



## **Conservation and Management of the Great Meadows Population of Blanding's Turtles, *Emydoidea blandingii*, in Concord, Massachusetts**

### **Final Report of 2014 Accomplishments and Observations**

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**Final Report for 2014**

**I. Introduction**

2014 was the 12<sup>th</sup> consecutive year in which Bryan Windmiller and colleagues, in partnership with the United States Fish and Wildlife Service, the Town of Concord, and other project collaborators, have been monitoring and managing a Blanding's turtle population occupying lands within and adjacent to Great Meadows NWR in Concord, Massachusetts. This same population of Blanding's turtles was studied in the 1970's and 1980's by Terry Graham and colleagues (Graham and Doyle, 1976). Though it is still one of the largest populations known in New England, the adult population of Blanding's turtles at Great Meadows has declined by nearly 60% from approximately 115 adults in 1973 to approximately 50 currently.

Now, under the management of Grassroots Wildlife Conservation, the primary goal of the Great Meadows Blanding's Turtle Conservation Project is to fully restore this regionally significant population to 200 or more adults within the next 20 years. Additional major project goals include:

- Using the Blanding's conservation project as a means to educate and engage as many children and adults as possible about local rare species conservation issues and about their own abilities to actively participate in protecting their natural heritage.
- Developing this project as a model that can be adapted to citizen-participation conservation efforts for Blanding's and other rare turtle species.
- Working to enhance the habitat at Great Meadows for Blanding's turtles and other vulnerable wildlife species.
- Securing, and if possible enhancing, other smaller Blanding's turtle populations in the region, including through the use of targeted turtle reintroductions.

More information on the background and objectives of the Great Meadows Blanding's Turtle Conservation Project can be obtained by contacting Dr. Bryan Windmiller of Grassroots Wildlife Conservation.

## **II. New Conservation Initiatives in 2014**

### **A) Estabrook Woods Reintroduction**

In June 2014, after seven years of discussion, we were able to begin a significant new phase of the Great Meadows Blanding's Turtle Conservation Project, the reintroduction of Blanding's turtles to extensive habitat in nearby Estabrook Woods in Concord and Carlisle, MA. Located less than one mile from the western edge of the Great Meadows impoundments, Estabrook Woods is a roadless, mostly forested area of about 2,000 acres. The land is owned by a variety of owners, the largest ownerships including Harvard University, Town of Concord, Town of Carlisle, Concord Land Conservation Trust, Carlisle Conservation Foundation, and Neil and Anna Rasmussen.

Given its close proximity to Great Meadows and the presence of a number of large suitable wetlands, it is highly probable that Blanding's turtles once occupied Estabrook Woods and moved regularly across the Concord River to and from the Great Meadows area. Estabrook Woods, however, is only likely to support Blanding's turtles when beavers are present, since they are able to modify the otherwise shallow wetlands of the area into deeper and more extensive open marsh habitat. After having been extirpated from the area for likely more than 300 years, beavers recolonized Estabrook Woods about 30 years ago. Currently there are a variety of excellent areas of beaver-modified Blanding's turtle habitat in the Woods, especially east of Mink Pond.

Throughout the past summer, we released a total of 13 headstarted juvenile Blanding's turtles into four Estabrook Woods wetlands and radio-tracked seven of them through the following autumn. We report on the movement and fate of those turtles below.

### **B) Habitat Enhancement at Great Meadows**

As we have noted in past reports, the decline of the Great Meadows Blanding's turtle population at Great Meadows appears to have been caused primarily by the poor rate at which young Blanding's turtles have been surviving to breeding age. Adult

Blanding's turtles at Great Meadows enjoy relatively high rates of survival despite the proximity of busy roads and many of these adults are old, with known ages of *at least* 50 – 65 years of age. In contrast, we have found few teenage and younger Blanding's turtles over the past 11+ years (see discussion below).

We believe that a primary limiting factor for the survival and growth of young juvenile Blanding's turtles at Great Meadows is the scarcity of dense wetland shrub habitat in the impoundments. Over the years, we have observed that released headstarted juveniles in the impoundments predominately chose habitat amidst dense wetland shrubs. We have made similar observations now at nearby Moore's Swamp and in Estabrook Woods, and Jared Green, of the University of Georgia and USFWS, reports generally similar findings at wetlands in the Assabet River National Wildlife Refuge. Additionally, a comparison of growth rates for released headstarted turtles in Moore's Swamp, which has a great abundance of woody cover, and the Great Meadows impoundments, which have little in the way of dead or live shrubs, has shown that young juveniles grow much faster in the dense cover of Moore's Swamp. Such rapid growth is likely a very important survival advantage for young Blanding's turtles, whose best path to survival is to grow quickly to a sufficient size that allows them to escape predation from many avian, mammal, fish, reptile, and amphibian predators.

