Study of the aquatic turtles within Lake Marburg, with emphasis on red-bellied turtles (*Pseudemys rubriventris*) – 2014

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Executive Summary:

A population of red-bellied turtles resides within Lake Marburg (Hanover, PA) and is of interest given the threatened status of red-bellied turtles in Pennsylvania. Aquatic turtles were studied within Lake Marburg during 2014 to continue to refine the population sizes and movements of turtles within the lake and to attempt to identify any additional locations where the threatened red-bellied turtles might be found within and around the lake. Environmental data was collected from several coves in the lake and turtles were observed on basking platforms and studied by mark-recapture.

Based on our observations of basking platforms, it appears that red-bellied turtles most commonly used Marburg Flats, Wildasin Cove, Chapel Cove, Dubs Cove, Sailboat Cove and Black Rock Flats. Despite a systematic effort to sample additional coves, red-bellied turtles were not observed basking in other locations. Based on mark-recapture data, the Schnabel method was used to estimate a red-bellied population size of 26 turtles for Lake Marburg (95% confidence interval 9-95).

The results of the basking study this year indicate that a citizen science program may be useful in providing additional data. Such a program would utilize a secondary marking method for captured turtles to make turtle identification easier from a distance. Community members could document turtles when observed and provide the information through e-mail. Citizen science programs provide several benefits, including increased data collection and increased community education. The results from this increased effort will help better define how red-bellied turtles utilize the lake and may help identify any additional locations of high red-bellied turtle activity. There are a number of state agencies and both groups and individuals within the community that are invested in maintaining and increasing the population of red-bellied turtles within Lake Marburg so now is an optimal time to pilot a citizen science program.

Background:

Lake Marburg is a reservoir located within Codorus State Park in southwest York County. It is approximately 515 ha, with 46 km of shoreline. Within the lake, several species of aquatic turtles can be found, including red-bellied turtles (*Pseudemys rubriventris*), painted turtles (*Chrysemys picta*), and red-eared sliders (*Trachemys scripta*). Red-bellied turtles are of particular interest within the lake as they are considered a threatened species within Pennsylvania. They are believed to be threatened primarily as a result of habitat loss. They require deep water locations, with soft bottoms, plentiful basking locations and an abundance of aquatic vegetation. These are quite similar to the requirements needed by painted turtles and red-eared sliders as well (Ernst *et al.* 1994). Red-eared sliders are an invasive species, introduced through the pet trade. There has been some concern, although no proof, that red-eared sliders might provide competition to the red-bellied turtle populations within Pennsylvania, thereby making it more difficult for these populations to recover (Urban *et al.* 2006).

Basic information about the population of red-bellied turtles within Lake Marburg, such as the population size and nesting characteristics, are not known. Nesting of red-bellied turtles was recently studied in the Patuxent River, MD (Swarth 1999), approximately 150 km to the south of Lake Marburg. The turtles in this population nested between mid-May and mid-July. The females nested between 10 and 225 m of the river at the edges of fields with ample sunlight, sandy soil and available leaf litter. Many turtles in study by Swarth (1999) showed nest site fidelity. Of the 78 turtles that were marked, 14 were seen again on the same nesting grounds. Some degree of nest-site fidelity has also been seen in painted turtles (Rowe *at al.* 2005, Janzen and Morjan 2001) and red-eared sliders (Tucker 2001). Whereas, high variability in nest-site fidelity between individual painted turtles was observed, with some turtles returning to sites within 2 m of their previous nests and others showing no fidelity (Rowe *at al.* 2005), very high nest-site fidelity was found in red-eared sliders, with more than 90% of the turtles that were recaptured nesting in the same area as their previous nests (Tucker 2001). Nest site fidelity may be influenced by the turtles' tendency to nest in suitable locations close to their aquatic home ranges. Some painted turtles and red-eared sliders have been found to nest in the nearest location that provides suitable nesting habitat, although others have been shown to travel longer distances (Rowe *et al.* 2005, Ernst *et al.* 1994). A better understanding of the aquatic home range size of turtles within Lake Marburg and their nest-site fidelity can have important implications for management.

Objectives:

The objectives of this study were:

1. To document the occurrence of red-bellied turtles, painted turtles, red-eared sliders, and yellow-bellied sliders within Lake Marburg and estimate population size.
2. To document the movement of red-bellied turtles, red-eared sliders and painted turtles within Lake Marburg in order to help identify home range size and potential nesting locations.
3. To investigate possible competition between red-bellied turtles and red-eared sliders and/or yellow-bellied sliders.

