

# The Canadian Field-Naturalist

Volume 125, Number 3

July–September 2011

## Presence of Mammals in Ontario, Canada, Verified by Trail Camera Photographs Between 2008 and 2010

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Rosatte, Rick. 2011. Presence of mammals in Ontario, Canada, verified by trail camera photographs between 2008 and 2010. *Canadian Field-Naturalist* 125(3): 193–199.

Trail cameras were used to determine the presence of medium to large-sized wild mammals in Ontario between 2008 and 2010. A total of 27 different species of mammals across the province were photographed during 17308 trail-camera-nights. Presence indices (photographs per trail-camera-night) for the areas sampled in southern Ontario were highest for the following species: White-tailed Deer (*Odocoileus virginianus*), Raccoon (*Procyon lotor*), Coyote (*Canis latrans*), Eastern Gray Squirrel (*Sciurus carolinensis*), and Red Squirrel (*Tamiasciurus hudsonicus*). Presence indices for the areas sampled in northern Ontario were highest for White-tailed Deer, American Black Bear (*Ursus americanus*), Moose (*Alces alces*), Snowshoe Hare (*Lepus americanus*), and Red Squirrel. Trail camera photographs depicted extensive use of snowmobile trails by wildlife in southern Ontario.

**Key Words:** diversity, mammals, trail cameras, White-tailed Deer, *Odocoileus virginianus*, Raccoon, *Procyon lotor*, Coyote, *Canis latrans*, Eastern Gray Squirrel, *Sciurus carolinensis*, Red Squirrel, *Tamiasciurus hudsonicus*, American Black Bear, *Ursus americanus*, Moose, *Alces alces*, Snowshoe Hare, *Lepus americanus*, Ontario.

Rarely does one have the opportunity to photograph secretive wildlife species in their natural habitat, other than species that have become habituated to humans. However, trail cameras triggered by movement or by body heat that take high-quality photographs have increased the probability of capturing a photograph of most wildlife species (Sanderson and Trolle 2005; Kelly et al. 2008; O'Connell et al. 2011).

Many books and manuscripts have been published regarding the distribution and abundance of mammals in North America, including Ontario (Whitaker 1996; Feldhamer et al. 2003). However, very few studies have been published that document the actual presence of mammalian species in Ontario (Dobbyn 1994; Eder 2002). This study provides photographic evidence of the presence of medium to large-sized mammals in Ontario using trail cameras maintained by government biologists and technicians.

### Study Area and Methods

A study was initiated in 2008 to determine the presence of Cougars (*Puma concolor*) on the Ontario landscape, as described in Rosatte (2011). Cameras were placed at the locations of credible Cougar sightings throughout the province. A secondary objective of the study was to evaluate the presence of other medium to large-sized mammalian species in Ontario

in the vicinity of Cougar sightings. Trail cameras (RECONYX RC60, Cuddeback infrared and flash, Wildview, and Moultrie infrared) were set up across Ontario from Red Lake in the northwest to Kapuskasing in the northeast to Grand Bend in the southwest and Brockville in the southeastern part of the province. For the purposes of analysis, northern Ontario was considered to be the area north of the French River (approximately 46°00 north latitude). Northern Ontario includes both the Boreal Forest and the Great Lakes-St. Lawrence Forest regions (Ontario Ministry of Natural Resources 2011\*). The area of southern Ontario where the trail camera study took place is primarily eastern mixed forest in the Great Lakes-St. Lawrence Forest region and the Deciduous Forest region (Ontario Ministry of Natural Resources 2011\*). Trail cameras in the north were located near Atikokan, Blind River, Chapleau, Kapuskasing, Kenora, Nakina, Nipigon, North Bay, Red Lake, Sault Ste. Marie, and Timmins. In the south, trail cameras were located near Bancroft, Belleville, Bobcageon, Brighton, Brockville, Campbellford, Frankford, Lindsay, Midhurst, Minden, Norwood, Omemee, Orangeville, Parry Sound, Pefferlaw, Peterborough, Sarnia, Uxbridge, Whitney, Wingham, and Woodville.

