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Basking Habitats of Painted Turtles (*Chrysemys picta*)

Ellen Munshower

Abstract: Painted turtles, a reptile native to North America, have been known to bask in areas of relatively shallow water with direct sunlight. In our study we looked for notable traits of basking sites being used by painted turtles around Lake Sagatagan in Collegeville, MN. Data was taken at every location that painted turtles were observed basking and was then paired with a random location around the lake to see if there were differences between the specific locations with turtles and the overall lake ecosystem. Through this process we observed that turtles tended to bask in areas of cooler, shallower water, while remaining close to shore. This is suspected to be because turtles need to bask when water is cooler, but not when it is warm enough to maintain the suitable body temperature. Their presence in shallow water near shore was likely due to the existence of potential substrates in areas of shallow water, like trees fallen from shore or rocks big enough to be above the water's surface.

Hypothesis: There is a relationship between habitat features / factors and turtle presence.

Prediction: We expect to find turtles in areas with shallow water and plenty of basking sites.

Introduction

Chrysemys picta, more commonly known as the painted turtle, can be found across the continent of North America, spanning from British Columbia to Nova Scotia to Louisiana (Iverson & Smith 1993). They thrive in wetlands, marshes, lakes and streams of a wide range of sizes, although they tend to prefer slow-moving, shallow water (Rowe 2003).

Because turtles, like all reptiles, are ectoderms, they bask in sunlight to control thermal regulation and dry out, removing ectoparasites (Linebraugh 1995). Basking is a thermoregulatory behavior and thus turtles will tend to bask in habitats that have environmental factors that can enhance heating (Schwarzkopf and Brooks 1985; Rasmussen and Litzgus 2010). Areas with more canopy coverage, for example, block out much of the sun's rays and would be less effective at providing heat to a basking turtle. In a study done by Brown et. al on wood turtles (*Glyptemys insculpta*) (2016), they observed that although the turtle population inhabited a forested landscape, they saw little indication that forested habitat patches were preferred by

wood turtles. They even noted that on average the wood turtles seemed to prefer open-canopy habitats over closed-canopy habitats (Brown et. al. 2006).

If preferable features (e.g. basking sites) are only seen within a specific habitat, then selection at the microhabitat level should mirror selection at the broader macrohabitat scale. In nature, however, patches of ideal microhabitats can be found in different macrohabitat types, thus selection for microhabitats will be more significant than selection of macrohabitats (Rasmussen and Litzgus 2010; Harvey and Weatherhead, 2006). In this study we investigated whether there are notable traits in the habitats of basking sites of painted turtles.

In a study done by Jaeger and Cobb (2012) on both *C. picta* and *Trachemys scripta*, it was observed that shoreline habitat was used the most by both species, with *C. picta* using shoreline above all other habitat choices (*T. scripta* also used open water areas in a lake). More specifically they noted that on average *C. picta* remained approximately 13.6 m from shore and that they rarely went farther than 50 m from the shore or sat in water over one meter deep (Jaeger & Cobb 2012). It is suggested by Jaeger and Cobb (2012) that one reason for *C. picta* preferring to remain close to shoreline is their small size. Larger species of animals on average need more resources than smaller species (Perry and Garland 2002). This can force larger species (in this case *T. scripta*) to move greater distances to maintain a suitable food supply. Because *C. picta* is a relatively small species of turtle it is not governed by this rule (Jaeger & Cobb 2012). Because they do not need to have a large range to maintain a food supply, they can remain in a smaller territory and can be choosier on what sort of habitat they spend most of their time in.

Other studies have noted that turtles of various species may select basking sites with high presence of submerged vegetation and water turbidity. These traits may be better for predator avoidance, or, as suggested by Vignoli et. al. (2015), aquatic vegetation has and influence on

water temperature and this may be an important variable for basking site selection. Many turtles bask in small coves along shoreline of rivers and ponds. Emergent tree trunks have also been seen to be selected by turtles over other substrates such as rocks or floating logs (Vignoli et. al 2015; Lindeman 1999).

Understanding how turtles use their habitats is an important factor for their effective conservation and management (Vignoli et. al 2015). In this study we investigated relationships between the habitats that *C. picta* bask in and the abundance of turtles at the site. We predict that there will be common characteristics between habitats, and turtles will preferentially remain in areas with shallow water and plenty of basking sites.

