SHORT COMMUNICATIONS

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Aural Abscesses in Wild Midland Painted Turtles (*Chrysemys picta marginata*) Admitted to a Wildlife Hospital in Ontario, Canada, 2011–20

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ABSTRACT: Between 2011 and 2020, the Ontario Turtle Conservation Centre's veterinary hospital admitted 6,335 turtles of eight different species, with 3,246 being midland painted turtles (*Chrysemys picta marginata*). At the time of admission from the wild, aural abscesses were present in 26 of the painted turtles (0.8%). Aural abscesses were never observed in juvenile turtles and were not found in any other species of turtle admitted to the hospital. An equal number of males and females were affected. All cases showed signs of chronicity. Abscesses alone did not appear to affect the overall health of turtles regardless of clinical signs. All turtles with abscesses as the sole cause for admission were released after successful treatment.

Key words: Aural abscess, *Chrysemys picta marginata*, Ontario Canada, painted turtle, polychlorinated biphenyl.

The Ontario Turtle Conservation Centre (OTCC) is a licensed wildlife rehabilitation center and accredited veterinary hospital that annually receives and treats 1,000-1,500 injured or ill native turtles from their range in Ontario and parts of Quebec, Canada. Turtles are brought to the OTCC by members of the public and field biologists, or are transferred from other licensed rehabilitation centers shortly after admission to their facility. Most admissions take place from April to October. The species admitted include an equal number of males and females from most of the eight native Ontario turtle species (Carstairs et al. 2018). Northern map turtles (*Graptemys geographica*) are the only exception to this, with male admissions being rare in this species.

Between 2011 and 2020, the OTCC admitted 6,335 turtles, all originating from the wild. Of these, 3,246 were midland painted turtles (*Chrysemys picta marginata*) and, in this species, aural abscesses in adults were an infrequent (n=26; 0.8%) but regularly observed clinical finding, presenting as a variably sized swelling in the middle ear cavity. This observation is comparable to a study in Minnesota that observed 0.7% of 2,700 painted turtles (*C. picta*) with evidence of aural abscesses (Gamble 2007). In contrast, Schrader et al. (2010) diagnosed aural abscesses in eastern box turtles (*Terrapene carolina carolina*) in 60 of 574 admissions (10%). The sex ratio of the 26 painted turtles in our study did not differ from the expected 1:1 ratio (15 females, 11 males; chi-square [df=1, n=26] χ^2=0.784, P=0.433). None of the 147 juvenile admissions (those beyond the hatchling stage, but not yet possessing distinguishing secondary sex characteristics), were observed with aural abscesses.

Figure 1 shows the locations of origin of abscess cases alongside all painted turtle admissions. We performed an average nearest neighbor analysis (ArcGIS 10.8.1) by measuring the distance between each point's centroid and its nearest neighbor's centroid location, the null hypothesis being complete spatial randomness. If the average distance between data points is smaller than for a hypothetical random distribution, the data are considered clustered. We performed this analysis for both data sets (the negative cases that showed no abscessation and the 26 cases that were positive). The test returns a z-score statistic (SD) with an associated P-value. The painted turtle negative admissions data were significantly clustered, showing a z-score of –83.5153 (P<0.0001, observed mean distance=2,029 m compared with expected mean distance=8,676 m). Positive abscess cases were not significantly clustered, with a z-score