Given the above, in 2014, we began to work with USFWS and the Massachusetts Division of Fisheries and Wildlife (who funded this initiative) to develop methods to increase the abundance of wetland shrub habitat in the Great Meadows impoundments. Eventually, we hope to greatly increase the number of shrub "islands" and "peninsulas" scattered throughout the impoundments. At the same time, we hope to work with USFWS on ways to greatly reduce the overgrowth of non-native American lotus (*Nelumbo lutea*), which currently covers almost the entirety of the open sections of the impoundments during the summer and autumn months. By doing so, we believe that we would not only increase the habitat value at Great Meadows for Blanding's turtles, but also for many species of birds, reptiles, amphibians, and invertebrates, including several species of rare marsh birds that occur at Great Meadows. These habitat enhancement measures would also enhance visitor experience by affording nature observers on the cross dike and other trails a view over a more diverse landscape in terms of both vegetation structure and the animal species utilizing the area.

We have prepared a separate report on the methods and early results and observations of the vegetation enhancement work that we did in cooperation with USFWS in 2014.

### **III. Monitoring and Management Activities – 2014 Field Season**

#### **A) Telemetry and Survival Analysis**

##### **1) Adult and Older Juvenile Blanding's Turtles**

In 2014, we found, by happenstance, one previously unmarked adult female and two unmarked older juveniles (>5 years of age and not previously headstarted). Since 2003, we have now captured a total of 24 individual adult females, 21 adult males, and 15 non-headstarted juveniles.

Of those 60 non-headstarted individuals captured, at least 7 have died in the past 11+ years.

Currently, we do not radio track adult male Blanding's turtles at Great Meadows, and generally relocate adult females only 1-2 times annually exclusive of nest surveys. In the 2014 field season, we recorded a total of 32 non-nesting observations on the location, size, and health of 21 different adult and older juvenile turtles. Most of these observations were made through the use of radiotelemetry.

We began 2014 with radio transmitters attached to 15 adult female Blanding's turtles, but lost four of those to our study: one through radio detachment and three through the deaths of the females. Including a late 2013 mortality, we recorded the deaths of four female Blanding's turtles in the space of one year. This is a starkly unusual observation. In the previous 11 years of study, in which we had variously tracked 24 adult females at Great Meadows, we had only found two of them dead. We strongly suspect that disease was a factor in the recent recorded deaths. Notably, all the 2013-2014 deaths and five of six overall deaths recorded since 2003 among adult females occurred among the oldest cohort of Blanding's turtles, those that had been marked, generally as adults, in the 1970's and 1980's. The individuals in this older cohort are known to have been at least 50-65 years of age in 2014; some may have been much older.

#### **Table 1: Captures of Adult and Older Juvenile Blanding's Turtles at Great Meadows in 2014**

Category	# Captures	# Turtles Captured	Notes
Adult Males	4	3	Encountered serendipitously, without radiotelemetry or trapping.
Adult Females*	24	14	3 found dead, 1 radio became detached, 1 new (unmarked) female found.
Older Juveniles**	5	5	2 previously unmarked individuals found (one in a trap).

\* Exclusive of observations made during nesting.

\*\* Exclusive of headstarted individuals.

To date, we have radio-tracked 40 individual adult Blanding's turtles for continuous periods ranging from 0.2 to 10.2 years, accumulating a total of 161.7 turtle-years of telemetry observations. Using these data and the Kaplan-Meier survival analysis, we have calculated that an individual radio-tracked Blanding's turtle has a 92.0% probability of being alive four years after its first observation. Annualizing this figure yields an estimated 97.9% probability of survival for one year from the last observation. Despite the newly observed deaths in 2014, the survival rate of adult Blanding's turtles at Great Meadows is very high compared to the eight independent values reported by Congdon *et al.* (1993) for a Michigan population (range of 91.5 – 94.5%). Our observations suggest that between-year survival rates for adult Blanding's turtles are generally extremely high, but that very old turtles (>50 or 60 years of age) may be vulnerable to death from periodic disease outbreaks or other environmental causes. One such disease outbreak was observed in 2009, which led to the deaths of two older adults (one male, one female) and would have killed two others had we not intervened and brought them to receive veterinary care. Thus mortality rates for old age cohorts may be episodically much higher than for the overall population.

