

# Crappy nesting sites: hyperthermia of Blanding's Turtle, *Emydoidea blandingii* (Holbrook, 1838), nests laid in manure piles

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**Abstract.** We found seven Blanding's Turtle (*Emydoidea blandingii*) nests laid in manure piles in two different locations in Lanark County, Ontario, Canada, from 2022–2024. Two of the nests were laid in the “active” part of manure piles and the eggs were hot to the touch when collected. Their temperature was estimated to be at least 35°C. The eggs from these two nests were collected less than 18 h after being laid and then incubated, but none of them hatched. All other incubated Blanding's Turtle eggs hatched successfully. Temperate zone female turtles may select nesting areas that are warmer than non-nesting locations to promote embryo development, but they may not be able to avoid areas that are too warm for the eggs.

**Keywords.** Incubation temperature, nest failure, nesting habitat

## Introduction

All turtles are oviparous, with adult females depositing eggs in cavities they dig into the ground. The temperature of the nesting site will affect the length of the incubation period (Yntema, 1968; Mitchell and Janzen, 2019) and for many species, the sex of the offspring (Bull, 1980; Ewert and Nelson, 1991). In temperate locations, eggs laid in shaded areas experience lower temperatures and possibly a reduced hatching success (Congdon et al., 2000). The substrate type can also influence nest temperature (Mitchell and Janzen, 2019).

Given the importance of temperature to nest conditions, embryo development, and sex determination, female turtles are expected to select nesting locations that benefit their eggs. Nesting in full sun may be beneficial in temperate locations, but in areas with hotter climates shallow nests in full sun might overheat. For example, Eastern Mud Turtles, *Kinosternon subrubrum* Bonnaterre, 1789, are fairly small and lay shallow nests, but they typically lay their eggs in shadier locations in the southeastern USA compared with larger-bodied turtles that lay deeper nests (Bodie et al., 1996). Species with a wide latitudinal range may also select different nesting habitats across that range. North American

Snapping Turtles, *Chelydra serpentina* (Linnaeus, 1758), are more apt to nest in shadier locations in the southern portion of the range than in the north (Ewert et al., 2005). Painted Turtles, *Chrysemys picta* (Schneider, 1783) nest in warmer areas with south-facing slopes and sparse vegetation in Algonquin Provincial Park in Ontario, Canada, an area with moderate summer temperatures (Schwarzkopf and Brooks, 1987; Hughes and Brooks, 2006). Soil temperature at nest sites for a number of turtle species is significantly warmer than non-nesting sites in Ontario, Canada (Hughes et al., 2009; Markle et al., 2021). Nesting Blanding's Turtles, *Emydoidea blandingii*, have been observed to press their face into the dig area (Standing et al., 1999) which could be a means of assessing whether soil temperature is suitable for nesting.

We documented Blanding's Turtle females nesting in manure piles produced from a variety of domestic animals including sheep (*Ovis aries*), cattle (*Bos taurus*), and horses (*Equus ferus*) in Ontario and witnessed the potential risks this can pose to their eggs. Blanding's Turtles (Fig. 1) are listed as an endangered species both in Canada (SARA Public Registry, 2024) and globally (van Dijk and Rhodin, 2011). The species faces many threats, but the risk of nest failure from excessive temperatures has not previously been documented. At least in some locations > 80% of nests can be in anthropogenic habitats (Beaudry et al., 2010), so a better understanding of the hatching success in these areas is important.

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**Figure 1.** Adult Blanding's Turtle (*Emydoidea blandingii*) basking on a hummock in a swamp. Photo by David Seburn.

## Materials and Methods

From 2022–2024 we collected and incubated eggs from Blanding's Turtle nests as part of a larger turtle conservation project in eastern Ontario, Canada. Nests were located either through surveys by our staff or by reports from concerned members of the public, excavated by hand, and the eggs placed into bins with local substrate for transport to our facility. The top of each egg was marked with a dull pencil to help ensure eggs were not rotated, as inverting turtle eggs can prevent embryo development (Limpus et al., 1979). Once at our facility, eggs were transferred to plastic bins with a mixture of vermiculite and water at a ratio of 1:1 by weight (Thompson et al., 2020). Eggs were incubated in Nature's Spirit reptile egg incubators (Garland Exotics, Charlotte, Michigan, USA) under a fluctuating temperature of 28°C during the day and 26°C during the night to simulate natural temperature variation in a nest. Once the eggs hatched, hatchlings were released near the nesting site. Locations of all nesting sites are being kept confidential given the risk of illegal collecting of Blanding's Turtles. All eggs were collected and incubated under a permit from the Ministry of Environment, Conservation and Parks of the Government of Ontario.