Methods

The study took place on Lake Sagatagan, located on campus of Saint John's University, in Collegeville, MN (Fig. 1). Lake Sagatagan has a surface area of 71.2 hectares (176 acres) and a maximum depth 12.8 meters with an average depth of 2.74 meters. It has no direct water inputs, and is filled by underground springs and precipitation runoff. The surrounding area is primarily hardwood forest with oaks, maples, birches, and tamarack trees. There are some areas of conifer forest with species of pine. Closer to the water are areas of aquatic vegetation (cattails, water lilies) along the shore and growing in wetlands that link up to the lake. The north edge of the lake borders the campus of Saint John's University and has a small sandy beach (Saint John's Outdoor U).

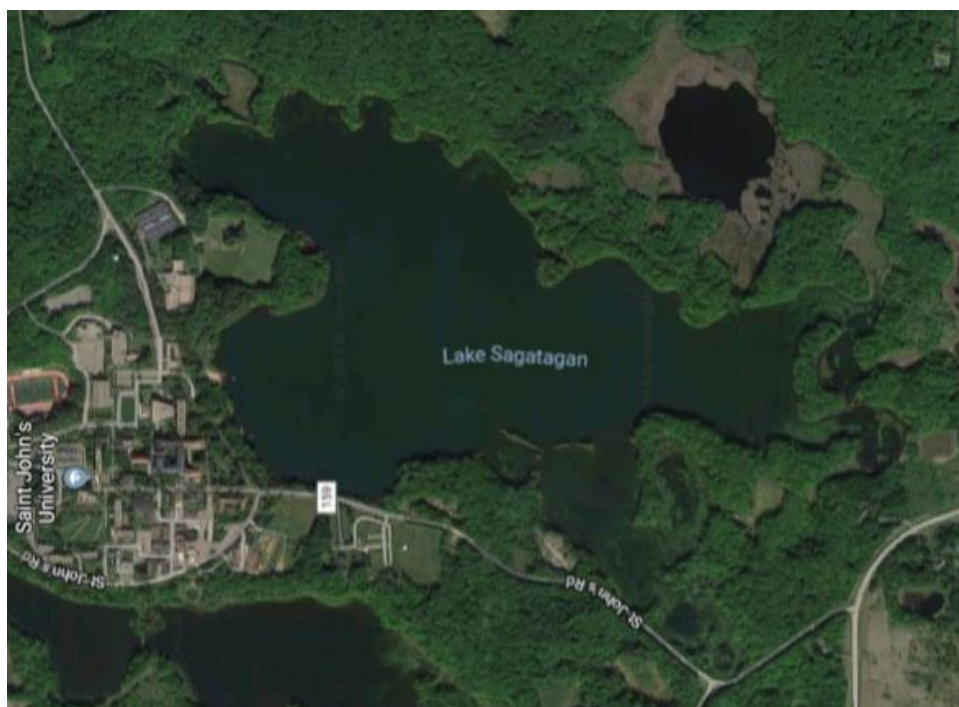


Figure 1. Aerial view of Lake Sagatagan, Collegeville MN. Image retrieved: Google Maps

Sites were located from canoe or on trails that were close enough to the water to see the turtles. Binoculars were used from trails in order to not startle turtles with the sound of crunching gravel. Any site with basking turtles present was measured. A site was defined by the location in the lake (UTM position). Basking areas were defined as the substratum that the turtles were able to bask on, such as a log or rock in the water. The site was reached by either canoe or walking on shore, and then wading into the water to take measurements. One or two researchers equipped with waders would enter the water and record data. The approximate area of the basking site was measured (length*width in meters) with a 50 m tape measure. Researchers would stand one meter away from the closest substratum and measure the distance between the furthest point and enclosing the whole site in a rectangle. The distance from shore was determined by the closest point a turtle was seen basking to shore and the distance was recorded. From there, the person on shore would continue to walk until they reached a site where humans would be present, either a

road or a maintained trail, this distance was also recorded. If either of these distances exceeded 50 m they were recorded as >50 m. Some sites were near islands in the lake and thus had low distances to a shoreline, but a very large distance to anthropogenic features.

