The Canadian Field-Naturalist

Using iNaturalist to assess road mortality in Northern Map Turtle (*Graptemys geographica*) in Canada

David C. Seburn* **and Kathryn Wu**

Canadian Wildlife Federation, 350 Michael Cowpland Drive, Ottawa, Ontario K2M 2W1 Canada
*Corresponding author: davids@cwf-fcf.org

Seburn, D.C., and K. Wu. 2026. Using iNaturalist to assess road mortality in Northern Map Turtle (*Graptemys geographica*) in Canada. Canadian Field-Naturalist 139(4): 269–274. https://doi.org/10.22621/cfn.v139i4.3539

Abstract

Many species of freshwater turtles are negatively affected by road mortality. Although the mostly aquatic behaviour of Northern Map Turtle (*Graptemys geographica*) may reduce road mortality, the magnitude and spatial extent of this threat are poorly understood. We assessed road mortality in this species using iNaturalist Canada data. We found 244 observations of Northern Map Turtles on roads in Canada, spanning most of the Canadian range of the species. Not surprisingly, more turtles found on roads were dead (n = 160) rather than alive (n = 84). Over 60% of observations occurred in June, which corresponds with the nesting season. Road mortality appears to be widespread and to affect adult female Northern Map Turtles more than males or juveniles.

Key words: Community science; *Graptemys geographica*; Northern Map Turtle; roadkill

Introduction

Road mortality is a major threat to many species of freshwater turtles (Ashley and Robinson 1996; Steen and Gibbs 2004; Aresco 2005). Turtle populations are susceptible to decline as a result of small increases in adult mortality (Congdon *et al.* 1993; Heppel 1998), and road mortality in particular has been identified as a potential cause of population decline for some species (Gibbs and Shriver 2002). Turtle populations can also be slow to recover from decline, with no evidence of recovery even decades later (Pitt and Nickerson 2012; Keevil *et al.* 2018). Although widespread and abundant species, such as Painted Turtle (*Chrysemys picta*) and Common Snapping Turtle (*Chelydra serpentina*), often dominate the turtle species found on roads in northeastern North America (e.g., Langen *et al.* 2012; Garrah *et al.* 2015; Carstairs *et al.* 2018), others, including Northern Map Turtle (*Graptemys geographica*), are also at risk from road mortality.

In Canada, Northern Map Turtle occurs throughout much of southern Ontario and into southern Quebec (COSEWIC 2012). As a highly aquatic species, its distribution is mostly limited to large lakes and rivers (Vogt *et al.* 2018). Northern Map Turtles are often not documented in road surveys, despite their occurrence in the general survey area (MacKinnon *et al.* 2005; Farmer 2007; Langen *et al.* 2012; Choquette and Valliant 2016; Durkin *et al.*, 2022). In Canada, Northern Map Turtles make little use of terrestrial habitat except for nesting. Even basking sites tend to be on structures, such as logs, stumps, and rocks, in water and away from shore (Flaherty and Bider 1984; Fenech 2023). However, although many roads pose little risk to Northern Map Turtles because of their distance from lakes or rivers, road mortality can occur in locations where a road is adjacent to a large water body (Ashley and Robinson 1996).

We sought to better understand the magnitude and spatial pattern of road crossings by Northern Map Turtles in Canada. This species is listed by the Government of Canada as "at-risk" (SARA Public Registry 2026) and a better understanding of the threats it faces will be valuable for recovery planning and future status assessments. To understand road use in this species, we obtained observations of Northern Map Turtles from iNaturalist Canada. This community science platform that documents native and exotic species includes more than 17 million observations of over 41 000 species, submitted by more than 249 000 people (as of May 2025). There are more than 90 000 observations of turtles and over 5000 observations of Northern Map Turtles, making this a large and valuable data resource (iNaturalist Canada 2025a).

Data from iNaturalist have been used to address a variety of questions in ecology and conservation, including patterns in urban biodiversity (Callaghan *et*

A contribution towards the cost of this publication has been provided by the Thomas Manning Memorial Fund of the Ottawa Field Naturalists' Club.

