

## Important Amphibian and Reptile Area

### **Narcisse Wildlife Management Area (NWMA)**

#### Personal Information

**Name:** Brandi Prouten and Pamela Rutherford

**Organization/Affiliation:** Brandon University

**Address:** Department of Biology, Brandon University, 270 18th St

**City/Town:** Brandon **Province/Territory:** Manitoba

**Postal Code:** R7A 6A9 **Telephone:** (204) 727-9607

**E-mail:** [prouteb134@brandonu.ca](mailto:prouteb134@brandonu.ca) and [rutherfordp@brandonu.ca](mailto:rutherfordp@brandonu.ca)

#### Location

**Site names:** Narcisse Wildlife Management Area (NWMA)

**Province/Territory:** Manitoba **County/Region/District(s):** Interlake Region

**Closest City/Town:** Town of Narcisse

**UTM/Geographical Coordinates:** 50°40'N 97°39'W

**Directions to Site:** Travelling from Winnipeg, 140km North on highway 7, switch to 17 at Teulon going North West. Continue north passing through Inwood and Narcisse. 6km north of Narcisse, turn east at the den sign on right hand side of the road. Follow the short road to the parking lot.

**Maps:** (Figures 1-3) maps attached at end of document.

**Other:** At the site, there are 3 kilometres of trails that are easy to travel for the most inexperienced of hikers (Figure 2). Interpretive signage provides a description of the area and natural history information on the resident red-sided garter snakes, as well as on other common wildlife species in the area.

#### Physical Description

**Area:** 11,822 ha

The NWMA has basic karst topography as well as a ridge and swale topography. The karst landscape of the region occurs where the limestone rock, which is very common for the Interlake region of Manitoba (Figures 1, 3), becomes exposed to the elements (Bilecki 2003). The exposed limestone is slowly dissolved away, creating caves, crevices, and sink holes. A mixture of elevations in the rock bed creates the above-mentioned ridge and swale topography.

The NWMA consists of Crown land which is now designated by the Province for the protection of wildlife habitat. Much of the work to create this WMA occurred during the Federal-Provincial Alternate Land Use Program of the 1970's; local private lands that were unsuitable for agricultural use were acquired by the program and added to the existing Crown land base to create the NWMA (Roberts, D. 2009: Personal Communication).

The area was previously grazed until the Narcisse Snake Dens were annexed from the Prairie Farm Rehabilitation Administration (PFRA) Narcisse Community Pasture in 1982 (Roberts, D. 2009: Personal Communication). Since the early 1980's, the area around the snake dens has not been used to graze livestock. Occasionally they allow haying of the old forage field in the area when local forage supplies are short due to drought or excess water (Roberts, D. 2009: Personal

Communication). Rather wet conditions and poor drainage in the area limits its suitability for most agricultural practices.

The NWMA generally and the Narcisse Snake Dens in particular are covered in large expanses of a mixture of aspen forest and open meadows. There are also a significant number of seasonal water bodies in the area and other temporary and permanent water bodies including the large Fish Lake complex to the east (Roberts, D. 2009: Personal Communication).

**Land Ownership**

**Name:** Narcisse Wildlife Management Area

**Organization/Affiliation:** Manitoba Conservation (Site Manager: Dave Roberts)

**Address:** Box 6000

**City/Town:** Gimli **Province/Territory:** MB

**Postal Code:** ROC 1B0

**Telephone:** 204-642-6078 **Fax:** 204-642-6108

**E-mail:** [Dave.Roberts@gov.mb.ca](mailto:Dave.Roberts@gov.mb.ca)

The land owners are aware of this site nomination. There were a number of people such as Dave Roberts, the Conservation Officer in the area and Dr. Robert Mason, Professor of Zoology, Oregon State University, who participated in the process.

