Bullsnake, *Pituophis catenifer sayi,* Nesting Biology in Alberta

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Bullsnakes were opportunistically observed at a site on Alberta's Red Deer River at the northern extreme of their range near the town of Drumheller. This site is significant for its importance to the local nesting ecology of this snake. Data were collected from captured snakes, and individuals were marked and photographed to enable identification upon subsequent recapture. A minimum of 39 adult Bullsnakes were known to utilize a single bluff over a period spanning five years from 1998 to 2002. Fifteen gravid females were found over this span nesting in a single burrow complex. Bullsnakes were found to excavate their own nesting burrows at the site, and to show nest site fidelity. The congregation of numbers of these snakes at localized sites of importance to nesting biology renders them potentially vulnerable, and may present conservation challenges.

Key Words: Bullsnake, *Pituophis catenifer sayi,* nesting, hibernacula, fidelity, northern limit, Alberta.

The northern limit of Bullsnake, *Pituophis catenifer sayi*, range occurs somewhat north and west of Drumheller, Alberta, Canada along the Red Deer River, on the Northern Fescue Prairie ecotype (Kissner and Nicholson 2003*). At this latitude, the microclimates occurring within the systems of coulees, bluffs and gorges associated with this river and its tributaries are likely necessary for the successful reproduction of this species. Records at this general latitude that place this species much west or north of Drumheller, in places not linked to the Red Deer River coulee system (Russell and Bauer 2000), are therefore either suspect as being in error or are for individuals ranging beyond the reproductive limit for the species.

Bullsnakes are designated as a "sensitive" species in Alberta and "data deficient" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Among the critical habitats that need to be protected for their conservation are nesting sites. This may be especially critical towards the northern edge of the species' range, where suitably warm nest sites may be limited. In Alberta, the warm microclimates of the coulees and gorges of the Red Deer River provide suitable conditions for the incubation of eggs. In this paper, I describe nesting biology as observed during the period 1998 to 2002 on one particular bluff of this system ("Bullsnake Bluff"; 51°25'12"N,112°36'51"W;). Bullsnake Bluff, overlooking the Red Deer River, and approximately 190 by 90 m in extent, is of southerly exposure and apparently has more friable soil than that of adjacent bluffs, arguably allowing for easy excavation of nests. I was motivated to investigate this site when I observed an obviously gravid Bullsnake entering a hole on this bluff. This was subsequently termed "Nest Site #1". This nest was located within a vertical bank, a sub-feature of the bluff approximately 1 m high and running parallel to its face. It was thereby accessible through the horizontal excavation of a "window" into the nest chamber, and repairable using water and local substrate subsequent to each opening. Focus was directed on this particular nest. Here I record observations of Bullsnakes utilizing this nest and the bluff in general.

Methods

Reconnaissance of the nesting-site and surrounding bluff was made on foot, with the greatest amount of focused effort occurring during the Bullsnake nesting period of June through mid-July. Effort was also focused on spring emergence time (from first week of April) and fall denning time (late September – early November) to locate hibernacula.

The original nest site (Nest #1) was opened during visits to the bluff, and closed again with rocks and moistened substrate from the site before leaving. Snakes were captured as encountered inside the nest chamber, on the surface adjacent to the nest, or elsewhere on the bluff. They were sexed visually or by probing, and if female, were noted as being in gravid, non-gravid, or post-oviposition condition. I weighed and measured (snout-vent length) each snake. Snakes were marked using a unique ventral scale-clipping code, and their unique dorsal head markings were photographed. Selected individuals (n = 11), representing a sample of the overall size range of gravid females, were retained in captivity until they laid their eggs. The resultant clutches were weighed in their entirety, sample measurements were taken of individual eggs, and the eggs were subsequently incubated on moistened (not damp) vermiculite in a closed, ventilated plastic box placed inside an indoor terrarium with controlled temperatures characterized by 24-hour fluctuations from approximately 22 to 32°C, similar to the range noted to occur inside Nest #1. Date of oviposition was noted, as was incubation period. Hatchlings were weighed collectively and an average hatchling weight calculated for the clutch.

The opened nest-chamber dimensions were measured and sketched, and side tunnels noted. On nine sample occasions immediately upon opening, air temperatures were taken inside the nest chamber and contrasted with the outside air and substrate temperatures. An ANOVA test was run on these three groups to determine statistical significance of temperature differences.

Additional nesting sites were recorded as found, but no effort was made to excavate these to avoid excessive intrusion. Excavating activities of female snakes, either on the surface or inside the nest chamber, were noted as encountered. Other features that appeared important to the snakes, such as holes that were not apparently nest sites, were noted.