For all other recorded data, such as water depth and clarity, measurements were taken in three to five different spots within the basking area, and averaged. The number of measurements taken was dependent on the size of the basking area. For example, an area with three logs each laying some distance from each other, would have several measurements taken in different spots within the basking area. To measure water depth a HawkEye depthtrax was used. Canopy coverage was determined by using a densiometer (CSP Outdoors). Water temperature was recorded at different depths. Temperatures were taken at the surface (~5 cm down) and either 50 cm down or at the bottom of the pond, whichever came first. Water clarity was determined with a Secchi disk. If the disk reached the bottom before becoming obscured, the clarity was recorded to be the same as the depth of the water. The types of plants within the area of the basking site were categorized as follows: Floating (lily pads, duckweed), algae, submersed (any plant that did not break the surface of the water), emergent (any plant that began underwater but grew up and out of the pond but was not floating on the water), or terrestrial (any plants within the basking site that grew out of ground and not from under the water).

A random site was paired with every recorded basking site. Random sites were determined by printing off a map of Lake Sagatagan and overlaying a 1cm x 1cm grid on it (Figure 2).

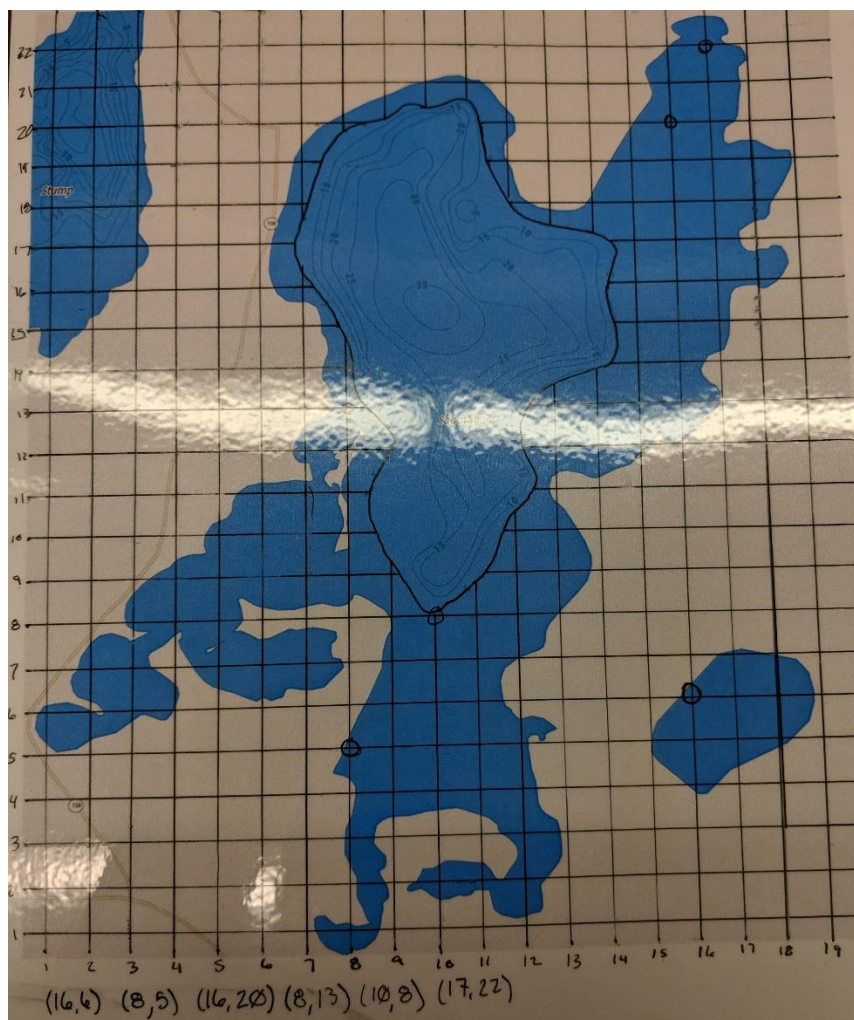


Figure 2. Grid over map of Lake Sagatagan used to select random sites during the study. Collegetown, MN

