

## **The Effects of Human Disturbance on Eastern Massasauga Rattlesnakes (*Sistrurus catenatus catenatus*) in Killbear Provincial Park, Ontario\***

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### **Introduction**

- Given the growing participation in outdoor recreation and the increasing popularity of parks and wilderness areas, animals are likely to encounter humans with increasing frequency. This suggests that an improved understanding of the effects of human disturbance would be prudent for conservation purposes, especially in relation to rare or endangered species.
- The Eastern Massasauga Rattlesnake is a small, venomous snake once found throughout much of southwestern Ontario. The snake has suffered pronounced range contraction due to human destruction of both individuals and habitat, and in 1991 was designated a threatened species by the Committee on the Status of Endangered Wildlife in Canada. Currently, four disjunct populations remain in Ontario; the largest occur on the Bruce Peninsula and the eastern shore of Georgian Bay, where their long-term viability is threatened by industrial, residential and recreational development.
- Protected habitat within the snake's remaining Ontario range can be found in a number of national and provincial parks, though the impact of the increasingly heavy use of these parks on snake populations is not known. Thus, whether human disturbance affects Eastern Massasauga Rattlesnakes is a question of increasing significance to the conservation of this species in Ontario.
- Although several investigators have suggested that human disturbance may affect snakes, this is the first study to address this issue systematically.

### **Methods and Materials**

#### *Description of Study Site*

- Killbear Provincial Park is located on a peninsula on the eastern shore of Georgian Bay, Ontario. The park is 1,756 ha in area and consists of mature second growth forest and scattered bedrock outcrops.
- The park attracts more than 200,000 visitors annually, primarily during the months of July and August. Human activity is concentrated in developed areas and along the shoreline, because park visitors engage in mainly aquatic-based recreation.
- Park visitors encounter rattlesnakes fairly frequently. For example, 21 snakes were captured on campsites from 1990-1993.
- The popularity of the park, and the frequency of human-snake interactions, make Killbear Provincial Park an ideal location to study the effects of human disturbance on Eastern Massasauga Rattlesnakes.

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\* This report arises from a poster paper at the 1998 Annual Meeting of the Parks Research Forum of Ontario.

### ***General Data Collection***

- We conducted a preliminary mark-recapture study of Eastern Massasauga Rattlesnakes in Killbear Provincial Park between 1992 and 1994.
- Most data for this study were collected from May-October in 1995 and 1996. All data were collected with the aid of a single field assistant in 1994 and 1995 and four field assistants in 1996.

### ***Radiotelemetry***

- Thirty adult Eastern Massasauga Rattlesnakes were captured in Killbear Provincial Park and surgically implanted with radio transmitters weighing 7.8 g or 9.4 g, with battery lifespans of 12 or 24 months, respectively.
- To minimize the effects of implantation, snakes were chosen in such a way that transmitter mass was less than 5% of body mass.
- All snakes were released within 15 m of their location of capture. Data collection did not begin until three days after release. When not in hibernation, snakes were generally located every second day.
- To determine whether snakes in disturbed areas increase their use of cover, we noted the visibility (not visible, partly covered or in the open) of transmitter-equipped snakes each time they were located.
- Similarly, to determine whether snakes in disturbed areas remain closer to potential refugia, we recorded the distance to nearest retreat site of transmitter-equipped snakes each time they were located.
- To assess the effects of disturbance on movement patterns, the distances and bearings between each transmitter-equipped snake's subsequent locations were determined. Distances <100 m were measured in the field using a tape measure and compass. Positions of locations separated by >100 m were determined by GPS and differentially corrected to  $\pm 2$  m.

### ***Quantifying Snake Exposure to Human Disturbance***

- The locations of transmitter-equipped snakes were given a disturbance rating ( $d_r$ ) based on the distance ( $d$ ) to the nearest source of human disturbance (road, trail, or campsite) ( $d > 50$  m,  $d_r = \text{low}$ ; 50 m to 10 m,  $d_r = \text{intermediate}$ ;  $d < 10$  m,  $d_r = \text{high}$ ). These ratings accurately reflect relative levels of disturbance at any given time because visitors rarely stray from developed areas.
- Mark-recapture data were collected from snakes not implanted with transmitters, so their exposure to human disturbance could not be quantified directly. Instead, we defined two sites within Killbear Provincial Park (A and B) that are subject to different levels of human disturbance. Snakes captured in Site A were assumed to have a higher exposure to human disturbance than those captured in Site B.