Methods:

We studied the aquatic turtle populations within Lake Marburg from April through August 2014. We placed baited traps in the lake to capture the turtles. The baited traps were modified crab traps. They had been modified to increase the size of the organism that could enter/exit the trap. Floats were also attached to the outside of the trap to ensure that 2 inches of the trap remained above the surface of the water so the turtles could breathe. The traps were baited with canned sardines. The traps were placed in the vicinity of the established basking platforms and were checked every 24 hours. Baited traps were deployed in Dubs Cove, Chapel Cove and the Girl Scout camp pond each week in June and early July.

When turtles were trapped, the following measurements /observations were taken:

-Species identification and sex

-Straight-line carapace length, width and shell height to the nearest mm using Haglof calipers

-Weight to the nearest 100 g using a hand-held scale

-Shell damage, scarring and algal growth
-If previously uncaptured, turtles were marked by filing notches into their marginal scutes (Ernst *et al.* 1974). If previously captured, the identification of the turtle was noted.

All measurements and marking were done in the field and turtles were immediately released in order to minimize impact.

We also observed turtles basking this season. Observations were made throughout the lake at all available basking platforms/natural basking locations to try to identify where in the lake red-bellied turtles were found. Observations were made once per week through June and July. In addition, the pond at the adjacent Girl Scout camp was also monitored. Observations of basking turtles were made when the conditions were favorable for basking (days were sunny and not too hot). Observations were made with binoculars or a spotting scope and the number and type of turtle basking were recorded.

Population estimates were made using the Schnabel Method (1938):

$$N = \frac{\sum_t (C_t M_t)}{\sum_t R_t}$$

Where C_t is the total number of turtles caught in sample t, M_t is the number of marked turtles in the population just before sample t is taken and R_t is the number of turtles already marked when caught in sample t.

Results:

1. Basking data: One focus of data collection this year was to investigate where in the lake red-bellied turtles could be seen basking. Historically, we have found them most often in a few coves, including Marburg Flats, Wildasin Cove, Chapel Cove, Dubs Cove, Sailboat Cove and Black Rock Flats. There are a number of smaller coves throughout the lake where red-bellied turtles could reside. In addition, members of the community have reported seeing red-bellied turtles in several nearby water bodies, including the pond at the Girl Scout Camp and at a nearby abandoned quarry. The goal of the observational monitoring was to determine if there were other locations within the lake or nearby where red-bellied turtles were frequently seen. Red-bellied turtles were observed in all of the coves where they have been historically observed. Of note, a young red-bellied turtle was observed in Wildasin Cove. This is only the second juvenile red-bellied turtle observed, but does indicate that reproduction is likely occurring within the Lake. Despite weekly monitoring throughout June and July, which should be an active swimming and basking time, red-bellied turtles were not observed in any additional coves. Only painted turtles were observed at the Girl Scout camp pond.

2. Mark-recapture data: Over the course of the past 6 years, 246 turtles have been marked (Table 1). Of these turtles, 192 have been painted turtles, 35 were red-eared sliders and 12 were red-bellied turtles. Several of the painted turtles captured this year were in the Girl Scout camp pond. The mark-recapture data allowed us to make estimates of population size for the aquatic turtles within the lake (Table 2). Red-bellied turtles have a very small population size estimate of 26 (95% CI 9-95). As expected, the painted turtles had a large population size, with an estimate of 201 turtles. However, most of these turtle captures were concentrated in 3 coves (Dubs, Chapel and Sailboat Cove) indicating

that it is likely an underestimate of the lake-wide population. Red-eared sliders also had a large population size, with an estimate of 170 turtles (95% CI 71-498).

Discussion and future recommendations:

1. Basking data: The basking studies from this year highlighted two important factors. First, it confirmed which coves within the lake are most heavily used by red-bellied turtles. Knowing this information is important for successfully managing the population and for directing future research plans. In addition, the study highlighted the difficulty in monitoring the red-bellied turtles over such a large area with limited personnel. Our past research has demonstrated that the red-bellied turtles can swim the length of the lake in less than a week. Thus, following the movements of the red-bellied turtles can be difficult when it is unknown where and how they will move in the lake.

Prior to my involvement in researching the turtle population, a citizen-based science project was attempted. The plan was for trained observers to visit designated basking platforms around the lake and report the number and type of turtles that they observed basking. Unfortunately, the program was unsuccessful for a few reasons. The distance between the basking platforms and observation locations on land is often great enough to require high-powered binoculars. In addition, identification of turtle species is difficult given the similarities between the basking turtles within the lake. This meant that most citizens had difficulty identifying the turtles at such a distance.