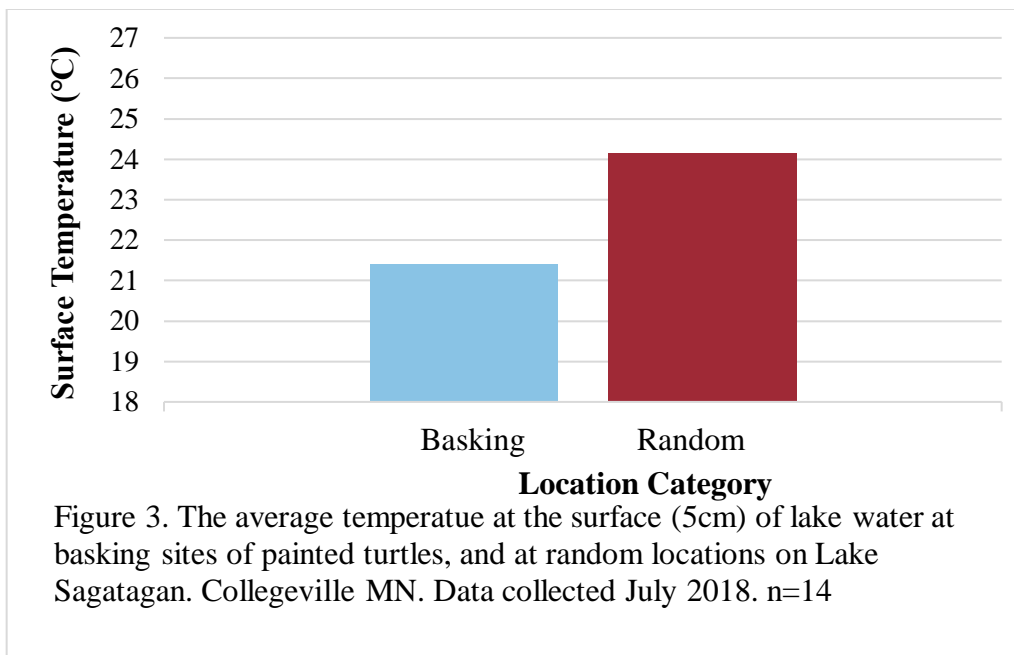
Because it has been recorded that painted turtles do not go into deep water, the gridlines stopped where the depth of Lake Sagatagan hit 5m in depth. Random numbers were generated from random.com and were paired and then used as coordinates. Any point that fell within the waters of Lake Sagatagan and were not within the deep zone were used as a random site. The same data collected from basking sites were collected from these sites. Data was analyzed using a student's paired t-tests (Encyclopedia of Mathematics).

Results

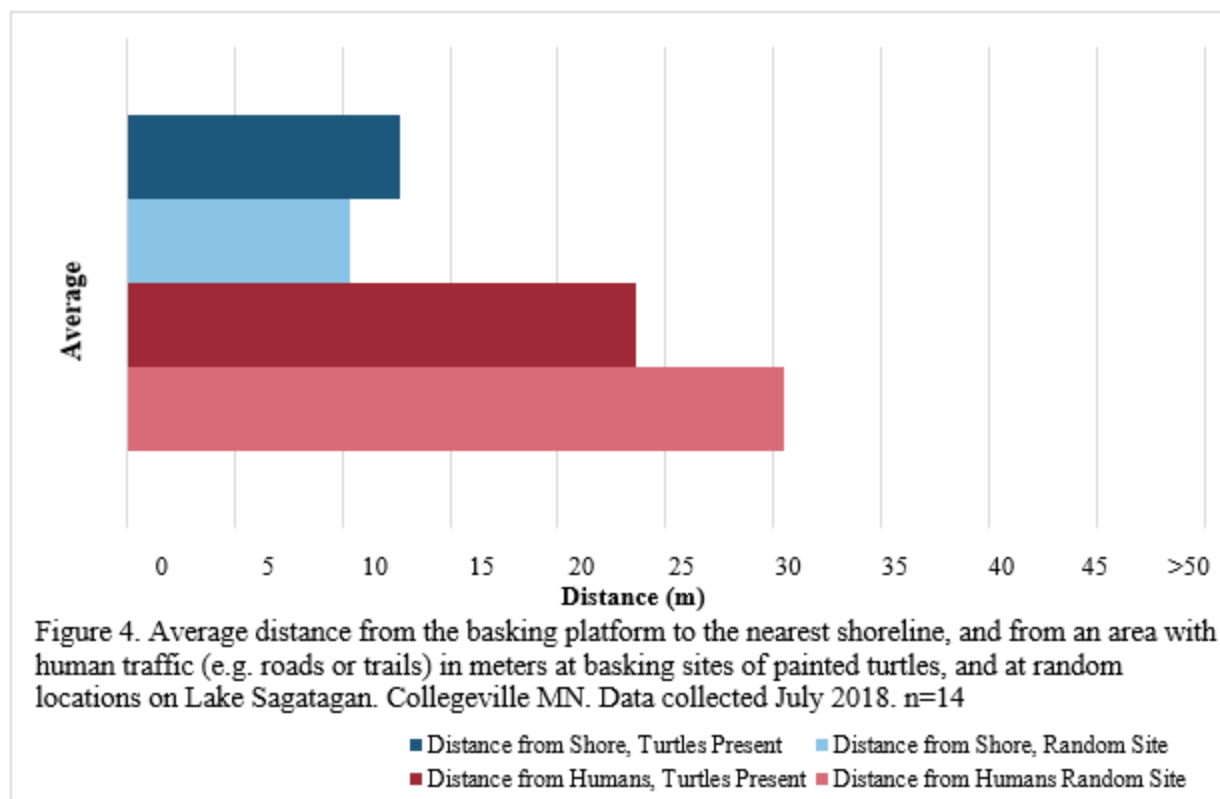
When comparing sites with turtles present to randomly selected sites, there was not a significant difference between basking areas (t -value= 1.995, df =12, p = 0.07). Although most often the sites that had turtles present had a larger basking area, there were two random sites that had a larger area of a potential basking site than their paired sites. When the overall averages were calculated and compared the difference in area between the average of areas with basking turtles compared to the average area of random sites was 0.32 m^2 (Table 1).