**Amphibian and Reptile Species**

| <b>Species</b>  | <b>Status</b>   | <b>No. of Individuals</b> | <b>References</b>  |
|---|-----------------|---------------------------|--|
| <i>Thamnophis sirtalis parietalis</i><br>(Red-sided Garter snake)         | Not at Risk     | ~ 50,000                  | <a href="http://www.gov.mb.ca/conservation/wildlife/spmon/narsnakes/snakes_status.html">http://www.gov.mb.ca/conservation/wildlife/spmon/narsnakes/snakes_status.html</a><br>Dave Roberts, Dr. Robert Mason, CARCNET |
| <i>Thamnophis radix</i><br>(Western Plains Garter snake)                  | Not at Risk     | Unknown                   | Dave Roberts, and Dr. Robert Mason, CARCNET  |
| <i>Storeria occipitomaculata</i><br>(Northern Red-Bellied Snake)          | Not at Risk     | Unknown                   | Dave Roberts, CARCNET  |
| <i>Chrysemys picta bellii</i><br>(Western Painted Turtle)                 | Not at Risk     | Unknown                   | Dave Roberts, CARCNET  |
| <i>Chelydra serpentina</i><br>(Common Snapping Turtle)                    | Special Concern | Unknown                   | Dave Roberts, CARCNET  |
| <i>Opheodrys vernalis</i><br>(Smooth Green Snake)                         | Not at Risk     | Unknown, but very common  | Dave Roberts, CARCNET  |
| <i>Anaxyrus americanus</i><br>(American Toad)                             | Not at Risk     | Unknown                   | Dave Roberts, CARCNET  |
| <i>Anaxyrus hemiophrys</i><br>(Canadian Toad)                             | Not at Risk     | Unknown                   | Dave Roberts, CARCNET  |
| <i>Hyla chrysoscelis</i><br>(Cope's Grey Treefrog)                        | Not at Risk     | Unknown                   | Dave Roberts, CARCNET  |
| <i>Hyla versicolor</i><br>(Gray Treefrog)                                 | Not at Risk     | Unknown, but very common  | Dave Roberts, CARCNET  |
| <i>Pseudacris maculata</i><br>(Boreal Chorus Frog)                        | Not at Risk     | Unknown                   | Dave Roberts, CARCNET  |
| <i>Lithobates pipiens</i><br>(Northern Leopard Frog – Prairie Population) | Special Concern | Unknown                   | Dave Roberts, CARCNET  |
| <i>Lithobates sylvaticus</i><br>(Wood Frog)                               | Not at Risk     | Unknown, but very common  | Dave Roberts, CARCNET  |

## **Other Species**

The table below lists a number of species that do not belong to either the reptiles or the amphibians, but are common in the area. Many of these species are listed by COSEWIC, and others are common, but require the area for life.

| <b>Species</b>                                     | <b>Status</b>   | <b>Importance of Site</b>                          | <b>References</b>  |
|--|-----------------|--|--|
| <i>Danaus plexippus</i><br>(Monarch)               | Special Concern | Summer breeding grounds                            | <a href="http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=294">www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=294</a> |
| <i>Asio flammeus</i><br>(Short-eared Owl)          | Special Concern | Breeding/Foraging/ Wintering Habitat               | <a href="http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=60">www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=60</a>   |
| <i>Coturnicops noveboracensis</i><br>(Yellow Rail) | Special Concern | Summer Breeding/ Foraging Habitat                  | <a href="http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=574">www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=574</a> |
| <i>Chordeiles minor</i><br>(Common Nighthawk)      | Threatened      | Summer Breeding/ Foraging Habitat                  | <a href="http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=986">www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=986</a> |
| <i>Hesperia dacotae</i><br>(Dakota Skipper )       | Threatened      | Breeding/Foraging/ Juvenile Rearing Habitat        | <a href="http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=792">www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=792</a> |
| <i>Ixobrychus exilis</i><br>(Least Bittern)        | Threatened      | Summer Breeding/ Foraging/Juvenile Rearing Habitat | <a href="http://www.mb.ec.gc.ca/nature/endspecies/sar/db08s12.en.html">www.mb.ec.gc.ca/nature/endspecies/sar/db08s12.en.html</a>             |

## **Site Criteria:**

### **1. Species of Conservation Concern**

The Northern Leopard Frog (Prairie Population) is an inhabitant of this area. This sub-population is of Special Concern in the province of Manitoba (COSEWIC 2009). This species is widespread but occurs as scattered populations that fluctuate widely in size. The destruction or modification of the species' breeding, summer, or overwintering habitat, or a change that prevents the frogs from moving from one habitat type to another, can eliminate a local population. Introduction of animals or plants, such as Common Carp or Purple Loosestrife, can make habitat unsuitable for Northern Leopard Frogs. Commercial collection of Northern Leopard Frogs in Manitoba may threaten local populations (COSEWIC 2009).

