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Environmental Cues that Trigger Nesting by Blanding's Turtles (*Emydoidea blandingii*)

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ABSTRACT. – **We compiled observations of 116 nesting events by 37 female Blanding's turtles between 2013 and 2017 for a population located along the western shore of Lake Michigan, USA, to identify triggers of nesting activity. Across years, nesting dates were negatively related to average daily temperature during April and May, such that each degree increase in average temperature during April–May was associated with a 7-d-long shift earlier in nesting (defined as the date by which 90% of females had nested). Within years, nesting was more likely to occur when mean daily temperatures were > 18.9°C, the moon was in its brightest phase, and wind emanated from the east or south. These thresholds may be useful for timing interventions to protect nests and nesting female Blanding's turtles, although they may differ among populations across the species' range.**

KEY WORDS. – **Blanding's turtle; *Emydoidea blandingii*; nesting behavior; nest success; weather; temperature; precipitation; moon phase; wind**

Blanding's turtles (*Emydoidea blandingii*) are semi-aquatic freshwater turtles that conduct nesting forays from their home range (Rowe and Moll 1991; Standing et al. 1999) guided by environmental cues (Emlen 1969; Pappas et al. 2009). Warming temperatures may trigger nesting movements by females for enabling oviposition under favorable thermal conditions and for initiating egg deposition early in the warm season to maximize length of the incubation period in the cold temperate regions where the species occurs (Edge et al. 2017). Precipitation may also trigger nesting by modifying soil composition to facilitate nest digging (Bowen et al. 2005).

Blanding's turtles are listed as threatened, endangered, or of conservation concern throughout the species' range in eastern Canada and the northeastern United States. Habitat fragmentation may increase the likelihood of mortality during long-distance nesting forays (Rowe and Moll 1991; Millar and Blouin-Demers 2012) because migrating females encounter roadways. As a long-lived species with delayed sexual maturity, a high level of annual juvenile and adult survival underpins population persistence (Congdon et al. 1993, 2000). As such, protection of nesting females and nests (e.g., via control of nest predators or installation of nest cages to promote recruitment of juveniles [Urbanek et al. 2016]), would benefit from a better understanding of nesting behavior, including identifying the cues that trigger nesting movements.

Although many reports and observations of Blanding's turtles nesting have been made (Snyder 1921; Brown 1927; Bleakney 1963; Linck et al. 1989), little is known about environmental triggers of nesting behavior (Congdon et al. 1983; Mui et al. 2016). We predicted that nesting would be triggered by 1) warmer temperatures in these exothermic reptiles at their range limit, where they face a limited-duration warm season in which to complete their reproductive cycle, and 2) rainfall and the weather conditions that precede rainfall, which can soften soils for digging. The goal of this study was to identify combinations of environmental variables that motivate nesting behavior in Blanding's turtles in order to inform conservation actions to protect nests and females during nesting activities.

METHODS

Blanding's turtle nesting activity was observed from May to July each year between 2013 and 2017 via radiotracking and incidental encounters of adult females, as part of a long-term population study being conducted by the Lake County Forest Preserve District. Our study site was a portion of the Chiwaukee Prairie–Illinois Beach Lake Plain in northeastern Illinois and southeastern Wisconsin, which has a variety of habitats that Blanding's turtles were found using, including sedge meadows, freshwater marshes, and drier open woodlands and sand prairies. Radiotransmitters (30 g, Model AI-2F; Holohil Systems, Ltd., Carp, ON, Canada) were bolted to the dorsal and caudal sections of the carapace of gravid females that were then tracked using standard ground-based radiotelemetry techniques (R-1000 telemetry receivers and hand-held 3-element Yagi antennas; Communication Specialists, Inc., Orange, CA). Turtles were palpated daily in the inguinal region to monitor egg development