Chelonian Conservation and Biology, 2020, 19(2): 302–304
doi:10.2744/CCB-1418.1

Observations on the Short-Term Effects of Motorboat Disturbance on the Use of Basking Sites by Female Northern Map Turtles

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Abstract. – **We observed the number of basking female *Graptemys geographica* (northern map turtles) at 4 basking sites before and after controlled motorboat disturbances using time-lapse cameras. In the 6 hrs following disturbance, the mean number of turtles basking at a site was 43.8% less than before the disturbance; this reduction in use of basking sites suggests that a single boat disturbance event can markedly affect the use of basking sites by female turtles for several hours. The behavioral and physiological impacts of such a shift in habitat use are unclear and should be the focus of future studies.**

Aerial basking is an extremely important behavior for the fitness of many species of freshwater turtles. Basking allows turtles to reach their physiologically optimal body temperature (Bulté and Blouin-Demers 2010a), which accelerates follicle development (Rollinson and Brooks 2007) and growth (Bulté and Blouin-Demers 2010b). Aerial basking also helps turtles rid themselves of ectoparasites and epizootic organisms (Boyer 1965; Vogt 1979). Freshwater turtles exhibit high fidelity to certain basking sites (Lefevre and Brooks 1995; Jones 1996; Selman 2017). Lefevre and Brooks (1995) suggested that familiarity with basking sites could facilitate escape from predators, but fidelity may also indicate limitations in the quantity or quality of basking sites.

Despite the importance of basking behavior, many species of turtles readily abandon their basking sites at the approach of boats (Moore and Seigel 2006; Selman et al. 2013), which may result in cooler body temperature (Jain-Schlaepfer et al. 2017; Heppard and Buchholz 2019), poorer body condition, and higher stress levels (Selman et al. 2013). Understanding the impacts of recreational boating on the behavior of turtles is necessary to minimize the conflicts between boating and turtle conservation.

Working toward the goal of turtle conservation, we report observations on the effects of controlled motorboat disturbances on the short-term (hours) use of preferred basking sites by northern map turtles (*Graptemys geographica*) in Ontario, Canada. Between 9 and 24 May 2018, we performed 16 disturbances at 4 basking sites (3 at 2 sites, 4 at 1 site, and 6 at 1 site). The disturbances were performed on days without rain between 915 and 1540 hrs. Most disturbances (12/16) were performed before 1315 hrs. To disturb the turtles, 2 seated occupants slowly approached the basking site in a 5.8-m aluminum motorboat (25-horsepower outboard motor) until all the basking turtles left the basking site to escape into the water. We turned the motor off approximately 10 m from the basking site and paddled the boat until we reached the site. We remained at the basking site on average 12 min and 53 sec (range, 7–20 min).

The number of basking turtles at each site was recorded with a time-lapse camera (Wingscapes TimelapseCam; Wingscapes, Calera, AL) taking pictures every minute from 600 to 2000 hrs. On the pictures, we counted the number of adult female map turtles basking every minute in the 10 min before the boat arrived and every 15 min after the boat departed, up to 360 min. We focused on adult females because over 90% of the observations at the basking sites were of adult females. We identified adult females based on relative body size, head size, carapace shape, and tail length. We considered a turtle to be basking if over half of its body was out of the water.

The number of turtles basking at a site 10 min before a boat disturbance ranged from 5 to 25 (mean = 14.7; median = 14; Fig. 1). The maximum number of turtles present at a site in the 360 min following the disturbance ranged from 0 to 21 (mean = 6.6; median = 5.5; Fig. 1). The number of turtles basking after the disturbance reached or exceeded the number basking before the disturbance in only 2 of 16 cases (12.5%). In 4 of 16 cases (25%), no turtles used the basking site for the remainder of the day. When turtles resumed basking after the disturbance, it took between 2 and 17 min (mean = 9 min; median = 9 min) for the first turtle to resume basking.