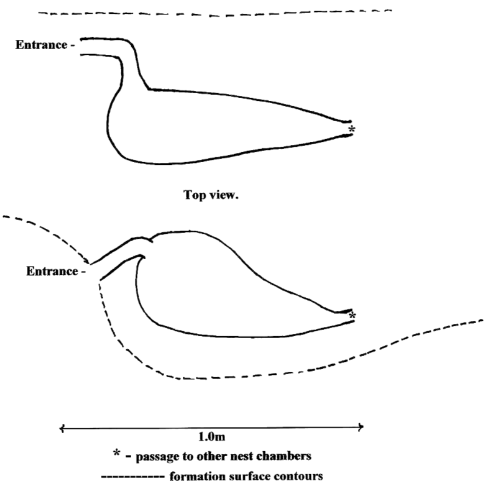

FIGURE 1. Diagram for nest number 1.

Results

A minimum of thirty-nine adult Bullsnakes [twenty-five females, five males, and nine unsexed additional adult snakes documented by unique head-patterns detectable on recovered shed-skins] utilized this bluff over the five-year period. The upper and middle portions of the bluff were most heavily utilized for nesting.

The peak period of movement to the nesting sites for the five-year period occurred consistently between 8 June and 16 July. The smallest adult snakes were the last to arrive. The period of oviposition, based on females taken temporarily from the bluff into captivity over the five-year period, is from 12 June to 22 July. The mean clutch size was 16 (n = 11; range: 8 – 26), with a direct positive relationship between body size and number of eggs laid. The mean incubation period, based on captive conditions, is 53 days. Shed skins from wild-hatched neonates at the bluff begin appearing at nest entrances as early as 17 August. The mean egg weight at oviposition is 30.2 g. The smallest documented gravid females were 1120 mm SVL (n = 2).

The "main" or "antechamber" (first chamber encountered by entering Bullsnakes) of Nest #1 (Figure 1) was approximately 76 cm long by 41 cm deep by 18 cm high. The anterior inside wall of the chamber was approximately 15 cm deep, measured from the exposed earth face of the approximately 1 m high vertical formation into which the nest had been excavated from above. The entrance was at the west end and above the chamber, with a tunnel running more or less horizontally for approximately 15 cm before dropping vertically a roughly equal distance into the chamber. At the east end of the chamber was an exit into a second tunnel, which likely led to subsequent nest chamber(s), because neonate shed skins were found projecting from this tunnel when the antechamber was opened in late summer.

Egg shells (at least 20) and neonate shed skins were found in the antechamber when it was originally opened. Multiple resting Bullsnakes (as many as five at a time) were often found in this antechamber; however, neither eggs, nor evidence of eggs, were found in the antechamber other than when originally opened. I hypothesize that the frequent opening of the antechamber lowered the humidity levels to the point at which the environment was unsuitable for incubation, the female snakes instead resorting to laying their eggs in an adjacent chamber or chambers, as verified by the location of neonate sheds.

On nine occasions when the antechamber of Nest #1 was opened during the peak nesting period, its inside air temperature was recorded with a digital thermometer. These openings coincided with varying weather conditions: cool and sunny, mild and rainy, and warm and sunny. The antechamber temperatures were compared to the ambient air and outside substrate temperatures at the time of opening and appeared from the sample to be on average intermediate to these, and comparatively more stable (Figure 2). These temperature differences were not statistically significant (F = 1.92, df = 2, P > 0.10), but a larger sample might have shown an effect on the development of the eggs.

Five other nests were found at Bullsnake Bluff, four of which were identified by snake tracks and "dump piles" – soil left characteristically by excavating Northern Pine Snakes (*Pituophis melanoleucus melanoleucus;* Burger and Zappalorti 1991) – along with the sheds of hatchling Bullsnakes found at the entrance to the nests in late summer. A fifth nest was identified when excavated on 12 June 1998 in the top section of a rounded clay "knob" formation, 12 cm beneath the surface of the formation, and approximately 30 cm deep horizontally from the entrance hole on the southwest-facing side of the formation. It contained 17 Bullsnake eggs and was the only nest located in a substrate