©Ottawa Field Naturalists' Club

al. 2020), the distribution of exotic species (Seburn and Burns 2024), the effects of boat strikes on turtles (Seburn *et al.* 2023), and patterns in roadkill (Sahlean *et al.* 2024). We used Northern Map Turtle data from iNaturalist Canada to address two main questions: How widespread are road crossings for this species? and Is there a temporal pattern to when Northern Map Turtles are found on roads?

Methods

We downloaded all observations of Northern Map Turtles from the Canadian Amphibians and Reptiles on Roads project in iNaturalist Canada as of 30 September 2024. All photos were checked to ensure that the turtle was on or adjacent to a road. Those that showed turtles not on roads (e.g., basking on a log) or were duplicate records were removed from the dataset. Duplicate observations were screened by comparing the approximate location, date, time of the observation, and the photos. Both D.C.S. and K.W. evaluated these observations to ensure consensus. Most observations had already been labeled as alive on road (AOR), dead on road (DOR), or injured on road (IOR) and we classified the remaining observations based on the photos. We also excluded observations in driveways, parking lots, and on trails based on the photos or comments from the observer. In addition, females nesting on road shoulders were excluded as these turtles may not have crossed the road to nest. Thus, the dataset provides a conservative estimate of Northern Map Turtles observed on roads.

Injured turtles were categorized as AOR in our analysis. We did not attempt to sex turtles or to distinguish juveniles from adults from the photos, because the road killed turtles were often in poor condition. We did identify hatchlings as, in some observations, the plastron was visible and the lack of growth lines was clear. It is possible, however, that some yearling turtles may have been misidentified as hatchlings.

iNaturalist Canada obscures the location of observations for some species of conservation concern, including Northern Map Turtle, by assigning a random point within a 0.2 × 0.2 degree grid cell (roughly 20 × 20 km, depending on the latitude) around the observation point (iNatHelp 2025). Logistical difficulties prevented us from obtaining the true coordinates of each observation and hence each observation could be off by up to 20 km. Given this geographic uncertainty, we were unable to examine the types of roads where Northern Map Turtles were found or the distance to the nearest waterbody.

We determined the number of observations by month and year, and calculated their percentage of the total number of observations. We divided the Canadian range of the Northern Map Turtle into six regions based on the spatial distribution of the observations on roads (Figure 1). Because the data were not normally distributed, we used non-parametric chi-squared tests to test for differences in the proportion of observations among years, months, and regions, and between turtle statuses (dead or alive), with statistical significance defined as $P < 0.05$.

Results

Between 2009 and 30 September 2024, 244 Northern Map Turtle observations on roads were submitted by 91 observers. The median number of observations per observer was one (range 1–30). The observations spanned a distance of more than 800 km from southwestern Ontario to southern Quebec and broadly matched the main areas with observations of Northern Map Turtles in iNaturalist Canada (Figure 1). Over half of the observations (63.5%) were from 2023 and 2024. Significantly more turtles were observed on roads in 2024 than in 2023 ($\chi^2 = 38.3$ $P < 0.001$). Significantly more turtles on roads were reported dead ($n = 160$) than alive ($n = 84$; $\chi^2 = 23.7$, $P < 0.001$).

Northern Map Turtles were observed on roads from May to September (Figure 2). Significantly more turtles were found on roads during June than May, the month with the second most observations ($\chi^2 = 40.3$, $P < 0.001$). Hatchlings were found on roads only during May and June and made up 23.4% of all Northern Map Turtles on roads. Significantly more dead hatchlings ($n = 52$) than live hatchlings ($n = 5$) were found on roads ($\chi^2 = 38.8$, $P < 0.001$).

The number of observations per region varied greatly (Table 1). Southern Ontario (region 2; Figure 1) had significantly more observations than Southwestern Ontario (region 1), which had the second highest number of observations ($\chi^2 = 20.9$, $P < 0.001$). In the Southern Ontario region, 92 of 103 (89.3%) observations were in or near Long Point Provincial Park.