## 2) Released Headstarted Juveniles

In the 2014 field season, we recaptured 28 individual juvenile Blanding's turtles that had been headstarted and then released to Great Meadows and Estabrook Woods between the years of 2009 and 2014 (cohorts are named according to their hatch year, not their release year). Nine of these turtles had been released more than three years earlier. Among the 28 individuals recaptured, one was found dead, possibly

the victim of mammalian predation.

To date we have placed radios on 91 headstarted turtles upon their release in the past seven years. These turtles have been successfully tracked for a cumulative total of 90.2 turtle-years (mean tracking period of 358 days per individual). Within that period of time, 14 of the turtles have been found dead<sup>1</sup>. Of these: 7 were likely the victims of predation, 6 apparently drowned in the exceptional flooding event of late March - early April, 2010, and 1 was hit by a car on Route 62.

Using the Kaplan-Meier survival analysis, we estimate the following annual survival parameters for headstarted Blanding's turtles after release:

**Table 2: Estimated Annual Survival Probability for Headstarted Blanding's Turtles at Great Meadows**

<b>Period After Release</b>	<b>Number Tracked at Start of Year</b>	<b>Observed Annual Survival Probability</b>	<b>Lower Confidence Limit</b>	<b>Upper Confidence Limit</b>
First Year	91	0.87	0.78	0.94
Second Year	22	0.95	0.94	0.97
Third Year*	13	1.00	n/a	n/a
Fourth Year*	7	1.00	n/a	n/a

\*To date, no radiotracked headstarted turtles have been found dead during their third, fourth, or fifth years following release.

The above survival estimates are extremely high for young turtles. Comparing our data with published values estimating annual juvenile survival and survival during the egg stage for Blanding's turtles (Congdon et al., 1993), we currently estimate that nest protection and headstarting efforts at Great Meadows confer a more than 40-fold advantage in odds of survival to adulthood for each individual that we headstart.

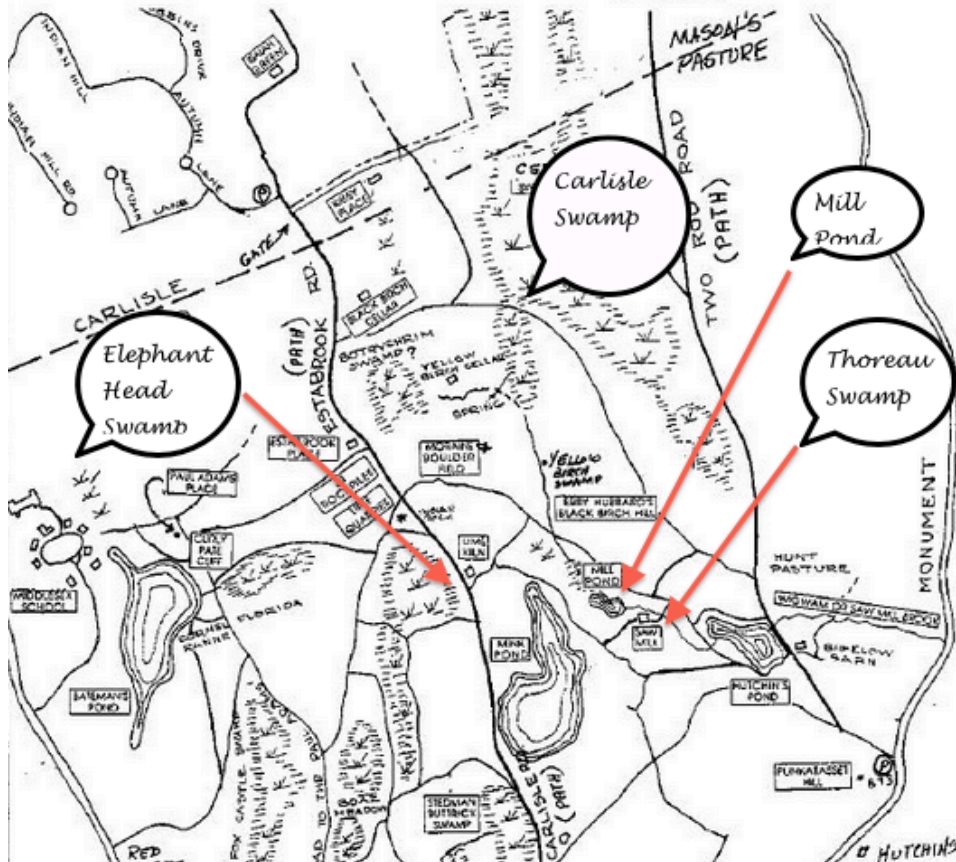
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<sup>1</sup> In keeping with standard practices, we here report only turtles actually found dead. In the past we counted as dead 4 individuals, whose radio transmitters were found with no evidence of a turtle but with marks indicating bites or scratches on the radio's epoxy surface. However, we have since recorded two instances in which turtles were recaptured alive and well after finding their detached radios with chew marks. This is the same standard being applied to survival estimates for Blanding's turtles by USFWS researcher, Jared Green, at ARNWR.

