Eastern Milksnake Monitoring in Rouge Park 2014 Report

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Eastern Milksnake Monitoring in Rouge Park: 2014 Report

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October 2014
Executive Summary

In 2010, a road mortality study conducted by the Ontario Road Ecology Group found a number of dead on road Eastern Milksnakes (*Lampropeltis triangulum*) on the roads bordering the Toronto Zoo. The discovery of high road mortality rates provided the impetus to investigate Milksnake movement and population sizes, and in 2011 an Artificial Cover Object (ACO) study was implemented. The study has continued for four consecutive years with an ever increasing number of Milksnakes identified. The investigation has taken place in the Rouge Park tablelands between Reesor Rd. and the Rouge River, from Steeles Rd. to Old Finch Ave, and near the Beare Road wetlands (Appendix I). The study seeks to determine the distribution, population size, and hibernacula (overwintering sites) of the Eastern Milksnake to develop a management plan that addresses mitigation and protection strategies. Using program MARK, the current population size is estimated at 48 ± 5 in the North and South study site and 88 ± 32 in the Valleyhalla study site. In the fall of 2014, one radio transmitter was attached to a Milksnake in the South study site which helped to successfully confirm an additional local hibernaculum. The six hibernacula identified from 2011 to 2014 represent important overwintering habitat for Milksnakes and should be protected to promote survival and stability in local populations. Knowledge of population demographics and critical habitat features represents a significant step forward for snake conservation and land management in Rouge National Urban Park. Given the park’s diverse landscape and proximity to some of the most urbanized areas in North America, species at risk that utilize unique habitat features should be celebrated and protected as an important part of Rouge Park’s natural heritage.
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1. Introduction

The Eastern Milksnake (*Lampropeltis triangulum*) is listed as a Special Concern Species at Risk (SAR) both provincially in Ontario (CASSARO 2008) and federally across Canada (COSEWIC 2002). Milksnakes in the Rouge National Urban Park (and in many places in Canada) have co-evolved with agricultural and urbanizing landscapes, and as a result, have learned to use anthropogenic (human made) structures as important habitat features (e.g. thermoregulation sites, overwintering areas, etc.). Historically, this species was often found in and around farmers’ fields and barns due to their attraction to the small mammal prey species that use farm field habitats for food and barns and sheds for shelter. Additionally, the foundations of large buildings such as barns provided the species with easily accessible hibernacula (overwintering sites). Therefore in order to conserve the species, it is important to conserve and protect anthropogenic features that are present where milksnakes are. The identification of these critical habitats for the Eastern Milksnake in Rouge National Urban Park (RNUP) will allow land managers to protect this species from further population decline and habitat loss. Key habitats include overwintering sites, nesting areas, thermoregulation sites, and travel corridors (COSEWIC 2002).

To investigate milksnake population sizes and movements in the RNUP tablelands between Reesor Rd. and the Rouge River, and from Steeles Rd. to Old Finch Ave., 100 Artificial Cover Objects (ACO) of aged plywood (120cm x 76cm) were placed in a 79 ha – area and spaced a minimum of 50 m apart (Appendix I). ACOs represent an ideal microhabitat for ectotherms because they have been shown to maintain consistent temperature and humidity levels over prolonged periods of time in contrast to fluctuating ambient air temperature and humidity levels (Joppa et al. 2009). The ACOs were concentrated near roads in a staggered pattern to maximize the area covered. Each ACO was checked a minimum of once per week from May-October in 2011, and April-October in 2012, 2013, and 2014.

The study utilizes data from all four years to draw conclusions about the movements and population size of the Eastern Milksnake population living north and east of the Toronto Zoo. From 2013 to 2014, there was a significant increase in the number of individual Eastern Milksnakes seen and recaptured. This finding coincides with previous research showing that ACOs become more effective as they age (Joppa et al. 2009). Currently, the population estimate of Eastern Milksnakes in the area surrounding the Toronto Zoo is estimated at 48 ± 5 for the North and South sites and 88 ± 32 for the Valleyhall site. As of 2014, the total number of non-unique Milksnake encounters was 130 and the total number of unique individuals identified was 65. With this large data set we can infer abundance, habitat use, movement patterns, and species distribution more effectively.