There are a number of species found in the area there that have stable populations, but are found to have relatively small populations within the NWMA or their population sizes are unknown, such as *T. radix*, *L. sylvaticus*, and *O. vernalis*. The majority of the species in this area lack detailed studies. Therefore most of them do not have an estimated population size for the area. This lack of information adds to the concern for these species.

### **2. High Species Diversity –of national, provincial, or regional importance**

This site does contain a relatively high number of species within its borders, as seen above. There are at least 13 known species of reptiles and amphibians as well as 6 species that are at some level of concern, and an unknown number of mammals, birds, and invertebrates.

Most importantly, however, NWMA is inhabited by what is believed to be the largest single population of snakes in a single location in the world. Although the species and their hibernacula have not been ranked under COSEWIC, the importance and uniqueness of this site are very significant (Roberts, D. 2009: Personal Communication). This includes the fact that the area provides ideal habitat for all life stages of the red-sided garter snake.

### **3. Important Life History Requirements**

The NWMA holds an exceptionally large proportion of Manitoba's red-sided garter snake population with an estimated fifty-thousand animals using the NWMA. In addition to the area's significance as a major snake over-wintering site, the NWMA is important for the migration to and from wintering hibernacula, as well as breeding and feeding sites during the summer (Shine *et al.* 2001).

Emergence from the hibernacula occurs from mid-April, to early May. After their emergence the snakes travel up to 20 km to reach the small wetlands they use for hunting small frog species, as well as for rearing grounds (Shine *et al.* 2001).

The site should be important at a national scale. One reason is that it contains snake hibernacula, which are the most important habitat for the snakes to be able to survive in the cold winter conditions that occur in Manitoba. In other regions, few hibernacula carry more than 5000 individuals. With the NWMA holding approximately 50 000 snakes in the hibernacula of one location, this may be unique in the world (Roberts, D. 2009: Personal Communication).

### **Human Impacts**

#### **Current site usage :**

The area was previously used extensively for grazing and haying until 1982. Since then, grazing has been banned, and haying only allowed occasionally at an old forage field (Roberts, D. 2009: Personal Communication). Occasionally haying this area is thought to have limited impacts on the snake population because the snakes are not found there in great numbers at any point in the year.

Currently, the area is largely used for ecotourism. There are 3 kilometres of developed trails that connect 4 of the 7 hibernacula in the area (Roberts, D. 2009: Personal Communication). These trails allow visitors to get close to hibernacula. The surrounding area has been severely degraded by road construction and land development. Marsh drainage which supports agricultural development continues to be a significant problem, and may be negatively affecting summer foraging grounds for the snakes (Roberts, D. 2009: Personal Communication).

#### **Pollution, :**

The NWMA is protected from the various types of pollution. It is far enough away from the surrounding small towns to avoid noise and light pollution. The major forms of pollution in the area are air pollution from vehicles and garbage, and are associated with the 35 000 people that visit the NWMA annually to view the spectacular snake activity that occurs here each spring and fall (Manitoba Conservation, 2009). In addition, the area is surrounded by agriculture so pesticides, and other chemicals may run-off into the waterbodies of the area. The roadsides are also sprayed to control noxious weeds (Roberts, D. 2009: Personal Communication). These practices may be degrading the habitat as well as reducing available prey for the snakes (Snakes Alive 2006).

#### **Threats to habitat:**

As listed above, the agriculture surrounding this WMA area may cause contamination from pesticide spraying, etc. The high level of ecotourism may cause damage to the habitat, but also to the snakes themselves.

Road construction has had a huge impact on the snake population. Mortality prior to the implementation of the mortality reduction project in 2000 (discussed below) was approximately 30 000 snakes annually (Roberts, D. 2009: Personal Communication).