## Results

We collected and incubated eggs from 57 Blanding's Turtle nests during 2022–2024. Seven of those 57 nests (12.3%) were laid in manure piles at two different locations in Tay Valley Township, Lanark County, Ontario, Canada (44.8°N, 76.4°W; Table 1). At one site the manure was mainly from sheep and cows and at the other from horses. Both piles were > 1 m in height, with the former > 10 m in length and the latter ca. 2 m in diameter. Most incubated nests were laid along roadsides or in backyards.

In five of the nests found in manure piles, eggs were at the same approximate temperature as the nearby substrate (ambient temperature). The eggs from the other two nests were laid in "active" parts of the manure piles at the two locations. Active decomposition produced high-temperature sections in the manure piles, and the eggs were hot to the touch when excavated. The temperature was estimated to be > 35°C in both cases. The eggs from both nests were excavated < 18 h after the eggs were laid, with the egg-laying time confirmed by both landowners, who directly observed the females nest the night before the eggs were collected. Despite the relatively short time period the nests were in the manure piles, none of the eggs from these two clutches hatched.

**Table 1.** Blanding's Turtle (*Emydoidea blandingii*) nests laid in manure piles at two locations in Tay Valley Township, Lanark County, Ontario, Canada. Both nests with eggs hot to the touch completely failed to hatch.

Nest ID	Site #	Date	# of eggs	# hatched	% hatched	Temperature
1	1	15 June 2022	11	0	0	Hot
2	1	15 June 2022	9	9	100	Ambient
3	1	15 June 2023	11	7	63.6	Ambient
4	1	16 June 2023	11	9	81.8	Ambient
5	1	5 June 2024	10	10	100	Ambient
6	2	15 June 2023	14	12	85.7	Ambient
7	2	4 June 2024	13	0	0	Hot

Nests from the other, inactive parts of the manure piles had a 63–100% rate of hatching success (Table 1), and these nests did not have eggs that were hot to the touch. The two clutches from active parts of the manure piles were the only Blanding's Turtle nests from any location that had no eggs hatch.

## Discussion

High temperatures can be lethal to turtle eggs. All Olive Ridley Sea Turtle (*Lepidochelys olivacea*) nests failed to hatch when the mean soil temperature around nests exceeded 35°C (Valverde et al., 2010). Hatching success of Blanding's Turtle eggs was only 77% when incubated at 31°C compared with 95% at 26.5°C (Gutzke and Packard, 1987).

Others have also found that temperate-zone turtles may nest in anthropogenic sites that are warmer than natural sites. Overall, *C. serpentina* nests in anthropogenic sites were 3.3°C warmer than nests in natural sites in Algonquin Provincial Park (Francis et al., 2019). Three *C. serpentina* nests were found in recently applied asphalt in the same park (de Solla and Gugelyk, 2018). One nest was subsequently predated, and it is unknown if any of the other eggs hatched. While nesting in warmer areas may be beneficial to turtle eggs in temperate locations, there is the risk of laying eggs in areas that are too warm.

Although we are not aware of any other published reports of turtles nesting in manure piles, turtles are known for nesting in piles that may be composting. Four clutches of *C. serpentina* eggs were found in a composting wood chip pile in Hamilton, Ontario, Canada in June 1999 (de Solla et al., 2001). One clutch of these eggs was incubated but none of the eggs hatched. Subsurface temperatures in the pile ranged from 28–60°C. Another *C. serpentina* nested in a wood chip pile in Brampton, Ontario in June 2023 (Wijewardena, pers. comm.), but the temperature of the eggs or the hatching result are not known.

Wood chip, compost, or manure piles may be attractive to nesting turtles. It is also likely that there are few if any natural nesting sites where the temperature is too warm for turtle eggs in temperate areas. Females can likely detect sites that are warmer than average, and hence good nesting sites in temperate locations, but they may not recognize some sites are too warm. Given that we have observed seven Blanding's Turtle nests in manure piles in just three years, it is possible that hyperthermia of nests is another risk to this globally endangered species. We encourage other researchers to report nesting of turtles in manure piles and the hatching results of those eggs.

**Acknowledgements.** We are grateful to the many concerned people who reported nesting Blanding's Turtles to us and the summer staff who helped with egg collection, incubation, and hatchling release. We thank the following organizations for funding our turtle conservation work during 2022–2024: Alder & Lipkus Foundation, Canada Summer Jobs program of the Government of Canada, Honda Canada, Ottawa Community Foundation, Ottawa Field-Naturalists' Club, Rogers Foundation, and the Species at Risk Stewardship Program of the Government of Ontario. We thank Tharusha Wijewardena for the observation of *C. serpentina* nesting in a wood chip pile and Brian Butterfield for comments on the manuscript.

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