Intensive research on Milksnakes is still required before the ecology of the species can be fully understood. Thus far, characteristics of the populations in the Rouge National Urban Park (RNUP) study area match those that have been observed in other populations in different geographic regions. Typically, Milksnakes are found in isolated populations in relatively large numbers, and they rely heavily on anthropogenic structures in the environment. These characteristics provide an important
framework for understanding and protecting the species’ habitats and sharing stories to celebrate the rich cultural and natural history of the Rouge National Urban Park.

2. Methods

The study makes use of geo-referenced Artificial Cover Objects (ACOs) as the main method of monitoring Eastern Milksnakes. This method was chosen because of the documented success of ACOs in sampling herpetofauna populations, especially snakes (Hampton 2007). ACOs are a relatively passive method of sampling which reduces risk of injury to the target species. ACOs are also effective because they attract prey species like insects and rodents, which have been shown to attract snakes (Kjoss and Livaitus 2001). ACOs were found to be effective in early succession sites like the current study area, and yielded more captures than drift fences (Kjoss and Livaitus 2001). ACOs are ideal for sampling Eastern Milksnakes because of the snake’s elusive behaviour. A study of Massasauga Rattlesnakes (Sistrurus catenatus) using ACOs, showed that diversity and number of snake interactions increased drastically after the first year of study (Yagi 2011). Time is often needed for ACOs to effectively establish and a period of a few weeks or a few months is usually required before snakes will consistently use them (Joppa et al. 2009).

The 0.79 km² study area (Appendix I) is located in Rouge National Urban Park, consisting of abandoned farmhouses, sheds, barns and newly restored fields and forest. The area is primarily an agricultural field that is in the process of being restored with adjacent forest habitat. This study site was originally chosen due to the high number of Eastern Milksnakes found Dead on Road (DOR) on the roads adjacent to the site, and due to the presence of suspected hibernacula.

In early May of 2011 a total of 46 120-cm x 76-cm plywood boards were distributed across the study site in a staggered grid pattern to maximize the area covered (Reading 1997). An additional fifty-four boards were placed around suspected hibernacula sites later in the season. The ACO arrangement that was used was consistent with other snake studies (Patrick and Gibbs 2009). The distance between adjacent ACOs ranged from 50 m to 200 m, with the greatest concentration of ACOs focused along areas bordering roads, suspected hibernacula sites or railway tracks. The ACOs were allowed to age and weather for a period of two weeks before surveying began.

ACOs were divided into three sectors referred to as South, North and Valleyhalla (Appendix I). The South sector is approximately 21.6 ha and bordered by three roads, Old Finch Ave. to the South, Reesor Rd. to the West and Plughat Rd. to the East. The western end of the sector is comprised of low-lying wetland. The South sector contains one abandoned building. The North sector is approximately 33.8 ha and bordered by Reesor Rd. to the West, farmland and a railway to the North and a tributary of the Rouge River to the East. The North sector contains 5 abandoned structures. The combined area of the North and South sector is 55.4 ha, which is well beyond the average home range size (20 ha) of milksnakes (COSEWIC 2002). The Valleyhalla sector is located along Meadowvale Rd. near the Beare wetlands. This sector contained a mix of forest and field, including 5 standing structures.
Each sector of ACOs was checked separately once per week in the morning, to reduce disturbance to snakes as per the established protocol. Boards were checked from April to October between 8:00 am and 12:00 pm to maximize Eastern Milksnake encounters as this has been shown to be the most effective time frame for investigating snake-cover board interactions (Joppa et al. 2009). Surveying was not done during thunderstorms, but ACOs were checked in moderate rain. Environmental factors including shaded temperature, substrate surface temperature, precipitation, humidity and cloud cover were also measured at the start and end of each session. Any Milksnakes caught were measured and weighed, and the location recorded. Head patterns were recorded as digital photographs for use in case of recapture. The snake’s surface body temperature, the air temperature and the substrate surface temperature were recorded using a non-contact infrared thermometer. The time of capture was also recorded. Milksnake sheds found under or near ACOs were collected, measured, photographed and added to the database.