Table 1. Area of substratum of painted turtle basking sites paired with random sites located on Lake Sagatagan, Collegetown MN. Data collected July 2018. $n=14$			
	Average Basking Area at Location (m^2)	Average Basking Area of Random Location (m^2)	Difference (m^2)
Average:	0.59	0.28	0.32
t-test:	0.07		

There was a significant difference in the surface temperature of the water between the random sites and the sites with turtles present ($t=3.80$, $df=12$, $p= 0.002$). Sites that had basking turtles exhibited a lower average surface temperature (Fig. 3). There was no recorded instance of a site with basking turtles present having a higher surface temperature than a random site. The maximum temperature recorded at a basking site was only 0.7 degrees centigrade warmer than the coolest temperature of the water at a random site.

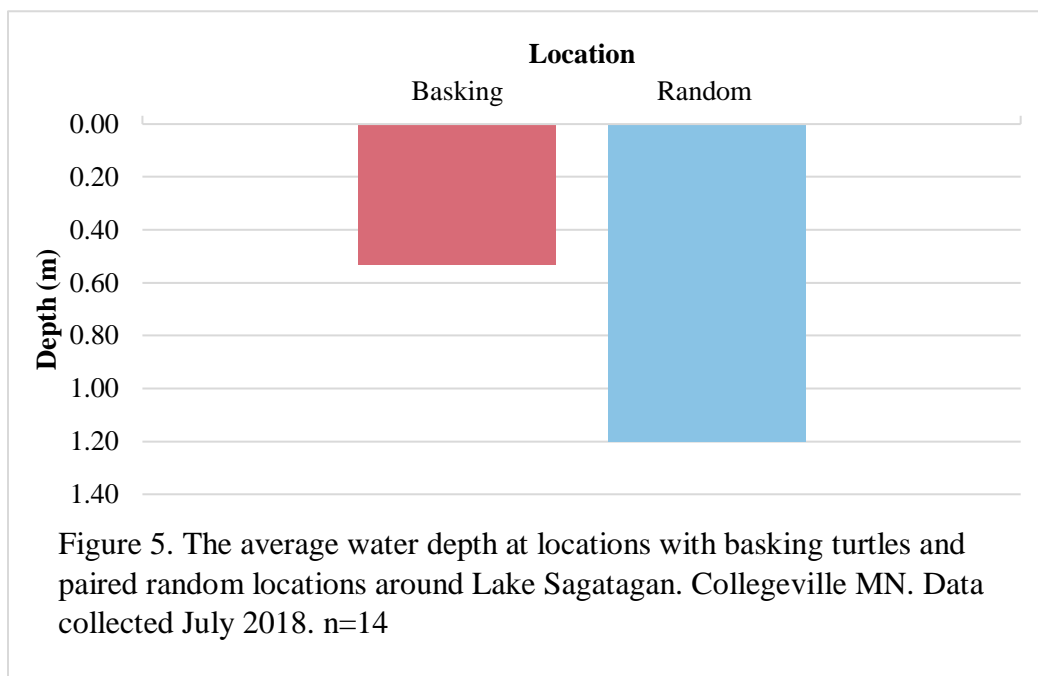


There was a lot of variation of the distance from the substratum to shore and to areas with human traffic (Fig. 4). Although most sites were close to a shoreline of some kind there were several occasions where the sites were very far from any human movements. There was not a significant difference of the distance from the basking site to shore between random sites and sites with turtles (t -value= 0.47, $df=12$ $p= 0.64$). There was also not a significant difference for the distance from the basking site to humans and random sites to humans (t -value= 0.76, $df=12$ $p= 0.46$). The distance from shore to the basking sites ranged from 2.13 meters to 31.62 meters, with an average of 12.64 meters.