Generally, cameras operated year round and were checked every one to two months, with batteries and



FIGURE 1A. Photograph of American Black Bears on a snowmobile trail near Sunderland, southern Ontario, September 26, 2008. Photo by R. Rosatte.

memory cards being replaced at that time. The memory cards were viewed using the trail camera or via a computer, photographs of mammals were verified to species by biologists and wildlife technicians, and the data (date the photograph was taken, location of the camera, and species) were tabulated in Microsoft Excel spreadsheets. I received the data files annually during the study. Where multiple photographs of the same animal had been taken in succession (e.g., the RECONYX cameras took five photographs in 5 sec), the animal was counted only once. However, if multiple animals of the same species were captured in a single photograph, the total number of animals present was counted.

Each camera operated on a 24-h basis which was considered to be one trail-camera-night. The data from all cameras were pooled, as initial testing of the cameras indicated there was little difference among cameras with respect to their ability to photograph medium to large-sized animals within 7 to 10 m of the camera. Since the dataset was limited to date, location, and species, analyses were restricted to presence/absence and a crude estimate of density in terms of animals/trail-camera-night. The data were standardized to provide presence indices by dividing the number of photographs per species by the number of trail-camera-nights. The locations of the photographed mammals were plotted and compared to range and distribution maps in Dobbyn (1994), Whitaker (1996), and Feldhamer et al. (2003) to determine whether the locations were within the species' present ranges as indicated on the published maps.

## Results

A total of 56 cameras recorded 154736 photographs during 17308 trail-camera-nights in Ontario from April 1, 2008, to March 31, 2010. About 96% of the photographs were either false triggers caused by the movement of vegetation on windy days or multiple photographs of the same animal that had remained within the range of a camera for several minutes, resulting in several hundred photographs being taken of the same individual.

In total, 27 species of wild mammals were photographed by the trail cameras: White-tailed Deer (*Odocoileus virginianus*), Raccoon (*Procyon lotor*), Coyote (*Canis latrans*), Eastern Gray Squirrel (*Sciurus carolinensis*), American Black Bear (*Ursus americanus*), Red Squirrel (*Tamiasciurus hudsonicus*), European Hare (*Lepus europaeus*), Snowshoe Hare (*Lepus americanus*), Red Fox (*Vulpes vulpes*), Moose (*Alces alces*), Gray Wolf (*Canis lupus*), Canada Lynx (*Lynx canadensis*), North American Elk (*Cervus elaphus*), Striped Skunk (*Mephitis mephitis*), Northern Flying Squirrel (*Glaucomys sabrinus*), Eastern Cottontail (*Sylvilagus floridanus*), North American Porcupine (*Erethizon dorsatus*), Virginia Opossum (*Didelphis virginiana*), Fisher (*Martes pennanti*), American Marten (*Martes americana*), Muskrat (*Ondatra zibethicus*), American Mink (*Neovison vison*), Wolverine (*Gulo gulo*), American Beaver (*Castor canadensis*), Woodchuck (*Marmota monax*), Ermine (*Mustela erminea*), and Bobcat (*Lynx rufus*) (Figures 1a to 1g). All locations fell within the published distribution ranges for each species, with the exception of the loca-



FIGURE 1B. Photograph of a male White-tailed Deer in the Peterborough area, southern Ontario, September 9, 2010. Photo by Rick Rosatte.



FIGURE 1C. Photograph of a Coyote in the Lindsay area, southern Ontario, January 6, 2010. Photo by Rick Rosatte.



FIGURE 1D. Photograph of a European Hare in the Cannington area, southern Ontario, December 20, 2009. Photo by Rick Rosatte.

tions of the North American Elk, which was restored to northern Ontario during 2000 and 2001, as described by Rosatte et al. (2007).