Roads were monitored once per week for Dead on Road (DOR) Milksnakes, and the perimeters of old barns and stone foundations were actively monitored on a regular basis to assess whether snake activity occurred there throughout the year. Snakes that were opportunistically discovered in this manner were recorded and referred to as "opportunistic". The 2011 sampling season totaled 65 days, 2012 totaled 75 days, 2013 totaled 80 days, and the 2014 totaled 71 days.

Starting in 2014, Milksnakes were brought in to the Toronto Zoo’s Wildlife Health Centre (WHC) if there was evidence of active dermatitis. This was done in order to test for the presence of Ophidiomyces ophiodiicola and Snake Fungal Disease (SFD) which has been known to affect the species (Sigler et al. 2013).

To calculate the estimated Milksnake population of the study area, the Cormack-Jolly-Seber (Cormack 1964; Jolly 1965; Seber 1965) method was used in conjunction with the population analysis (POPAN) model through program MARK (White and Burnham 1999). The model with the best goodness-of-fit was selected based on both the Akaike Information Criterion (AIC), which is a statistical model comparing relative quality between different sets of data, and the Quasi-likelihood Estimation (ĉ), which accounts for overdispersion (i.e. greater variability in the data than would be expected from the statistical model). The models selected were used to describe: abundance, immigration and birth rates, survival probability, and encounter probability. The North and South study area were treated as a separate population from the Valleyhall study area because of the absence of movement detected from one site to the other.

In early fall of 2014, one radio transmitter (model 1615, Advanced Telemetry Systems) was attached to an Eastern Milksnake from the South area north of Old Finch Ave. The transmitter was attached by taping the Eastern Milksnake's body posterior to the cloaca with gaffers tape, super gluing the transmitter to that layer of tape, and then taping over the transmitter. This method of attachment has been shown to be an easy, less invasive way to attach short term transmitters (Madrid and Garcia 2008). The transmittered Milksnake was tracked 2 times a day for a period of 1 week to identify potential hibernacula. The Milksnake’s GPS coordinates, body temperature, and shaded air
temperature were measured when located, and its GPS coordinates were mapped to illustrate movement patterns and habitat usage (Appendix II).

3. Results

For the Eastern Milksnake population size analyses, data from the North and South sites was combined; The North-South area was treated as a separate site from the Valleyhalla area because the sites are assumed to have very limited connectivity. The two sites are separated by 500 m, a four lane road with curbs, and a small forested area. Over the course of four years, no individuals have been found to utilize both sites. The separation of the study area into two sites helped to reduce error among the population size estimates.

For the analyses of this data the Population Analysis (POPAN) and Cormack-Jolly-Seber (CJS) models were employed. These two models were deemed to best analyze the data for the purposes of this report. The POPAN model estimates the population abundance (N) of the sample and the birth and immigration rates. The CJS model estimates the survival probability (phi) and the encounter probability (p) of the population.

For the purpose of this report the CJS and POPAN models have been simplified below.

The CJS model is represented as:

\[ \varphi(t)\rho(t) \]

Where:

- \( \varphi = \) phi, the survival probability
- \( \rho = p, \) the encounter probability
- \( t = \) t, time dependence on the model

There are four estimated parameters with this model represented as:

\[ \varphi(t)\rho(t) \]
\[ \varphi(t)\rho(.) \]
\[ \varphi(.)\rho(t) \]
\[ \varphi(.)\rho(.) \]

Where the period (.) represents a lack of time dependence on the model.