Discussion

A number of biases are related to wildlife-on-road data. Driving surveys will underestimate the amount of roadkill (Langen *et al.* 2007), but walking surveys will also fail to detect all reptile roadkills (Winton *et al.* 2018). In our current study, we do not know what percentage of observations were from observers walking versus driving. Although dead turtles will be present on the road for longer than live ones, carcasses typically remain on roads less than five days (Santos *et al.* 2011). The size of the carcass will also affect detectability. Hatchling Northern Map Turtles, which are ~3 cm in carapace length and weigh <10 g (Vogt *et al.* 2018), will likely have lower detection rates than adults.

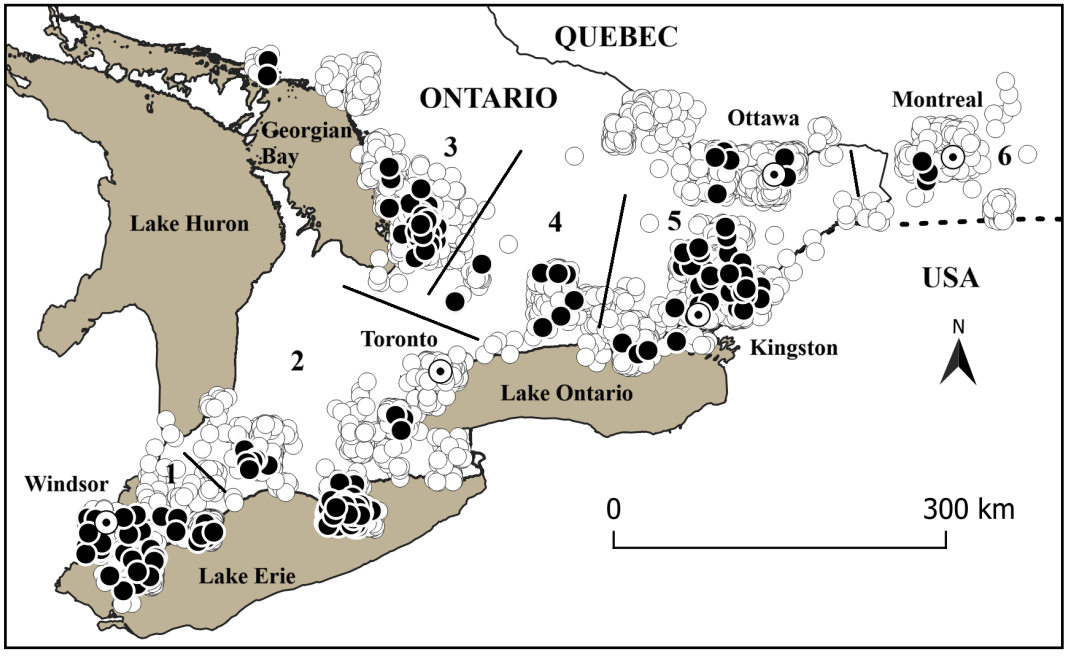


FIGURE 1. All 5635 observations of Northern Map Turtle (*Graptemys geographica*) from iNaturalist Canada (2025b; open circles) and 244 observations of individuals on roads (filled circles), 2009 through 30 September 2024. Note that iNaturalist has shifted all points by up to 20 km to keep exact locations obscured. We slightly shifted some points on roads to be more visible. The six regions are also indicated.

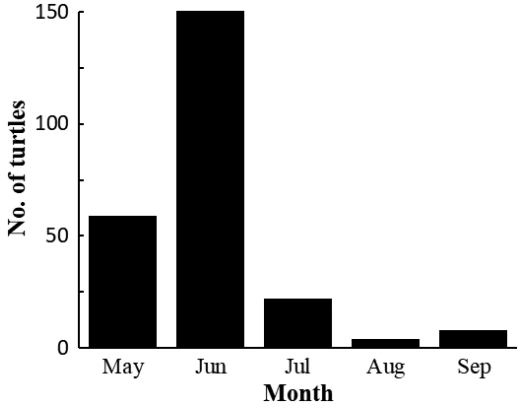


FIGURE 2. Number of iNaturalist Canada (2025b) observations of Northern Map Turtle (*Graptemys geographica*) found on roads in Canada, by month, 2009 through 30 September 2024.