Our observations indicate that a single boat disturbance can strongly affect the use of basking sites by female *G. geographica* in the hours following the disturbance. After a boat disturbance, the mean maximum proportion of turtles resuming basking at the size was 43.8% (range, 0%–105%) of the number of turtles basking before the disturbance. This reduction in the number of turtles basking is substantially lower than the 77% reported by Moore and Seigel (2006) for *G. flavimaculata*. Several factors may explain this difference in the magnitude of the effect of boat disturbance, including interspecific differences in behavior, the type of disturbance, and the

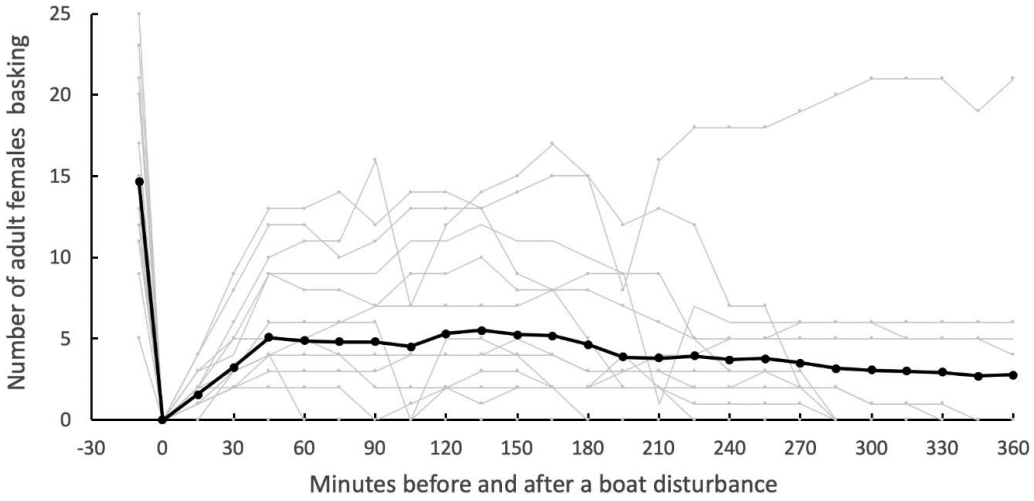

Figure 1. Number of adult female northern map turtles (*Graptemys geographica*) basking before and after 16 experimental boat disturbances (gray lines) performed at 4 basking sites in Lake Opinicon, Ontario, Canada. The black line shows the mean value for all the disturbances. The dots indicate the turtle counts from time-lapse pictures.

availability of alternative basking sites. We disturbed turtles with a motorboat and forced all basking turtles to retreat into the water. In contrast, Moore and Seigel (2006) observed disturbances from a range of boat types and distances and documented that, on average, 69% (range, 0%–100%) of turtles entered the water when disturbed and that the highest percentage (74%) of turtles entering the water was caused by anglers setting trot lines. Interestingly, the slow approach we used during our boat disturbance is comparable to a trolling fishing boat. Similarly, Selman et al. (2013) found that larger and slower-moving boats disturbed more turtles than smaller and faster boats.

Acclimation to the presence of boats could reduce the overall impacts of boat disturbances on turtles. Observations consistent with behavioral acclimation to boats have been reported in some species of turtles (e.g., Lester et al. 2013; Lindeman 2013; Moore and Seigel 2006; Selman et al. 2013), but the time (and/or the number of disturbances) required for acclimation to occur is unknown. Basking sites are in limited supply for some turtle populations (e.g., Moore and Seigel 2006; Pittfield and Burger 2017). In such instances, the impact of motorboat disturbance may be greater than in populations in which the availability of basking sites is high. Testing this hypothesis would offer useful insights on the potential use of artificial basking sites as a mitigation measure to reduce the impact of boat disturbance.

Our observations contribute to the mounting evidence that recreational boating can negatively affect turtle behavior. Outreach and educational programs promoting responsible boating practices with regard to aquatic wildlife may help mitigate the impacts of boats on turtles, but research on the environmental and social factors dictating basking site selection by turtles is also necessary to fully evaluate the impacts of boat disturbance.

Acknowledgments. — We are thankful to C. McKinnon and A. Zoldero for assisting with the fieldwork. Funding for this research came from the Natural Sciences and Engineering Research Council of Canada, Carleton University, and the University of Ottawa. This research was carried under a permit from the Ontario Ministry of Natural Resources and Forestry (permit no. 1082630) and was approved by the Carleton University Animal Care Committee (protocol no. 108771).

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Received: 4 October 2019
Revised and Accepted: 22 April 2020
Published Online: 31 December 2020
Handling Editor: Will Selman