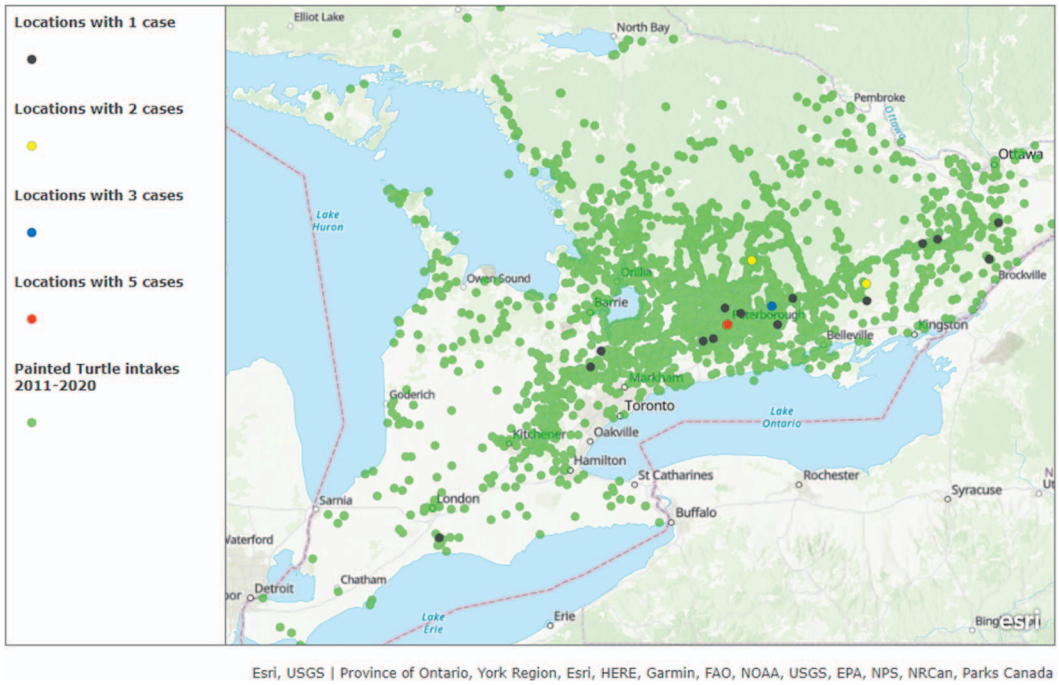

FIGURE 1. Location of origin of 26 cases of free-living midland painted turtles (*Chrysemys picta marginata*) admitted to Ontario Turtle Conservation Centre between 2011 and 2020, compared with all painted turtles admitted during that time. Green dots represent 3,246 painted turtle admissions. Colored markers indicate individuals with aural abscesses: black markers represent one individual, yellow markers represent two individuals, blue markers represent three individuals, and red markers represent five individuals.

of −1.8655 (P=0.0621, observed mean distance=19,693 m compared with expected mean distance=24,350 m). We also performed spatial scanning for clusters with high incidence rates, by using the Kulldorff algorithm (Kulldorff, 1997) on the basis of a Bernoulli probability model in SaTScan (version 9.7, www.satscan.org) and found no significant spatial clusters. Our findings do not support specific geographic clustering of abscess cases in Ontario, contrary to Brown et al. (2003), who found that geographic location was a factor for increased risk for aural abscess formation in box turtles in Virginia, US. An evaluation of temporal clustering of aural abscesses could not be carried out; because of the chronic nature of the abscesses, date of admission to the hospital reflects the time of maximum turtle activity, not the time of abscess development.

Aural abscess was the sole reason for admission in 10 turtles (38%), whereas 16 (62%) presented with the aural abscess as an incidental finding concurrent to a presenting injury. Three of the latter had evidence of resolved chronic abscesses, with boney proliferation evident but no active abscess. Presenting injuries were a result of vehicular trauma in all but one of these cases; that individual showed evidence of predation. In all 26 cases (100%), aural abscesses appeared to be chronic (Fig. 2), often with extensive boney remodeling in the region (Fig. 3). Of the 10 turtles admitted with aural abscesses with no concurrent injury, all were in good physical condition (body weight consistent with average weight for their species and size), and 100% were released after treatment. Four of these turtles required overwintering because they were not deemed ready to be released while the weather was still favorable. The other six turtles were released between 14 and 63 d after admission. Of those individuals with aural abscesses and with

FIGURE 2. Example of aural abscess in free-living midland painted turtles (*Chrysemys picta marginata*) admitted to the Ontario Turtle Conservation Centre between 2011 and 2020.