The presence indices (photographs per trail-camera-night) for the areas of southern Ontario that were sampled were highest for the following species: White-tailed Deer, Raccoon, Coyote, Eastern Gray Squirrel, and Red Squirrel (Table 1). Presence indices for the areas sampled in northern Ontario were highest for

White-tailed Deer, American Black Bear, Moose, Snowshoe Hare, and Red Squirrel (Table 2).

There was also extensive use of snowmobile trails by wildlife in southern Ontario during all seasons, 2008 to 2010. A total of 4465 trail-camera-nights in the Lindsay, Ontario, area resulted in 85760 photographs showing 15 species of wildlife using the trails as travel corridors. Species photographed using snowmobile trails included Coyote ( $n = 574$ ), Raccoon

TABLE 1. Number of photographs and number of photographs per trail-camera-night of mammals in northern Ontario taken between April 1, 2008, and March 31, 2010.<sup>1</sup>

	Species <sup>1</sup>															
	White-tailed Deer	American Black Bear	Moose	Snow-shoe Hare	Red Squirrel	Gray Wolf	Canada Lynx	American Elk	Red Fox	Coyote	Muskrat	Northern Flying Squirrel	Raccoon	Eastern Cottontail	American Marten	Fisher
Number of photographs	403	304	188	167	81	79	74	74	50	21	18	18	12	11	9	6
Number of photographs/trail-camera-night	0.08	0.06	0.04	0.03	0.02	0.02	0.01	0.01	0.009	0.004	0.003	0.003	0.002	0.002	0.002	0.001

<sup>1</sup>Total trail-camera-nights = 17308; trail-camera-nights for northern Ontario = 5289.

TABLE 2. Number of photographs and number of photographs per trail-camera-night of mammals in southern Ontario taken between April 1, 2008, and March 31, 2010.<sup>1</sup>

	Species <sup>2</sup>															
	White-Tailed Deer	Raccoon	Coyote	Eastern Gray Squirrel	Red Squirrel	Red Fox	Northern Flying Squirrel	Striped Skunk	European Hare	American Black Bear	Fisher	Virginia Opossum	North American Porcupine	Eastern Cottontail	Moose	Ermine
Number of photographs	1454	929	904	781	264	150	73	61	56	35	34	18	17	17	7	3
Number of photographs/trail-camera-night	0.12	0.08	0.08	0.07	0.02	0.01	0.006	0.005	0.005	0.003	0.003	0.002	0.001	0.001	0.001	0.0003

<sup>1</sup>Total trail-camera-nights = 17308; trail-camera-nights for southern Ontario = 12019.

<sup>2</sup>Four or five different White-tailed Deer, Coyotes, or Raccoons were found in single photographs taken by trail cameras in southern Ontario.



FIGURE 1E. Photograph of a Fisher in the Sunderland area, southern Ontario, August 23, 2009. Photo by Rick Rosatte.



FIGURE 1F. Photograph of a Canada Lynx in the Red Lake area, northern Ontario, September 1, 2009. Photo by Kim Austen.

( $n = 481$ ), White-tailed Deer ( $n = 183$ ), Red Fox ( $n = 72$ ), Striped Skunk ( $n = 39$ ), American Black Bear ( $n = 38$ ), European Hare ( $n = 23$ ), Eastern Gray Squirrel ( $n = 23$ ), and Fisher ( $n = 10$ ) (Figure 2). Six other species that were photographed using snowmobile trails are noted in Figure 2.