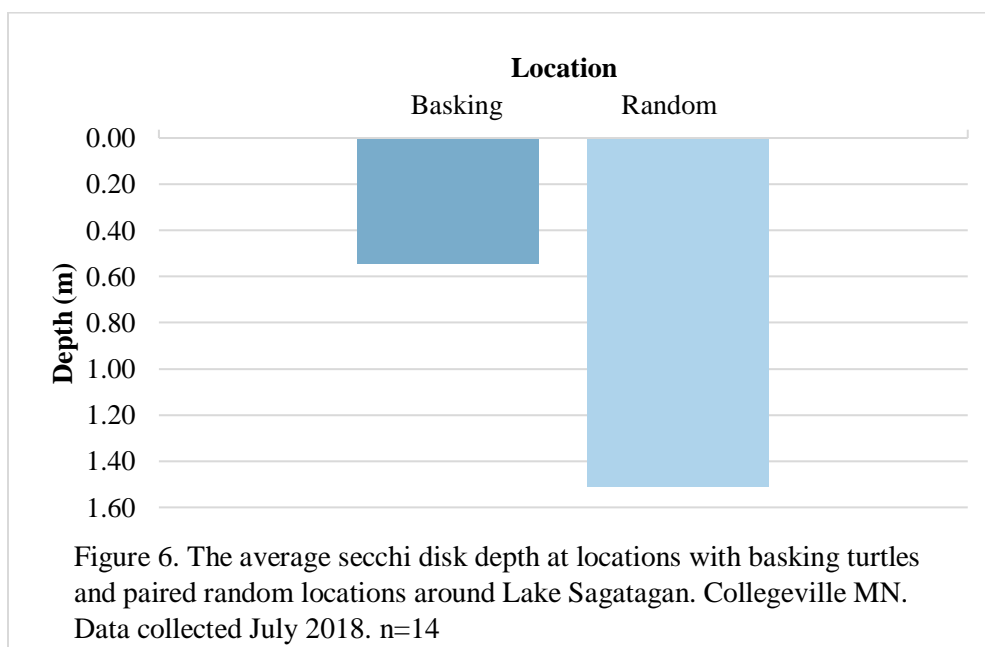


There was extremely high variability in canopy coverage in both the basking sites and the random locations. There was no significant difference between random versus basking sites, although the average canopy coverage for basking sites was 12.25% and the average for random sites was 10.76%. Turtles were never observed basking in locations that had canopy coverage greater than 35% covered.

There was a statistically significant (t -value= 3.01, df = 12, p =0.011) difference between the depth of the water at basking sites compared to random sites (Fig. 5). Turtles were seen basking in areas of much shallower water- an average of 0.53 m deep- compared to random sites, that had an average depth of 1.20 m. The random sites also had a greater variation in depths, the shallowest being 0.57 m, and the deepest up to 2.10 m, resulting in a range of 1.53. The sites with basking turtles had a much smaller range (0.39 m) and the site with the deepest water was only 0.67 m and the shallowest area was 0.28 m.



Water clarity also varied between sites (Fig 6). The turtles were found in murkier water compared to the random locations 83% of the time. The difference of the secchi disk depths between the random sites and the locations with turtles was significant (t-value= 2.88, df=12, p=0.014). The average secchi disk depth for basking locations was 0.53 m compared to the average of random locations which was 1.20 m.



Site	Terrestrial	Emergent	Floating	Submerged	Algae
Basking	14%	86%	100%	86%	57%
Random	14%	57%	100%	100%	14%

The lake had lots of submerged and floating vegetation during the summer, and thus both were seen at almost all sites, random or not. The only differences in vegetation types between the random sites and the sites with basking turtles was the higher occurrences of algae and emergent vegetation at basking sites than random sites. While emergent vegetation was observed at all but one basking location, it was only present at four of the seven random sites. Algae was seen at four sites with turtles and only at one random location. Terrestrial plants were seen once at a basking site and once at a random site. There was only one site with terrestrial plants near a basking site.