### ***Mark-Recapture***

- To assess the effects of human disturbance on the relative condition and growth rates of Eastern Massasauga Rattlesnakes, snakes were captured, measured, marked and then released.
- Snakes were located by searching suitable habitat or were discovered and reported by park staff and visitors.

- Adult snakes were marked by branding unique combinations of ventral scales or were injected subcutaneously with Passive Integrated Transponders (PIT tags). Neonate snakes were judged too fragile for either method and instead had their dorsal patterns photographed. These markings are unique to the individual and do not change over time.
- To assess the effects of human disturbance on the reproduction of Eastern Massasauga Rattlesnakes, we used ultrasonography to determine the reproductive condition (gravid vs. non-gravid) of captured females and to estimate the brood size of those found to be gravid.

## **Results**

### ***Radiotelemetry***

- We obtained a total of 1,217 radiotelemetry locations from 11 male and 19 female Eastern Massasauga Rattlesnakes.
- Snakes were tracked for variable lengths of time, and often not simultaneously. Many snakes were monitored for periods less than allowed by battery lifespan. For example, 10 snakes were killed during the course of the study. Two snakes were killed by predators, two were run over by cars, three died in hibernation, and three died of unknown causes. In addition, transmitters were removed from three snakes following complications, and three snakes could not be relocated due to transmitter failure.
- Neither ambient temperature or human disturbance affected the visibility of male and non-gravid females. Since snakes are known to avoid open areas, this apparent lack of response may actually reflect a perception of constant predation risk.
- Gravid females were significantly less visible in more disturbed areas. This result may reflect the tradeoff between these snakes' increased thermoregulatory requirements and their reduced ability to avoid predators through flight.
- Exposure to human disturbance did not affect the distance at which the snakes were found from potential retreat sites. This suggests that the antipredator behaviour of Eastern Massasauga Rattlesnakes does not emphasize flight, and is consistent with their apparently heavy reliance on crypsis and their potential for active defense (rattling and striking) if found.
- Gravid females moved significantly less per day than males and non-gravid females.
- The average distance moved per day by gravid females, non-gravid females, and males declined with increasing exposure to human disturbance. A number of investigators have noted that snakes remain motionless or freeze when approached by humans. In areas subject to heavy human disturbance, this response could disrupt normal snake movement patterns. We suggest that this behaviour explains the observed negative correlation between average distance moved per day and exposure to human disturbance by Eastern Massasauga Rattlesnakes in Killbear Provincial Park.

### ***Mark-Recapture***

- Exposure to human disturbance did not affect the condition or the growth rates of gravid female, non-gravid female or male Eastern Massasauga

Rattlesnakes. However, these findings must be accepted with caution, because none of the snakes used in these analyses were implanted with a transmitter. Thus, their exposure to human disturbance could not be determined accurately.

- Brood size (number of young) was positively correlated with female snout-vent length, but was not affected by female exposure to human disturbance. Again, these results must be interpreted with caution, due to small sample sizes and the concomitant low power of statistical tests.

## **Discussion**

- This study suggests that snakes may respond to even apparently benign human activities, and that these responses may be subtle, and thus easily-overlooked. Identification of such impacts will undoubtedly become an increasingly important aspect of protected areas management, especially for rare or endangered species.
- The conclusion that snakes do not suffer fitness costs as a result of human disturbance must be viewed with caution. Other effects, not assessed in the course of this study, may be present. For example, increased crypsis in areas subject to heavy human disturbance could decrease individual male reproductive success by disrupting the long distance movements involved in mate-searching behaviour. Sufficient human disturbance could isolate populations and thus contribute to inbreeding. Ongoing characterization of Eastern Massasauga Rattlesnake population structure in Killbear Provincial Park will address this issue.
- Human disturbance could also affect the survival and dispersal of neonates, which in turn could affect population age structure. Investigation of this issue is currently hampered by technological limitations.

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