### Discussion

In the past, researchers have used photographs acquired by cameras set up on trails to estimate the abundance and relative density of certain mammalian species (Kelly et al. 2008; Negroes et al. 2010). However, in those studies, individual animals were identified in the photographs and were used to estimate animal density. Even though camera study locations were separated by several animal home ranges, individual animals could not be identified in this study because of the large volume of photographs. In addition, some species do not have significant variation in attributes, such as fur coloration or markings that would allow individuals in photographs to be differentiated. Since individual animals in this study could not be identified with any certainty, an indicator of presence in terms of animals per trail-camera-night was the only practical approach. It was not possible, given the limitations of the dataset, to examine other aspects of Ontario mammalian ecology, such as temporal behaviour patterns.

A significant number of photographs of White-tailed Deer, Raccoons, and Coyotes were acquired in southern Ontario; however, one should not infer from these data that these three species exist in high densities. Nevertheless, one can infer a significant presence of those species based on the sheer magnitude of the photographs. In some instances during this study, there were four or five different individuals of the same species in a single photograph at several camera locations spaced several home ranges apart in southern Ontario (e.g., this was true for White-tailed Deer, Raccoons, and Coyotes). This is indicative of a significant presence



FIGURE 1G. Photograph of a Wolverine in the Red Lake area, northern Ontario, July 8, 2009. Photo by Kim Austen.

on the landscape. At the other end of the spectrum, species that were seldom photographed in this study do not necessarily exist at low densities in the province. This could merely be a function of the fact that cameras may not have been placed in the habitats preferred by those species.

The trail cameras photographed about 31% of the wild mammalian species that are thought to be present in Ontario. There are 86 species of mammals in Ontario (Dobbyn 1994), and about 38% of those are small mammals, such as mice, moles, voles, shrews, and bats, which would not be expected to trigger the trail cameras due to their small body size. In addition, there was no possibility that another 11% of the mammalian species in Ontario would be photographed, as cameras were not placed in their ranges. Polar Bears (*Ursus maritimus*), seals, and whales fall into this category. Some of the other species present in Ontario that were not photographed include American Badger (*Taxidea taxus*) (which is a species at risk), Cari-

