shore land is essential to the quality of life in Vermont.
- The Nature Conservancy
  The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends.
- The Orianne Society
  The mission: The Orianne Society works to conserve critical ecosystems for imperiled reptiles and amphibians using science, applied conservation and education. Their Great Northern Forest Initiative is headquartered in Vermont
- Vermont Land Trust
  Protecting the land that makes Vermont special. Over the last 40 years, the VLT has protected more than half a million acres.
- Vermont Association of Conservation Districts
  Dedicated to the conservation, maintenance, improvement, and development and use of land, soil, water, trees, vegetation, fish and wildlife and other natural resources.
- Vermont Reptile and Amphibian Atlas
  Our Mission: The Vermont Reptile and Amphibian Atlas Project collects and disseminates data needed to make informed recommendations regarding the state status, state rank, and conservation of Vermont's reptiles and amphibians.
- Trust for Public Land
  The Trust for Public Land works with Vermont communities to protect the land and waters that matter most to them – to balance growth with conservation, reduce risk of flooding, attract tourists, support local economies, ensure access to trails and streams, preserve water quality, and protect the land that wildlife needs to thrive in a changing climate.

2. Explore options to work cooperatively to study and manage the Spotted Turtle in Vermont

- The American Turtle Observatory
- The Orianne Society
- Regional Cooperative State Wildlife Grant project on Spotted Turtle under the direction of Liz Willey
- Regional Conservation Need (RCN) turtle project under the direction of Mike Jones

Fundraising

Explore future funding opportunities such as:

- Recovering America's Wildlife Act (RAWA) legislation
  RAWA would redirect $1.3 billion of existing revenue annually to state-led wildlife conservation efforts, effectively allowing the states to more fully implement their State Wildlife Action Plans.
- State Wildlife Grants (SWG)
  The SWG program provides Federal grant funds to state fish and wildlife agencies for developing and implementing programs that benefit wildlife and their habitats, including reptiles and amphibians
- Competitive State Wildlife Grants
  The CSWG program provides states, the District of Columbia, Commonwealths, and territories Federal grant funds for the development and implementation of programs for the benefit of wildlife and their habitats, including species that are not hunted or fished.
- Regional Conservation Needs (RCN)
  The purpose of the RCN grant program is to address critical landscape-scale wildlife conservation needs by combining the resources of numerous wildlife management agencies, leveraging funds, and prioritizing conservation actions identified in State Wildlife Action Plans.
- Nongame Wildlife Fund (VFWD)
  Helps protect and restore Vermont's nongame wildlife for all Vermonters to enjoy.
- Lintilhac Foundation
  Support organizations that are making sustainable, positive change for Vermont's environment and its people and providing Vermonters the information and resources they need to control their environmental destinies and strong traditions of democratic engagement.
- Natural Resource Conservation Service (NRCS)
  NRCS provides America's farmers and ranchers with financial and technical assistance to voluntarily put conservation on the ground, not only helping the environment but agricultural operations, too.
- Vermont Housing and Conservation Board
  Create affordable housing for Vermonters, conserve and protect Vermont's agricultural land, forestland, historic properties, important natural areas and recreational lands.
- National Fish and Wildlife Foundation (NFWF)
  NFWF works with both public and private sectors to protect and restore our nation's fish, wildlife, plants, and habitats.
- American Wildlife Conservation Foundation
  Provides grants supporting research and public education towards enhancing scientific wildlife management and conservation of wild habitats in North America.
- American Turtle Observatory
  Has a grants program to support landscape conservation for North American freshwater turtles.

- Turtle Conservation Fund
  The Turtle Conservation Fund is a strategizing and funding partnership coalition of leading turtle conservation organizations and individuals focused on ensuring the long-term survival of tortoises and freshwater turtles.
- Private foundations and businesses

List of high priority actions

Reinforce the need to keep locations confidential when discussing Spotted Turtles with landowners.

Monitoring is needed for detecting problems that should be addressed in a timely manner (threat monitoring).

If an incidental encounter was reported in an area that had potential habitat, we would try to verify if a population exists.

Prioritize parcels for acquisition or easement based on likelihood of turtle occupation, threat of habitat loss, and landowner receptiveness.

Continue to acquire core wetlands.

Maintain and monitor nesting pits along railroad tracks.

Maintain and enhance internal communications with law enforcement and biologists to build awareness and support for turtle protection.

Encourage use of the Vermont Reptile and Amphibian Atlas by a wider array of Vermont citizens and highlight its importance in the identification, protection and survival of Spotted Turtles and other Species of Greatest Conservation Need.

Leverage relationships with The Orianne Society, ECHO Leahy Center, through the Reptile and Amphibian SAG, and with other partners to raise awareness and promote conservation of Spotted Turtles in a careful manner that does not put populations at risk.

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