The POPAN model is represented as:

\[ \varphi(t)\rho(t)\beta(t) \]

Where:
- \( \varphi = \text{phi, the survival probability} \)
- \( \rho = p, \text{the encounter probability} \)
- \( \beta = \text{pent, the entrance probability} \)
- \( t = t, \text{time dependence on the model} \)

There are four effective estimated parameters with this model represented as:

\[
\varphi(t) \rho(t) \beta(t) \\
\varphi(t) \rho(.) \beta(t) \\
\varphi(.) \rho(t) \beta(t) \\
\varphi(.) \rho(.) \beta(t)
\]

Where the period (.) represents a lack of time dependence on the model. The pent value must always have time dependence for this model (White and Burnham 1999).

### 3.1 North and South

The North and South (NS) area is bordered by 3 moderately busy single lane roads: Reesor Road, Old Finch Avenue, and Plughat Road (Meadowvale). Milksnakes in this defined area have the option to travel unimpeded 2 kilometres north before hitting the next road, Steeles Avenue. The area north of the study area has similar habitat features with successional areas, and reclaimed farm fields with anthropogenic features. Historic OREG surveys found DOR and AOR Milksnakes moving east and west between habitats across Reesor Road. There is a road culvert where the Little Rouge Creek bisects Reesor Road that may allow for some unimpeded movement between habitats. The population at the survey site is considered open because individuals have the option to travel safely outside of the immediate study area. There are two confirmed hibernacula in the study site.

#### 3.1.1 Cormack-Jolly-Seber

The best fit CJS parameter for this model was found to be \( \varphi(.) \rho(t) \) which indicates a time dependence on the encounter probability and no time dependence on the survival probability. This matches with literature correlating a time dependence on ACO studies and their effectiveness over time (Joppa et al. 2009). With this model it was found that the survival probability of the population over the course of 4 years was 45\% \pm 16\%. This survival probability figure includes neonates as well as full grown adults which may have separate survival probabilities accounting for the large variance. It is assumed that there is a significantly higher mortality rate in neonates than in full grown adults.

#### 3.1.2 POPAN

The POPAN analysis for the North-South population of Milksnakes showed the best fit parameter to be \( \varphi(.) \rho(t) \text{pent}(t) \). This parameter again corresponds with previous literature and also suggests that the survival probability of the species has remained constant over time. Using this population model, the gross population size estimate for the NS population is 48 \pm 5.
3.2 Valleyhalla
The Valleyhalla area is bordered by one four lane road, Meadowvale Road, which may severely affect connectivity to other habitats to the west of the study site. The site is close to the Little Rouge River, the Beare wetlands and many anthropogenic features with limited disturbance. There are two potential hibernacula available for the large population of snakes present.

3.2.1 Cormack-Jolly-Seber
The best fit CJS parameter for this model was found to be phi(.)p(t) which again indicates a time dependence on the encounter probability of snakes, and no time dependence on the survival probability. With this model it was found that the survival probability of the population over the course of 4 years was 30% ± 1%. What is interesting about this site is that there are very few neonate and yearling Milksnakes present at the site, which may explain the small margin of error. Over the course of 4 years only 3 neonate Milksnakes were found. All young Milksnakes were found at board 86 which is at the northern corner of the cluster of ACOs on the site. If the probability of Milksnakes using ACOs is the same across all age groups, this suggests there may be no ideal nesting habitat for Milksnakes at this site. This also may suggest that the population of Milksnakes present have all immigrated to the site.

3.2.2 POPAN
The POPAN analysis for the Valleyhalla population of Milksnakes showed the best fit parameter to be phi(.)p(t)pent(t). This parameter corresponds well with previous literature suggesting that survival probability is constant and encounter probability is changing. The gross population estimate for Milksnakes in the Valleyhalla area is 88 ± 32.