Although this previous attempt at citizen science was unsuccessful, there were several very positive aspects of engaging in such a plan. There are a large number of community members and groups that are invested in increasing the population of red-bellied turtles within the lake. These community members frequently offer to help monitor the population. In addition, citizen science raises awareness of the issue within the community. So, those not aware of the need to protect red-bellied turtles or the harm that can result from releasing invasive species in the lake, may learn through such a citizen outreach effort.

One way that it may be possible to approach a citizen science project is by using a supplementary marking method. The notching method we have used since starting the program is the best practice for marking turtles. The marks are permanent and a large number of turtles can be marked. However, these notches cannot be observed at a distance. Several secondary marking methods have been used to number turtles, including nail polish (Davis and Burghardt 2007) and sharpies (personal communication, National Aquarium at Baltimore). Although these methods only last for a few months, they make it possible to identify individual turtles from a much greater distance. A secondary marking method could, therefore, make it possible to include community members in the monitoring program.

Such a program could involve citizen scientists photographing turtles that are numbered when they observe them basking on a platform. They would then e-mail the photo, along with information on the locations, day and time so the observations could be collected and compiled. The results from this increased effort should help us better define how red-bellied turtles utilize the lake and may help identify and additional locations of high red-bellied turtle activity.

2. Turtle populations: Over the 6 years, our population estimates for red-eared sliders have remained consistently higher than the estimates for red-bellied turtles. However, these differences are not

significant as the 95% confidence intervals overlap. There are significantly more painted turtles than red-bellied turtles in the lake. In the past, our population estimates reflect the trends we saw in basking turtles, with the most painted turtles followed by red-eared sliders. We typically observed relatively few basking red-bellied turtles or yellow-bellied turtles. Stone (2010) has suggested that in Southeastern Pennsylvania, trends in the number of basking aquatic turtles reflect trends in population abundances. Capture with more varied trapping methods (including hoop traps) as well as continued monitoring of basking at different times of day and in more coves around the lake will help to continue resolve the population abundances and trends in the lake.

Future directions

Today the red-bellied turtle population within Lake Marburg faces several potential threats. Adult, female turtles experience road mortality as they leave the water to lay their eggs. They may also be impacted by tractors when nesting locations are chosen within agricultural fields. Nest predation by foxes and raccoons may be elevated due to increased mesopredator abundances in PA (a result of plentiful food sources and a lack of natural predators). Hatchling turtles may be impacted by vehicles, tractors or lawn mowers or may be caught by dogs on their way to the lake. Within the lake, loss of basking locations due to waterline fluctuations, accidental catches by fishers and increased recreation, especially by motorized boats, have the potential to impact the population. Finally, invasive turtles, fish and plants within the lake may impact predator-prey and competitive interactions with other species.

Given the number of potential threats, several conservation actions can be considered...

1. Education of the community should be a priority. These education efforts should focus on reducing the continued introductions of invasive species to the lake and improving accurate identification of red-bellied turtles through a citizen science program to help protect nesting locations and protect adults from road and fishing mortality.
2. An increased number of basking platforms, especially deeper platforms, should be placed within the lake to ensure adequate basking locations.
3. Scientific monitoring should continue within the lake to establish baselines for future comparison and to help identify nesting locations and potential threats to the red-bellied population.
4. Finally, increased effort should be invested to identify where red-bellied turtles are nesting both on park and private lands and steps, such as caging, should be taken to decrease egg disturbance and hatchling mortality.

There are a number of state agencies, groups and individuals within the community that are invested in maintaining and increasing the population of red-bellied turtles within Lake Marburg so now is an optimal time to begin taking steps towards this goal.