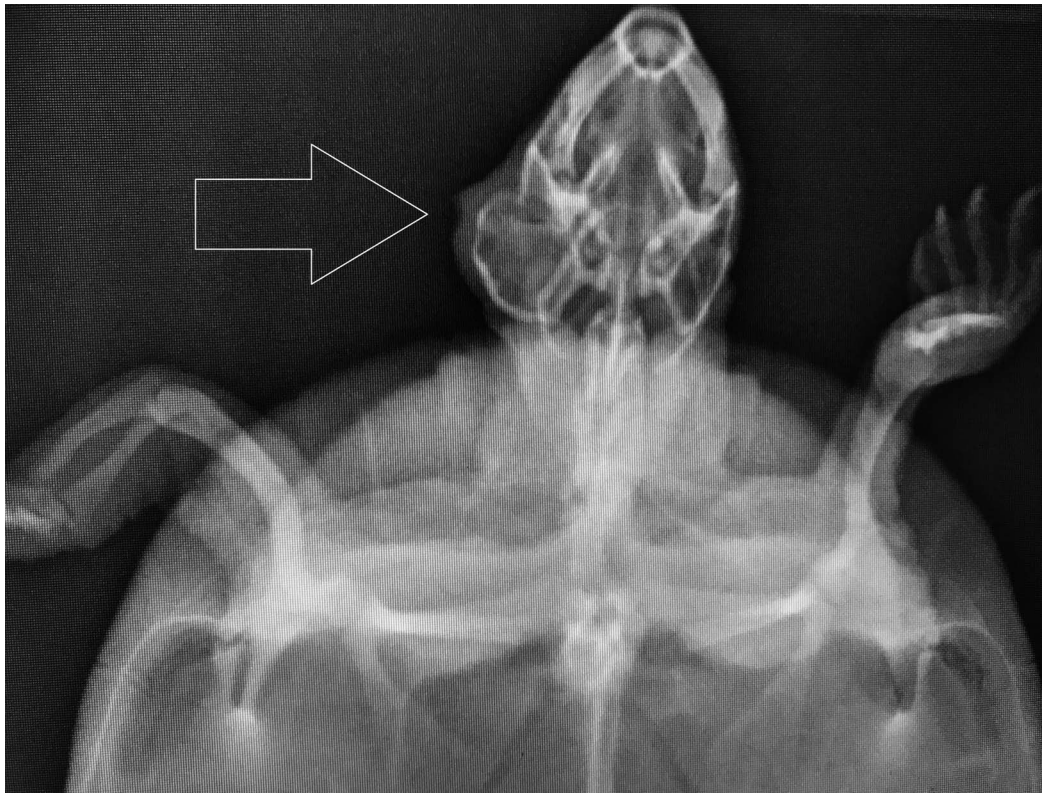

FIGURE 3. Typical radiographic changes from aural abscessation (arrow) in a midland painted turtle (*Chrysemys picta marginata*).

vehicular injuries, 14 (88%) responded to treatment for the traumatic injuries and were released. Two turtles (13% of those with concurrent vehicular injuries) died in care as a result of their traumatic injuries.

In 24 of 26 cases, no presenting clinical signs were attributable to the aural abscess other than swelling in the tympanic region. Clinical signs besides obvious swelling are generally lacking in captive turtles with aural abscesses, although head tilts are occasionally observed (Kischinovsky et al. 2019). Two turtles were brought in by members of the public after being seen swimming in circles, and it was assumed that this activity was secondary to the aural abscess. This clinical sign resolved with treatment in both cases.

Previous studies have isolated multiple species of bacteria from turtle aural abscesses, with gram-negative opportunistic bacteria being the most common isolates (e.g., Wilier et al. 2003). Likewise, in our study, aerobic cultures from these abscesses demonstrated a variety of bacteria, with *Pseudomonas*, *Citrobacter*, *Klebsiella*, and *Proteus* spp. featuring prominently (Table 1).

All 23 turtles admitted with an active aural abscess received treatment in the form of surgical excision of the tympanic membrane under anesthesia, removal of purulent (caseous) material, and flushing of the resultant cavity; in most cases samples were taken for aerobic bacterial culture and antibiotic sensitivity testing. Some turtles received implantations of antibiotic-impregnated polymethylmethacrylate beads with closure of the wound, and others were left open to heal by second intention. All turtles healed successfully.

Aural abscesses have primarily been reported in captive aquatic turtles but can occur in both captive and wild turtles (Kischinovsky et al. 2019). They can be unilateral or bilateral

TABLE 1. Summary of aerobic bacterial isolates from aural abscesses in 26 free-living midland painted turtles (*Chrysemys picta marginata*) admitted to the Ontario Turtle Conservation Centre between 2011 and 2020.