3.3 Radio Tracking
In 2013, 3 transmitters were attached to 3 individual Milksnakes that were tracked once per day. This led to the successful identification of one hibernaculum. In 2014, one additional transmitter was attached to a Milksnake. This Milksnake was tracked twice per day over the course of two days before the transmitter was removed. An additional hibernaculum was successfully located and confirmed at 43.826681, -79.184106 (Appendix II). The Milksnake’s movements over the course of this period appeared to be very direct in nature, as it moved directly from the coverboard to the hibernaculum (Appendix II).

3.4 Snake Fungal Disease
Two Milksnakes with significant dermatitis (scale rot) were brought in to the Toronto Zoo’s WHC to test for the presence of Ophidiomyces ophiodicolula and Snake Fungal Disease (SFD) which has been known to affect the species (Sleeman 2013). The first Milksnake (ID 1302) had a large portion of its tail missing as well as its right eye. A biopsy was taken of a growth on the ventral side of the snakes’ body anterior to the cloaca. Additionally, a fecal sample and x-ray were taken of the snake. The fungal analysis showed the presence of Fusarium sp. with superficial debris and fungi consistent with dermatitis. The Fusarium sp. fungus grows on a variety of plants and is usually non-pathogenic to animals but the fungal presence is thought to be ancillary to the presence of scale rot (Reavill et al. 2004). A second Milksnake (ID 1310) was brought in with a large patch of scale rot on the posterior
side of the snake. A fungal swab was taken as well as a fecal sample. The fungal analysis was inconclusive.

3.5 Artificial Cover Object Usage
A total of 15 new Eastern Milksnake individuals were found in the 2014 season. This brings the total number of unique individuals identified in both populations to 65. Years 3 and 4 of the study account for 71% of the total number of individuals found. These findings correspond with the scientific literature and the models we used to analyse our data which demonstrate that ACOs become more effective over time.

The most successful month for Milksnake surveying using ACOs is July (Figure 1). When the ambient air temperature exceeds 30°C Milksnakes may seek refuge underneath the ACOs, making the snakes easier to find in warmer conditions (Row et al. 2006).

![Figure 1: Eastern Milksnake ACO interactions per month from 2011-2014 (includes recaptures of the same individuals).](image)

ACO interactions with other snake species were also recorded. It is evident that the increase in use of the ACOs is not species-specific (Figure 2 and Appendix III).
4. Discussion

The abundance of Milksnakes found in the study area is, in part, due to the complexity of the landscape with forest clearings, edge habitat, increased rodent populations associated with agricultural crops, and a reliance on anthropogenic overwintering habitats. The robust population of milksnakes in this section of the park is also very much tied to the agricultural history of the area. Animals which use anthropogenic structures within Rouge National Urban Park fill a unique ecological niche; this species at risk can serve as an example of an animal that can adapt and co-exist with humans if it is afforded the habitat it needs and accepted as an integral part of the environment.

Connectivity throughout the RNUP is important for all wildlife, including Milksnakes. Finding ways to reconnect fragmented habitats will benefit all species, and is essential to the preservation of species at risk snakes in the park. Milksnakes in the study area exist in two separate populations in habitats fragmented by 500 metres of road; the connectivity between the two populations appears to be entirely severed, since no individual has ever been captured in both study areas in four years. The installation of terrestrial ecopassages along Meadowvale Avenue may therefore benefit Milksnakes, as well as other terrestrial species, by increasing habitat permeability and permitting increased gene flow between populations.