The carapace length of adult male Northern Map Turtles is ~10–16 cm; for adult females it is ~17–29 cm (Vogt *et al.* 2018). Adult male Northern Map Turtles may be observed less frequently on roads than adult females because of their smaller size. However, this did not apply to Painted Turtles, where no significant difference was found in the sex ratio of individuals on roads in Ontario (Carstairs *et al.* 2018) despite the larger size of females. In addition, male Northern Map Turtles rarely move away from water. During a three-year survey of Northern Map Turtles, Seburn *et al.* (2025) never observed an adult male on land.

Data on iNaturalist are biased toward the recent past, because the number of users and observations has been growing exponentially (Di Cecco *et al.* 2021). This was also true for the Northern Map Turtle data where most observations were from 2023 and 2024. This bias confirms that roads are a continuing, ongoing threat. iNaturalist data are also biased toward more developed areas (Di Cecco *et al.* 2021), likely because more people live in urban areas. Thus, Northern Map Turtle observations may be biased toward cities and highly human-visited areas. The iNaturalist Northern Map Turtle data were widely dispersed across the known Canadian range of the species, although this area also corresponds with one of the most populated areas of the country.

The spatial distribution of iNaturalist data may be biased by a few keen observers surveying particular roads. This effect likely explains the high number of observations in the Southern Ontario region (Table 1) and particularly in Long Point Provincial

TABLE 1. Distribution of alive-on-road (AOR) and dead-on-road (DOR) Northern Map Turtle (*Graptemys geographica*) by region, based on data obtained from iNaturalist Canada (2025b), 2009 through 30 September 2024.

Region	No. AOR	No. DOR	Total
1. Southwestern Ontario	13	34	47
2. Southern Ontario	27	76	103
3. Georgian Bay area	13	23	36
4. Central Ontario	6	2	8
5. Eastern Ontario	22	25	47
6. Quebec	3	0	3
Total	84	160	244

Park. In this area, a major road mitigation project was installed during the 2000s, and there has been a long history of monitoring roads there (Ashley and Robinson 1996; Markle *et al.* 2017). Five of the seven people submitting >10 observations of Northern Map Turtles on roads had observations in the Long Point area. Overall, the iNaturalist Northern Map Turtle data are not strongly driven by a few observers, as the median number of observations was only one, and no observer submitted more than 30 observations.

Northern Map Turtles were observed on roads from extreme southwestern Ontario to southern Quebec (Figure 1). However, observations were aggregated, with just over 40% in the Long Point area, with other aggregations around Windsor, Georgian Bay, and Kingston. Areas with few or no observations of Northern Map Turtles on roads largely corresponded to areas lacking observations of the species (Figure 1). Noteworthy is the absence of observations of Northern Map Turtles on roads in the northeastern Georgian Bay area and northwest of Ottawa, two areas with numerous observations of the species. In general, our data suggest that roadkill is a threat for this species across its range, despite it being a highly aquatic turtle.

The number of hatchlings found dead on roads was not particularly high, although given the small size of hatchlings it is likely that many go unobserved. The dead hatchlings found on roads do suggest that even when nests hatch successfully on road shoulders, hatchling turtles face other threats. Slow-moving hatchlings that cross the road are at risk of being killed by vehicles. Although turtle populations are generally more sensitive to increased adult mortality (Congdon *et al.* 1993; Heppell 1998), juvenile road mortality can influence population viability (Keevil *et al.* 2023) and sustained road mortality of hatchlings could reduce recruitment into populations.