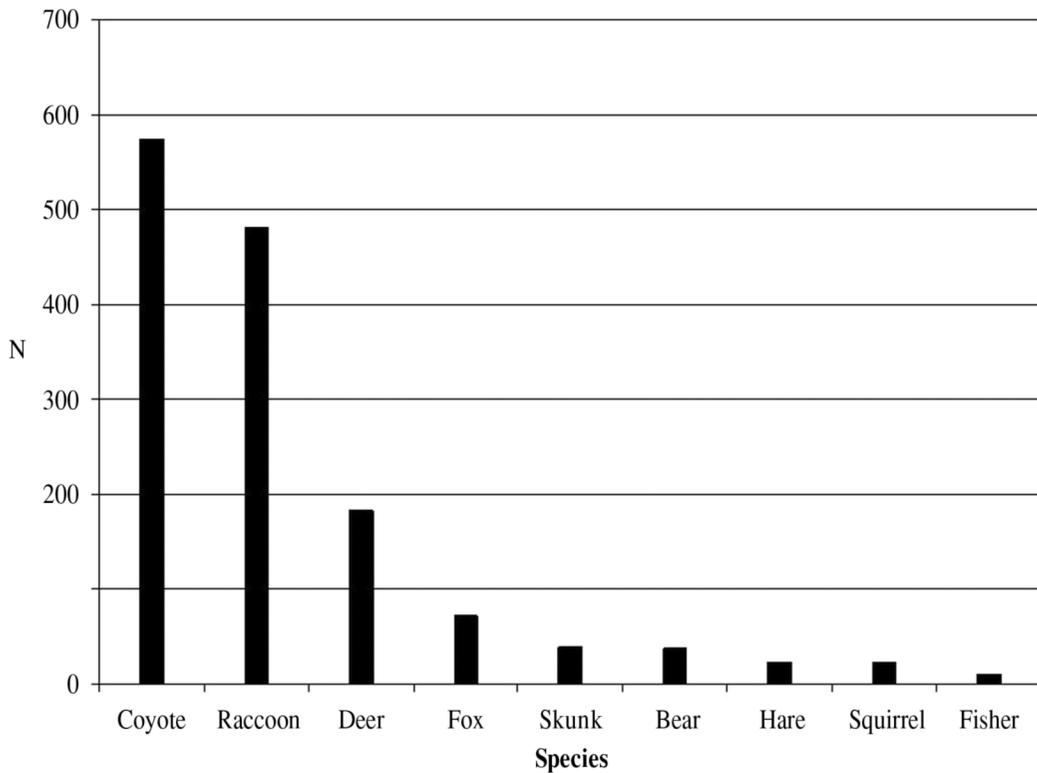


FIGURE 2. Number of photographs of mammals taken by trail cameras on snowmobile trails in southern Ontario between April 1, 2008, and December 31, 2010.<sup>1</sup>

<sup>1</sup> Other mammals included Eastern Cottontail ( $n = 8$ ), North American Porcupine ( $n = 7$ ), Virginia Opossum ( $n = 7$ ), Red Squirrel ( $n = 1$ ), American Mink ( $n = 1$ ), and Woodchuck ( $n = 1$ ). Deer = White-tailed Deer, fox = Red Fox, skunk = Striped Skunk, bear = American Black Bear, hare = European Hare, squirrel = Eastern Gray Squirrel. N = number of photographs of each species.

bou (*Rangifer tarandus*), and Arctic Fox (*Vulpes lagopus*), because few or no cameras were placed within their ranges. No photographs of the North American River Otter (*Lontra canadensis*) were acquired because cameras were not set up in aquatic habitats, and no photographs of the Eastern Chipmunk (*Tamias striatus*) were acquired because it would likely be too small to trigger the cameras.

The presence indices (animals per trail-camera-night) do not reflect actual density of animals but rather provide an indication of the presence of these species on the Ontario landscape. The presence and range of mammals in Ontario are affected by many factors, including climatic conditions, habitat (including forest type), land-use (e.g., agriculture), food availability, predation, and disease. For example, Virginia Opossums were photographed in southern Ontario only. This species is a recent immigrant to southern Ontario. The Virginia Opossum is not very hardy and

it has not yet adapted to severe winters, so it would not be expected to be present in northern Ontario. Another example is Raccoons and Striped Skunks, which do well in the agricultural and urban regions of southern Ontario. However, the boreal forest of northern Ontario is generally unsuitable habitat for Raccoons and Striped Skunks, and densities of these species are low in the north (Rosatte 2000; Rosatte and Larivière 2003; Rosatte et al. 2010).

Trail cameras proved to be a valuable and non-invasive wildlife research tool for recording the presence of medium and large-sized animals in Ontario. Cameras were able to operate year round in temperatures colder than  $-20^{\circ}\text{C}$  when batteries and memory cards were changed every one to two months. Trail cameras with appropriate experimental designs are currently being used in Ontario for such diverse projects as estimating the density of North American Elk in northern Ontario, determining their calving sites in the

southern part of the province, and determining the presence of an endangered species, *Puma concolor* (Rosatte et al. 2007; Rosatte, 2011).

### Acknowledgements

Appreciation goes to staff from 14 districts of the Ontario Ministry of Natural Resources who participated in the study. Trail camera data were provided by staff, including M. Allan, K. Austen, L. Anderson, E. Armstrong, B. Brown, S. Bird, G. Cull, R. Geauvreau, S. Haw, J. Hoare, T. Honsberger, L. Leduc, S. Lockhart, G. Moraal, N. Orton, C. Robinson (Ontario Parks), J. Sadowsky, J. Scheifley, B. Shirley, B. Steinberg (Ontario Parks), B. Stevenson, J. Trotter, N. Tuyten, M. Twiss, and several Timmins District staff. Thanks to T. Winter at Sault College, who also provided data for the study.

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Received 15 December 2010

Accepted 23 August 2011