When looking at the 2010 OREG study map (Appendix IV), there is a high volume of DOR snakes localized around the crushed gravel road at 3 Reesor Road. Eastern Milksnakes are known to prefer a forest edge habitat which is bisected in this case by Reesor Road. Snakes may be utilizing the crushed gravel road at 3 Reesor Road as a travel corridor which could explain the increase in DOR snakes at the junction. A terrestrial culvert may lower the frequencies of DOR snakes but future research would be needed to find out what types of culverts would be effective (Garrah 2012).
Attaching radio transmitters to Milksnakes in 2013 and 2014 helped to identify a hibernaculum at 3 Reesor Road, a hibernaculum (Old Finch Barn) on Old Finch Ave., and another potential hibernaculum in the Valleyhalla area (Appendix II). These critical overwintering habitats should be protected by RNUP as it is unclear how many other hibernacula support the present population. Habitat protection and creation strategies that are developed based on these sites will be useful to extrapolate to other areas in the park, as it is likely that the conditions of these hibernacula will be similar to the conditions of other hibernacula in areas of similar habitat.

A population viability assessment would be necessary to finalize a recovery action plan for the Rouge Park’s Eastern Milksnake populations. The data collected in the past four years will help to determine if the population is at risk of extinction, and help to identify appropriate mitigation strategies to protect the species from further declines.

4.1 Future Recommendations
Further study is required to better understand the overall distribution of Milksnake populations in RNUP. In order to identify different populations and quantify population sizes, mark-recapture studies should be expanded to focus on suitable habitats throughout the park, and population estimates should be compared with areas outside of the park as well. Dr. Jeff Row, a post-doc at the University of Waterloo specializing in herpetology, is well-placed to conduct this type of investigation; Jeff has initiated a proposal to conduct this research, in partnership with the Toronto Zoo, through Parks Canada and the MNRF’s Species at Risk Research Fund for Ontario. Further radio-telemetry can also be paired with mark-recapture studies to determine egg-laying sites, prime basking areas, travel corridors and additional hibernation sites. Ideally, an investigation to look at prey densities and test for correlations between the abundance of prey and Milksnakes would be paired with a park-wide ACO and radio-telemetry study to help explain the distribution of the species in the park.

Future studies should focus on identifying critical habitat and primary sites for mitigation of road mortality. It will be important to protect the sites that are most critical to the persistence of the species (e.g. sites for denning, reproducing, thermoregulating, hibernating) and this includes identifying primary movement pathways intercepted by roads in order to provide mitigation options (e.g. installation of signage, ecopassages, etc.). Road mortality surveys can be expanded to include roads adjacent to additional snake populations in other areas of the park; this will help inform land managers about snake roadkill hotspots and identify priority areas for mitigation.
5. References


Jolly, G. M. “Explicit estimates from capture-recapture data with both death and immigration-stochastic models.” Biometrika 52 (1965); 225-247.


Appendix I: ACO Distribution and Study Site
Appendix II: Milksnake Hibernacula

Milksnake Movement

ACO

Date

- August 28
- August 29
Appendix III: Total ACO interactions of all snakes found from 2011-2014 (includes recaptures of the same individuals).

<table>
<thead>
<tr>
<th>Species</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<tbody>
<tr>
<td>Eastern Milksnake</td>
<td>10</td>
<td>13</td>
<td>56</td>
<td>34</td>
</tr>
<tr>
<td>DeKay’s Brownsnake</td>
<td>2</td>
<td>2</td>
<td>24</td>
<td>49</td>
</tr>
<tr>
<td>Eastern Gartersnake</td>
<td>26</td>
<td>19</td>
<td>67</td>
<td>58</td>
</tr>
<tr>
<td>Northern Red-bellied Snake</td>
<td>11</td>
<td>2</td>
<td>8</td>
<td>31</td>
</tr>
</tbody>
</table>
Appendix IV: Snake Hotspots on Reesor Road (OREG Study – 2010)

Legend
- Red: Snake hotspots
- Purple: AOR and DOR snakes
- Black: Roads
- Brown: Railway tracks

Natural Habitat
- River
- Wetland
- Successional
- Meadow
- Forest

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<tr>
<th>Number</th>
<th>Distance</th>
<th>Density</th>
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<td>2</td>
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<tr>
<td>4</td>
<td>2170</td>
<td>0.076</td>
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</table>

Hotspot locations for snakes found along Reesor Road during the 2010 Rouge Park wildlife/road interaction study, Restoration, Roads & Wildlife.