iNaturalist users reported 244 Northern Map Turtles on roads between 2009 and 2024. We likely underestimated the total number of turtles observed on roads, because, to be conservative in our threat assessment, we excluded observations of nesting on road shoulders. Although some of these turtles may not have crossed the road, it is likely that many did and were at risk of being hit by vehicles. Some road surveys have found few or no Northern Map Turtles on roads, but others have had different results. For instance, 11 Northern Map Turtles were found on the 1000 Islands Parkway in eastern Ontario over two years (Garrah *et al.* 2015). During a four-year study on the Long Point causeway in southern Ontario, 25 individuals were found dead (Ashley and Robinson 1996). From 2013 to 2017, 34 injured Northern Map Turtles were admitted to a turtle rehabilitation centre after being hit on roads in Ontario (Carstairs *et al.* 2018). Nagle and Russell (2020: 210) mention "substantial road mortality" of Northern Map Turtles after the construction of a highway next to a river in Pennsylvania. Taken collectively, our study adds to the body of evidence that road mortality is a threat to this species. We acknowledge, however, that road collisions in this species do not approach the number for some other species. Northern Map Turtles injured on roads made up <2% of turtles taken in by a turtle rehabilitation centre in Ontario (Carstairs *et al.* 2018).

Over 60% of turtles in our study were observed on roads during June, the nesting season in Canada, suggesting that most of these turtles were adult females on the move to lay eggs. Similarly, over 90% of the injured Northern Map Turtles brought to a turtle rehabilitation centre in Ontario were female (Carstairs *et al.* 2018). Sustained mortality of adult females can result in skewed sex ratios in turtle populations (Steen and Gibbs 2004; Aresco 2005) and possibly population declines (Congdon *et al.* 1993; Heppell 1998). Given that road mortality appears to preferentially affect adult female Northern Map Turtles, this threat should not be ignored in recovery planning for this species at risk.

Acknowledgements

We thank the many people who took the time to submit observations of Northern Map Turtles on roads to iNaturalist Canada. We are grateful to the Alder & Lipkus Foundation, ECO-Canada, and the Honda Canada Foundation for supporting the Canadian Wildlife Federation turtle conservation program. Thanks also to the reviewers who provided valuable comments on an earlier draft.

Literature Cited

Aresco, M.J. 2005. Mitigation measures to reduce highway mortality of turtles and other herpetofauna at a north Florida lake. Journal of Wildlife Management 69: 549–560. https://doi.org/10.2193/0022-541x(2005)069[0549:mmtrhm]2.0.co;2

Ashley, E.P., and J.T. Robinson. 1996. Road mortality of amphibians, reptiles and other wildlife on the Long Point Causeway, Lake Erie, Ontario. Canadian Field-Naturalist 110: 403–412. https://doi.org/10.5962/p.357494

Callaghan, C.T., I. Ozeroff, C. Hitchcock, and M. Chandler. 2020. Capitalizing on opportunistic citizen science data to monitor urban biodiversity: a multi-taxa framework. Biological Conservation 251: 108753. https://doi.org/10.1016/j.biocon.2020.108753

Carstairs, S., M. Dupuis-Desormeaux, and C.M. Davy. 2018. Revisiting the hypothesis of sex-biased turtle road mortality. Canadian Field-Naturalist 132: 289–295. https://doi.org/10.22621/cfn.v132i3.1908

Choquette, J.D., and L. Valliant. 2016. Road mortality of reptiles and other wildlife at the Ojibway Prairie Complex and Greater Park Ecosystem in southern Ontario. Canadian Field-Naturalist 130: 64–75. https://doi.org/10.22621/cfn.v130i1.1804

Congdon, J.D., A.E. Dunham, and R.C. Van Loben Sels. 1993. Delayed sexual maturity and demographics of Blanding's Turtles (*Emydoidea blandingii*). Conservation Biology 7: 826–833. https://doi.org/10.1046/j.1523-1739.1993.740826.x

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2012. COSEWIC assessment and status report on the Northern Map Turtle *Graptemys geographica* in Canada. COSEWIC, Ottawa, Ontario, Canada.