Bacterial isolate	No. isolated	Growth
Nonpathogenic environmental	5	Light
Aeromonas spp.	14	Heavy
Aeromonas sp.	1	Moderate
Citrobacter spp.	11	Heavy
Proteus sp.	1	Heavy
Klebsiella spp.	3	Heavy
Old, healed abscess	3	Not applicable
No culture carried out	3	Not applicable

and are seen clinically as a variably sized swelling in the middle ear cavity (Kischinovsky et al. 2019). Most reports in free-living turtles have involved eastern box turtles (e.g., Brown et al. 2004), with some studies in painted turtles in the US (e.g., Gamble 2007; Smith et al. 2009). No previous reports of aural abscesses in free-living turtles in Canada have been published.

The cause(s) of aural abscesses is not completely understood. In captive turtles, improper husbandry is thought to be responsible. Examples include inadequate water quality leading to increased potential for opportunistic bacteria, suboptimal temperature leading to immunosuppression, and dietary vitamin A deficiency leading to hypovitaminosis A (Murray 2006). All the turtles in our study were admitted to our hospital from the wild. The cause of aural abscesses in wild turtles remains unknown. Although Brown et al. (2004) suggested a relationship between bioaccumulation of organochlorine compounds and vitamin A deficiency, Kroenlein et al. (2008) could not replicate this experimentally.

Our study illustrates the need for further research, including evaluation of vitamin A levels in wild turtles, comparative evaluation of water quality, and exploration for potential environmental contaminants.

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LITERATURE CITED

Brown JD, Richards JM, Robertson J, Holladay S, Sleeman JM. 2004. Pathology of aural abscesses in free-living eastern box turtles (*Terrapene carolina carolina*). *J Wildl Dis* 40:704–712.

Brown JD, Sleeman JM, Elvinger F. 2003. Epidemiologic determinants of aural abscessation in free-living eastern box turtles (*Terrapene carolina*) in Virginia. *J Wildl Dis* 39:918–921.

Carstairs SJ, Dupuis-Desormeaux M, Davy CM. 2018. Revisiting the hypothesis of sex-biased turtle road mortality. *Can Field-Nat* 132:289–295.

Gamble T. 2007. Incidence of aural abscesses in painted turtle (*Chrysemys picta*) populations in Minnesota. *Chelonian Conserv Biol* 6:293–295.

Kischinovsky M, Divers SJ, Wendland LD, Brown MB. 2019. Otorhinolaryngology. In: *Mader's reptile and amphibian medicine and surgery*, 3rd Ed., Divers ST, Stahl SJ, editors. Elsevier, St. Louis, Missouri, pp. 736–751.

Kroenlein KR, Sleeman JM, Holladay SD, Joyner PH, Brown JD, Griffin M, Saunders G, Smith SA. 2008. Inability to induce tympanic squamous metaplasia using organochlorine compounds in vitamin A-deficient red-eared sliders (*Trachemys scripta elegans*). *J Wildl Dis* 44:664–669.

Kulldorff M. 1997. Bernoulli, discrete Poisson and continuous Poisson models: A spatial scan statistic. *Commun Stat Theory Methods* 26:1481–1496.

Murray MJ. 1996. Aural abscesses. In: *Reptile medicine and surgery*, Mader DR, editor. W. B. Saunders, Philadelphia, Pennsylvania, pp. 349–352.

Murray MJ. 2006. Aural abscesses. In: *Reptile medicine and surgery*. 2nd Ed., Mader DR, editor. Saunders Elsevier, St. Louis, Missouri, pp. 742–746.

Schrader GM, Allender MC, Odoi A. 2010. Diagnosis, treatment, and outcome of eastern box turtles (*Terrapene carolina carolina*) presented to a wildlife clinic in Tennessee, USA, 1995–2007. *J Wildl Dis* 46: 1079–1085.

Smith GR, Iverson JB, Rettig JE. 2009. *Chrysemys picta* (painted turtle), *Graptemys geographica* (northern map turtle), *Trachemys scripta* (pond slider) aural abscesses. *Herpetol Rev* 40:213–214.

Wilier CJ, Lewbart GA, Lemons C. 2003. Aural abscesses in wild eastern box turtles, *Terrapene carolina carolina*, from North Carolina: Aerobic bacterial isolates and distribution of lesions. *J Herpetol Med Surg* 13(2):4–9.

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