## B) Juveniles Released in Estabrook Woods

We released 13 headstarted juvenile Blanding's turtles in four different Estabrook Woods wetlands during the summer of 2014 (see Fig. 1). Seven of these reintroduced turtles were fitted with radio-transmitters and were, jointly, recaptured a total of 15 times in the summer and autumn of 2014. All seven were alive and seemingly well when last observed.

**Figure 1: Map of Estabrook Woods Release Locations**



Base map by Stephen Ells

The distance moved between release and our last observation of the radio-tracked turtles in 2014 varied by the release wetlands (Table 3). The turtles released at Mill Pond barely moved over the 100+ days that we tracked them over the summer and fall (mean of 19 meters from release location). Conversely, the two tracked turtles released at Carlisle Swamp moved 436m and 851m (average of 643m) from their release locations. The three radio-tracked turtles released at Thoreau Swamp were intermediary, having moved an average of 97m between their release and their last points of capture in 2014. One of the turtles released in Thoreau Swamp made its way to the Mill Pond and stayed there for the rest of the fall.



**Table 3: Net Movements of Seven Headstarted Blanding's Turtles Released in Estabrook Woods in 2014**

ID #	Release		Final Capture		Days	Distance travelled (m)
	Location	Date	Location	Date		
1059	Mill Pond	6/30	Mill Pond	10/14	106	16
1035	Mill Pond	6/30	Mill Pond	10/14	106	22
3333	Thoreau Swamp	8/7	Thoreau Swamp	11/1	86	44
316	Thoreau Swamp	8/7	Thoreau Swamp	10/27	81	60
321	Thoreau Swamp	8/7	Mill Pond	9/29	53	186
313	Carlisle Swamp	8/7	Yellow Birch	9/22	46	436
330	Carlisle Swamp	8/7	N. Carlisle Swamp	10/20	74	851

C) Nesting and Headstarting

In 2014 we found and protected six nests of 11 radio-tagged adult females. The remaining five females either did not nest, or may have been missed by our nest monitors. Summary data for clutch size and hatching success for the period 2008-2014 are provided in Table 4, below:

**Table 4: Clutch Size and Hatching Success for Protected Blanding's Turtle Nests at GMNWR**

Hatch Year	# Nests Monitored	Total Eggs	Total Emerged	% Eggs Surviving to Emergence
2008	6	65	44	67.7
2009	8	83	67	80.7
2010	10	102	93	91.2
2011	5	50	29	58.0
2012	9	88	73	83.0
2013	11	111	74	66.7
2014	6	71	61	85.9
<b>Totals</b>	<b>55</b>	<b>570</b>	<b>441</b>	<b>76.1</b>
<b>Mean # Eggs per nest</b>	10.4			
<b>Mean # live emergences/nest</b>	8.0			

In the 2013 - 2014 headstarting year, we headstarted 58 hatchling Blanding's turtles from the Great Meadows population into our headstarting program, in addition to two turtles that were kept for a second year from the 2012-2013 cohort. All of those 60 survived to release in early summer 2014.