Source: Base Maps: 2002 OMNR colour infrared aerial imagery, and TRCA Natural Habitat mapping

ecokare international
Appendix V: Milksnake Inventory Field Data Sheets

**MILK SNAKE SEARCH EFFORT SHEET**

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Starting Location Description</th>
<th>Date</th>
<th>UTM Easting</th>
<th>UTM Northing</th>
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<tr>
<th>Time</th>
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<th>STOP</th>
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<td>Shaded Air Temp</td>
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<td>°C</td>
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<td>Substrate Temp</td>
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<td>°C</td>
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<td>Wind Speed</td>
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<td>m/sec</td>
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<td>Humidity</td>
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<td>%</td>
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<th>Cloud Cover</th>
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<th>25%</th>
<th>50%</th>
<th>75%</th>
<th>100%</th>
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<tbody>
<tr>
<td>Precipitation</td>
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<td>mod. rain</td>
<td>none</td>
<td>drizzle</td>
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<th>Time Out</th>
<th>Penalties</th>
<th>Total Min.</th>
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<table>
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<th>Transect length (by GPS)</th>
<th>Total Survey Time</th>
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<table>
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<tr>
<th>Total Snakes Found</th>
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<tbody>
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<td>□ Eastern milksnake Lampropeltis triangulum</td>
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<tr>
<td>□ Dekay snake Storeria dekayi</td>
</tr>
<tr>
<td>□ Eastern Gartersnake Thamnophis sirtalis</td>
</tr>
<tr>
<td>□ Red Bellied snake Storeria occipitomaculata</td>
</tr>
<tr>
<td>□ Northern Ribbonsnake Thamnophis sauritus</td>
</tr>
<tr>
<td>□ Ring Neck snake Diadophis punctatus</td>
</tr>
<tr>
<td>□ Water snake Nerodia sipedon</td>
</tr>
<tr>
<td>□ Smooth Green Snake Opheodrys vernalis</td>
</tr>
<tr>
<td>□ Unknown species</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coverboards checked WITH snakes (Coverboard ID #s):</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Pit-fall/Funnel traps checked WITH snakes (Trap ID #s):</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Comments (use back as needed)</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

|                               |                               |                               |                               |                               |
|                               |                               |                               |                               |                               |
|                               |                               |                               |                               |                               |
|                               |                               |                               |                               |                               |
|                               |                               |                               |                               |                               |
**MILK SNAKE DATA SHEET**

| General Location: __________________________ | Filled out by: __________________________ | Site Name: __________________________ |

### 1. Thermal Data

- Infrared Temps
  - Body: ________ °C
  - Shaded Air Temp: ________ °C

### 2. Behavioral Data

- Lying still
- Coiled tight
- Moving
- Looped (curled, not touching)
- Fully exposed
- Straight
- Partially covered

### 3. Encounter Information

- Date: (MM/DD/YY)________________________
- Time of sighting ____________
- General Location______________________
- UTM Northing ____________ UTM Easting___________
- +/- ____________ m

### 4. Mortality Data

- Snake dead? ☐ Yes ☐ No
- Estimated time since death ____________

### 5. Habitat and Spatial Data

- Photo #s: ____________

#### Percent Cover Types

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>S</th>
<th>E</th>
<th>W</th>
<th>Dist. to nearest tree ____________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dist. to nearest shrub ____________</td>
</tr>
<tr>
<td>% Canopy Cover</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dist. to nearest forest edge _______</td>
</tr>
<tr>
<td>Log</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dist. to nearest road ____________</td>
</tr>
<tr>
<td>Mean Dist Tree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Dist Shrub</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Other Notes (use back if needed):**