Di Cecco, G.J., V. Barve, M.W. Belitz, B.J. Stucky, R.P. Guralnick, and A.H. Hurlbert. 2021. Observing the observers: how participants contribute data to iNaturalist and implications for biodiversity science. BioScience 71: 1179–1188. https://doi.org/10.1093/biosci/biab093

Durkin, B.P., T.M. Richards-Dimitrie, K.P. Anderson, H.J. Howell, and R.A. Seigel. 2022. High conservation value of an urban population of a state-endangered turtle. Diversity 14: 354. https://doi.org/10.3390/d14050354

Farmer, R.G. 2007. Factors associated with vertebrate roadkill in southern Ontario parks. M.Sc. thesis, University of Guelph, Guelph, Ontario, Canada. Accessed 7 October 2026. https://tinyurl.com/2s366mjx.

Fenech, M. 2023. Why do freshwater turtles aggregate at basking sites? M.Sc. thesis, University of Ottawa, Ottawa, Ontario, Canada. Accessed 26 June 2026. https://ruor.uottawa.ca/items/7b522482-33fd-4142-9413-51afa42f27fb.

Flaherty, N., and J.R. Bider. 1984. Physical structures and the social factor as determinants of habitat use by *Graptemys geographica* in southwestern Quebec. American Midland Naturalist 111: 259–266. https://doi.org/10.2307/2425320

Garrah, E., R.K. Danby, E. Eberhardt, G.M. Cunnington, and S. Mitchell. 2015. Hot spots and hot times: wildlife road mortality in a regional conservation corridor. Environmental Management 56: 874–889. https://doi.org/10.1007/s00267-015-0566-1

Gibbs, J.P., and W.G. Shriver. 2002. Estimating the effects of road mortality on turtle populations. Conservation Biology 16: 1647–1652. https://doi.org/10.1046/j.1523-1739.2002.01215.x

Heppell, S.S. 1998. Application of life-history theory and population model analysis to turtle conservation. Copeia 1998: 367–375. https://doi.org/10.2307/1447430

iNatHelp. 2025. What is geoprivacy? What does it mean for an observation to be obscured? Accessed 21 May 2025. https://tinyurl.com/nhc9dawv.

iNaturalist Canada. 2025a. Help the turtles/Aidons les tortues project. Accessed 21 May 2025. https://www.inaturalist.ca/projects/help-the-turtles-aidons-les-tortues.

iNaturalist Canada. 2025b. Canadian amphibians and reptiles on roads project. Observations of Northern Map Turtles (*Graptemys geographica*) on roads in Ontario, Canada, from 2009 to 30 September 2024. Accessed 21 May 2025. https://www.inaturalist.ca/projects/canadian-amphibians-reptiles-on-roads.

Keevil, M.G., R.J. Brooks, and J.D. Litzgus. 2018. Post-catastrophe patterns of abundance and survival reveal no evidence of population recovery in a long-lived animal. Ecosphere 9: e02396. https://doi.org/10.1002/ecs2.2396

Keevil, M.G., N. Noble, S.P. Boyle, D. Lesbarrères, R.J. Brooks, and J.D. Litzgus. 2023. Lost reproductive value reveals a high burden of juvenile road mortality in a long-lived species. Ecological Applications 33: e2789. https://doi.org/10.1002/eap.2789

Langen, T.A., K.E. Gunson, C.A. Scheiner, and J.T. Boulerice. 2012. Road mortality in freshwater turtles: identifying causes of spatial patterns to optimize road planning and mitigation. Biodiversity and Conservation 21: 3017–3034. https://doi.org/10.1007/s10531-012-0352-9

Langen, T.A., A. Machniak, E.K. Crowe, C. Mangan, D.F. Marker, N. Liddle, and B. Roden. 2007. Methodologies for surveying herpetofauna mortality on rural highways. Journal of Wildlife Management 71: 1361–1368. https://doi.org/10.2193/2006-385

MacKinnon, C.A., L.A. Moore, and R.J. Brooks. 2005. Why did the reptile cross the road? Landscape factors associated with road mortality of snakes and turtles in the South Eastern Georgian Bay area. Pages 153–166 *in* Proceedings of the Parks Research Forum of Ontario. Waterloo, Ontario, Canada.