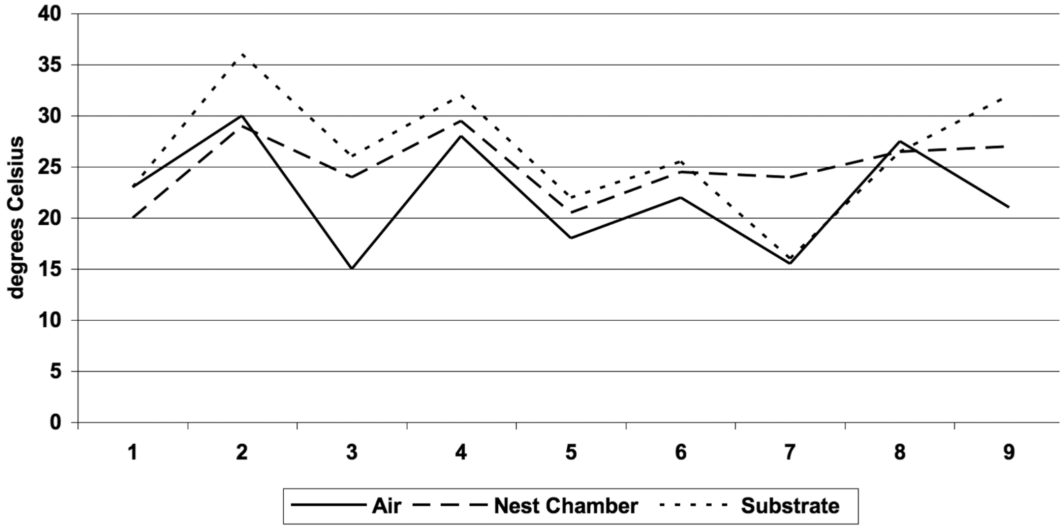

FIGURE 2. Sample temperatures at nest number 1.

type that would not have been easily excavated by the snake itself, and may have been a rodent burrow.

Bullsnakes of both sexes were found in the antechamber of Nest #1 outside the nesting period. Northern Pine Snakes are known to excavate "summer dens" not used for oviposition (Burger et. al. 1988), but I have found no record of them using nests as summer dens. Conversely, I have found no evidence of the Bullsnakes excavating burrows specifically for use as shelters outside the nesting season. The formations at Bullsnake Bluff are riddled with cracks, fissures, sinkholes and other tunnels, which provide ready-made retreats for the snakes.

Discussion

Bluffs with a southerly exposure are known to be important to the general biology of Bullsnakes elsewhere at the northern periphery of their range (Kapfer et. al. 2008). Bullsnake Bluff is important as a communal nesting site for Bullsnakes on two levels. First, Nest #1 (and probably other nests like it) is a communal nest complex with a single entrance that hosts numerous females, similar to nest sites recorded for the Great Basin Gopher Snake (*P. c. deserticola)* in British Columbia (Shewchuk 1996). Secondly, there is the bluff site in its entirety, characterized by multiple nest sites over its face and an obvious draw for nesting Bullsnakes over an unknown radius, and on a level that was not evident on adjacent bluffs. Additionally, the Bullsnakes at Bullsnake Bluff exhibit nest site fidelity to the bluff and to the specific nest, although not necessarily to the specific nest in a given year. A female may exhibit fidelity to a given nest for several years, only to select a different nest site on the Bluff in a subsequent year, even while the original nest site is still being used as such by other females. The minimum of fifteen females known to utilize Nest #1 over a limited period is notably greater than the maximum of four females per-nest recorded for the Northern Pine Snake (Burger and Zappalorti 1986), the taxon for which communal nesting in *Pituophis* has been most thoroughly documented. Known Bullsnake nests documented at Bullsnake Bluff other than Nest #1 were not excavated for purposes of examination to avoid disturbing snakes and perhaps rendering the sites unusable.

The substrate at Bullsnake Bluff, while friable, was heavier than the sand I have examined at other Bullsnake nesting sites in Alberta. Loose, sandy substrate on a south-facing aspect appears to be important to the subspecies *P. c. deserticola* in British Columbia, and rodent burrows are sometimes modified and enlarged by the female of this subspecies, although there appears to be no record of this subspecies excavating its own burrows (Shewchuk 1996). Bullsnakes, however, like the Northern Pine Snakes which are known to dig their own nests (Burger and Zappalorti 1991), are characterized by a similar, heavier skull structure better adapted to burrowing than that of *P. c. deserticola*, (Knight 1986). Bullsnakes at Bullsnake Bluff have indeed been witnessed digging their own burrows utilizing the method described by Carpenter (1982) for Bullsnakes and by Burger and Zappalorti (1991) for Pine Snakes.

Bullsnakes have additionally been captured inside the antechamber of Nest #1 in the process of beginning excavation of side-chambers. Gravid females have been observed on the surface of the bluff traveling slowly and digging "pre-test holes" as described for Pine Snakes in New Jersey (Burger and Zappalorti 1991) by probing the substrate with their snouts, apparently testing the suitability of the soil for excavation. Dump piles of soil were not only located outside nest burrows at Bullsnake Bluff, but inside the antechamber of Nest #1 as well. Female Bullsnakes in gravid and post-ovipositional states at Bullsnake Bluff sometimes showed considerable abrasion of the rostral scale, presumably resulting from burrowing behavior. In extreme cases, the rostral showed some minimal bleeding, and at least one female had permanently worn down her rostral scale, presumably again by nest-digging.

Localized landscape features are likely important to local Bullsnake populations. Nest sites may be important to aspects of Bullsnake biology not only during the period of oviposition, but also at intervals throughout their active season. The congregation of these large snakes at sites characterized by specific and locally uncommon features renders them potentially vulnerable to predation, and especially to collectors. A conservation challenge here is to monitor and protect these sites from collection and disturbance by enlisting reporting by an informed and concerned public while simultaneously encouraging and facilitating further study without undue disruption of the nesting process.

Acknowledgments

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