In September 2014, we entered 61 hatchling Great Meadows Blanding's turtles into our headstarting program<sup>2</sup> at the following institutions: Zoo New England, Concord Public Schools, Concord-Carlisle High School, Pike School, Carlisle School, Hill View Montessori, Qualters Middle School, Weston High School and Bates Elementary School. Additionally, GWC is currently overseeing the care of hatchlings from Oxbow NWR at the New England Aquarium, Groton-Dunstable High School, Quinn Middle School, Lynn Classical High School, Hillside School, and Ephraim Curtis Middle School. To date, one of the hatchlings died during headstarting.

#### **IV. Plans for the 2015 Field Season and Onwards**

In 2015, we plan to:

- 1) Continue headstarting our current cohort of juveniles, which are scheduled for release near the beginning of June 2015.
- 2) Release 20 more headstarted juvenile Blanding's turtles into Estabrook Woods, placing radios on up to 10 of these turtles.
- 3) If we can find funding, build upon last year's habitat enhancement measures at the Great Meadows impoundments, monitoring the results of last year's work and considerably increasing the scale of the project.
- 4) Track as many females as possible to their nesting sites, protect their nests, and headstart as many hatchlings as we are permitted for the 2015-2016 headstarting season.
- 5) Begin phasing out telemetry of formerly headstarted turtles at Great Meadows, reducing the total number tracked at GM and adjacent locations to perhaps 10-1 individuals.
- 6) Continue to work with the Town of Concord to manage Moore's Swamp, a critical habitat area, especially for juvenile Blanding's turtles, in a way that is as favorable as possible to the recovery of the Blanding's turtle population.

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<sup>2</sup> In total, 61 hatchlings emerged from protected nests in 2014, and a 62<sup>nd</sup> hatchling was found dispersing from an unprotected nest. One hatchling died before distribution into the headstarting program.

We also remain interested in the possibility of the following long-discussed initiative:

- 7) Create pens for “soft-releases” of headstarted turtles into protected transitional habitat where they can be kept safe from predators and fed with supplemented indigenous invertebrates for at least 6 weeks after release from their headstarting aquaria.

Additionally, we hope to begin working at one or two new Blanding’s turtle population sites in 2015, expanding our model of citizen-participation active conservation management. We are currently discussing the possibility of beginning work to protect nests, and possibly headstart hatchling Blanding’s turtles at Borderlands State Park in Easton, MA and in the vicinity of Groton Dunstable Regional High School in Groton, MA.

Overall, our goals for the Great Meadows population are to assist in the recovery of the population to a level at least as high, if not well above the 115 adult turtles estimated to live there in 1973. We believe that the area can easily accommodate 200 adults. For now, we plan to continue headstarting Blanding’s turtles until approximately 2025. Ultimately, we hope that by:

- A) Increasing the number of juveniles recruited eventually into the adult population,
- B) Improving Blanding’s turtle habitat quality in the Great Meadows impoundments, and other nearby areas,
- C) And working with local private landowners to increase their commitment to the stewardship of the local Blanding’s turtle population

we can help foster the recovery of a large Blanding’s turtle, exceeding 200 adults at Great Meadows and Estabrook Woods combined, that will be sustainable without future headstarting but likely with some degree of continued monitoring and nest protection.

## V. Acknowledgements

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More than 20 teachers and over 1,000 students made our conservation work possible by raising Blanding's turtle juveniles skillfully and successfully. Many people in the vicinity of Great Meadows also assisted by graciously accommodating nesting Blanding's turtles and the biologists tracking them on their properties and by keeping us posted on the movements of the turtles.

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## VI. References Cited

Congdon, J. D., A. E. Dunham, and R. C. Van Loben Sels. 1993. Delayed sexual maturity and demographics of Blanding's turtles (*Emydoidea blandingii*): implications for conservation and management of long-lived organisms. *Conservation Biology* 7(4):826-833.

Congdon, J. D., R. D. Nagle, O. M. Kinney, M. Ostenoski, H. W. Avery, R. C. Van Loben Sels, and D. W. Tinkle. 2000. Nesting ecology and embryo mortality: Implications for hatching success and demography of Blanding's turtles (*Emydoidea blandingii*). *Chelonian Conservation Biology* 3:569-579.

Graham, T. E., and T. S. Doyle. 1977. Growth and population characteristics of Blanding's turtles (*Emydoidea blandingii*) in Massachusetts. *Herpetologica* 33:410-414.