As the summer progressed, turtle sightings became less and less frequent. This is to be expected as the average ambient temperature increases, the water temperature rises along with it. Turtles become capable of reaching an optimal body temperature without having to leave the water, thus basking sites were no longer used. This behavior has been observed in many other studies (Grayson & Dorcas 2004).

Discussion

There was not a significant difference in the size of basking areas between random sites and sites with turtles present (Table 1). This may mean that turtles do not have a preference on how large the substratum is. We recommend a second study to be conducted to reinforce or refute this as the sample size was not as large as initially desired. The difference of surface temperatures was also likely impacted based on the varying temperatures of the days that the data was collected (Fig. 2). Most of the random locations were measured days after the sites with

turtles were measured. In future studies, random sites and basking sites should be measured the same day. Because part of basking behavior is associated with raising the body temperature of ectotherms, it is feasible that turtles would bask in areas with lower water temperatures and remain underwater when the water is warm.

The painted turtles were seen basking an average of 12.64 meters from shore (Fig. 3). As mentioned by Rowe (2003), painted turtles prefer shallow water, which is often found near shorelines of lakes. While turtles were observed basking in the middle of Lake Sagatagan, it was usually along small islands. Remaining close to shore puts them at a higher risk of encountering potential predators, such as raccoons (Ernst 1994), but provides their preferred water depth. There are also more objects for turtles to bask on near shore, such as rocks that rise above the water surface and floating logs to rest on. These risk/benefit factors likely contribute to the distance that turtles choose to bask. When compared to random sites on Lake Sagatagan, the turtles tended to bask closer to shore, implying that distance is a factor in their selection of basking sites.

This tendency to remain near shorelines is also a contributor to the depth of the water recorded at basking sites. When compared to the random sites the turtles basked in areas of much shallower water (Fig. 4). More rocks protrude above the surface of the lake in shallower water and can act as substrates, and once again, floating logs and fallen trees originate from shore and are thus more likely to be found in shallow water. The random sites were never selected in the middle of the lake, where it would be highly unlikely for a turtle to be found basking, but still ended up having water deeper than areas with basking turtles present.

Although turtles need to bask in sunlight, and thus select spots with little to no canopy coverage, there was not a significant difference in canopy coverage between random sites and

areas with basking turtles. While turtles were always present at sites with low levels (<35%) of canopy coverage, their tendency to remain close to shorelines boosted the average canopy coverage percentage to be slightly higher than the average of the random sites. The random locations were also further out into the lake than basking sites, and thus did not have any canopy coverage. Turtles clearly avoid dense canopy coverage, but do not require exclusively open sky above their basking sites. This tendency may also be due to the occasional predation by certain birds of prey, such as ospreys (Ernst 1994). While they need sunlight, some nearby canopy coverage may provide some protection from avian predators.

There was emergent, floating, and submersed vegetation at almost every basking location. However, there was floating and submersed vegetation at almost every random location as well, implying that these plants are not a specific trait of basking sites, but rather a feature found all throughout the lake (Table 2). There was not, however, many random locations with emergent vegetation compared to nonrandom sites (57% had emergent vegetation compared to 86% of sites with turtles present). This is likely related to the tendency for turtle to bask near shorelines, where emergent vegetation often thrives. Emergent vegetation may also contribute easy coverage should the turtles sense danger and want to escape from view.

It must be noted that turtles may select different habitats at different times of the year. In a study led by Rasmussen and Litzgus (2010) on spotted turtles (*Clemmys guttata*), results indicated that habitats selected in the fall/winter period were significantly different from those selected in the nesting period. To understand the habitat preference of painted turtles completely, a study must be done for a longer span of time, from their first emergence in the spring, to when they begin brumation in autumn. Their selection for overwintering sites is also a point of interest for fully understanding the yearlong habitat choices of painted turtles.

Should someone wish to create an optimal habitat for painted turtles, proper basking sites are important to include. Based on this study features that ought to be incorporated when creating basking sites include proper substrates, low canopy coverage, and the basking sites must be close to shore, in shallow water (under 1 meter). Turtles will tend to bask when the water is cold, in areas with murky water. The presence of aquatic vegetation is seen in most basking sites, so some floating, submerged, and emergent vegetation is also recommended. If there are areas with lots of human traffic, the turtles will bask further from shore.

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