Markle, C.E., S.D. Gillingwater, R. Levick, and P. Chow-Fraser. 2017. The true cost of partial fencing: evaluating strategies to reduce reptile road mortality. Wildlife

Society Bulletin 41: 342–350. https://doi.org/10.1002/wsb.767

Nagle, R.D., and T.J. Russell. 2020. Nest site fidelity of Northern Map Turtles, *Graptemys geographica*. Chelonian Conservation and Biology 19: 209–216. https://doi.org/10.2744/CCB-1439.1

Pitt, A.L., and M.A. Nickerson. 2012. Reassessment of the turtle community in the North Fork of White River, Ozark County, Missouri. Copeia 2012: 367–374. https://doi.org/10.1643/CE-10-172

Sahlean, T.C., I. Gherghel, R. Zaharia, V.D. Gavril, R. Melenciuc, C.R. Stanciu, and A. Strugariu. 2024. Spatial and temporal patterns of road mortality in the Caspian Whip Snake (*Dolichophis caspius* Gmelin 1758) in Romania. Journal for Nature Conservation 77: 126547. https://doi.org/10.1016/j.jnc.2023.126547

Santos, S.M., F. Carvalho, and A. Mira. 2011. How long do the dead survive on the road? Carcass persistence probability and implications for road-kill monitoring surveys. PLoS ONE 6: e25383. https://doi.org/10.1371/journal.pone.0025383

SARA (*Species at Risk Act*) Public Registry. 2026. Species summary: Northern Map Turtle (*Graptemys geographica*). Government of Canada, Ottawa, Ontario, Canada. Accessed 16 October 2026. https://species-registry.canada.ca/index-en.html#/species/712-76.

Seburn, D.C., and M. Burns. 2024. Distribution and breeding potential of the exotic False Map Turtle (*Graptemys pseudogeographica*) in Canada. Canadian Field-Naturalist 138: 39-45. https://doi.org/10.22621/cfn.v138i1.3217

Seburn, D.C., M. Burns, I. Akinrinola, P. McIntyre, and J. Pagé. 2023. Assessing injury rates in Northern Map Turtles (*Graptemys geographica*) from motorboats using iNaturalist Canada. Herpetological Conservation and Biology 18: 244–253.

Seburn, D.C., M. Burns, and M. Fenech. 2025. Prevalence and severity of motorboat injuries in an urban population of Northern Map Turtles, *Graptemys geographica* (Lesueur, 1817) in Ottawa, Canada. Herpetology Notes 18: 629–634.

Steen, D.A., and J.P. Gibbs. 2004. Effects of roads on the structure of freshwater turtle populations. Conservation Biology 18: 1143–1148. https://doi.org/10.1111/j.1523-1739.2004.00240.x

Vogt, R.C., G. Bulté, and J.B. Iverson. 2018 *Graptemys geographica* (LeSueur 1817): Northern Map Turtle, Common Map Turtle. Pages 104.1–104.18 *in* Conservation Biology of Freshwater Turtles and Tortoises. *Edited by* A.G.J. Rhodin, J.B. Iverson, P.P. van Dijk, K.A. Buhlmann, P.C.H. Pritchard, and R.A. Mittermeier. Chelonian Research Monographs No. 5. https://doi.org/10.3854/crm.5.104.geographica.v1.2018

Winton, S.A., R. Taylor, C.A. Bishop, and K.W. Larsen. 2018. Estimating actual versus detected road mortality rates for a northern viper. Global Ecology and Conservation 16: e00476. https://doi.org/10.1016/j.gecco.2018.e00476

Received 29 May 2025
Accepted 3 July 2026
Associate Editor: W.D. Halliday