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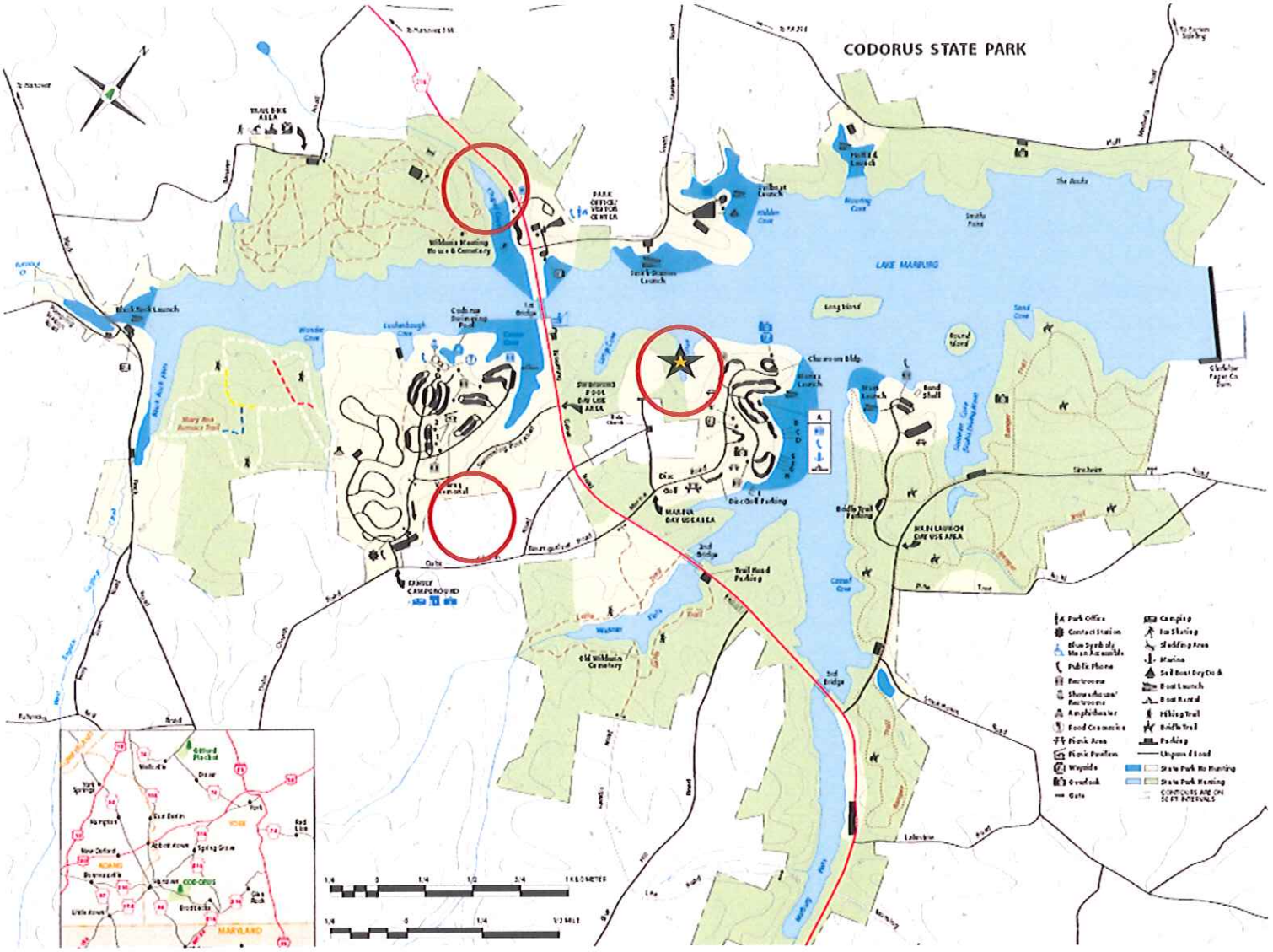

Figure 1: Map of Codorus State Park, York County, PA. Star indicates the location protected by the park for red-bellied turtle nesting. The red circles indicate sampling sites where traps were deployed

Table 1: Turtles captured at Lake Marburg 2009 – 2014 sampling season

Species	Number marked	Number recaptured	Recapture location
Red-bellied turtle	**12**	**2**	**Both female red-bellied turtles were recaptured in different locations then their original captures**
Painted turtle	**192**	**65 (some recaptured multiple times – 135 total recaptures)**	Two females and 3 males were recaptured in different locations. One male turtle moved from Chapel Cove to Dubs Cove and then back again.
Red-eared slider	**35**	**4**	**One female originally captured at Dubs Cove was recaptured at Sailboat Cove**
Yellow-bellied turtle	**7**	**2**	All were recaptured at original location

Table 2: Population estimates for Lake Marburg based on mark-recapture for the 2009 – 2014 sampling season

Species	Population estimate	95% confidence interval
Red-bellied turtle	26	9-95
Painted turtle	201	176-230
Red-eared slider	170	71-498
Yellow-bellied turtle	4	1-20