**Habitat conservation or restoration.**

In 2000, a partnership was formed between the Narcisse Snake Management Advisory Group, the Rural Municipality of Armstrong, Centra Gas, as well as other businesses, organizations and volunteers in the area. Their goal was to significantly reduce the mortality of snakes on the highway. A stretch of fence, totalling approximately 2 kilometres long (the north section is approximately 1 km and the south section is approx. 0.8 kms) (Roberts, D. 2009: Personal Communication) was installed along the highway that runs through the NWMA. The fences, which are the same distance from the highway on both sides, were installed along the ditch to guide the snakes through numerous 15cm diameter tunnels that were installed under the highway (Roberts, D. 2009: Personal Communication). Educational signage was also used to deter vehicles from moving at excessive speeds. Snake mortality has been reduced by approximately 75% with the implementation of the fences and tunnels (Roberts, D., and Mason, R.T. 2009: Personal Communication).

Human visitors may also affect the snakes. The hibernacula area is partially protected due to the fact that the general public is not aware that there are another three large dens to the south and two smaller dens to the west of the Narcisse Snake Dens in the main visitor area. There are also a number of fences to keep the visitors out of the dens, and away from the majority of the snakes. Site interpretive staff attempt to mitigate impacts on the snakes by enforcing the den entry prohibition as well as by instructing the public on how to respectfully handle the snakes. However, some incidences of mistreatment still occur (Roberts, D. 2009: Personal Communication).

**Recommended conservation actions for this area.**

The major conservation concerns for this area are to protect the large hibernacula, migration corridors, and feeding/rearing areas. Disturbance and mishandling of the snakes tends to be a real issue at the public viewing site. Increased interpretive staffing is required to improve the protection of the snakes and to reduce the mistreatment of these animals at the Narcisse Snake Dens.

**Other Concerned Organisations:**

|  |  |
|--|--|
| <p><b>Manitoba Conservation</b></p>  | <p>Murray Industrial Park,<br/>200 Saulteaux Cres Winnipeg, MB R3J 3W3<br/>Phone: 204-945-6784, 800-214-6497<br/>Fax: 204-945-2474<br/>Website: <a href="http://www.gov.mb.ca/conservation">www.gov.mb.ca/conservation</a><br/>Email: <a href="mailto:nrinfo@gov.mb.ca">nrinfo@gov.mb.ca</a></p> |
| <p><b>Rural Municipality of Armstrong</b></p>                                    | <p>PO Box 69<br/>Inwood, MB R0C 1P0<br/>Phone: 204-278-3777</p>  |
| <p><b>Narcisse Snake Management Advisory Group</b><br/>Contact: Dave Roberts</p> | <p>Box 6000, Gimli, MB R0C 1B0<br/>Phone: 204-642-6078<br/>Fax: 204-642-6108<br/>email: <a href="mailto:Dave.Roberts@gov.mb.ca">Dave.Roberts@gov.mb.ca</a></p>   |

## **Previous Work**

Aleksiuk, M. 1970. The effects of in-vivo light and temperature acclimation on in-vitro responses of heart rate to temperature in a cold climate reptile *Thamnophis sirtalis parietalis*. Canadian Journal of Zoology 48(6): 1155-1161.

Aleksiuk, M. 1971. Temperature dependent shifts in metabolism of a cool temperate reptile, *Thamnophis sirtalis parietalis*. Comparative Biochemistry and Physiology 39(3A): 495.

Aleksiuk, M. 1976. Metabolic and behavioral adjustments to temperature change in red-sided garter snake (*Thamnophis sirtalis parietalis*) - Integrated approach. Journal of Thermal Biology 1(3): 153-156.

Aleksiuk, M. 1976. Reptilian hibernation - Evidence of adaptive strategies in *Thamnophis sirtalis parietalis*. Copeia 1976(1): 170-178.

Aleksiuk, M., and Gregory, P.T. 1974. Regulation of seasonal mating behavior in *Thamnophis sirtalis parietalis*. Copeia 1974(3): 681-689.

Aleksiuk, M., and Stewart, K.W. 1971. Seasonal changes in body composition of garter snake (*Thamnophis sirtalis parietalis*) at northern latitudes. Ecology 52(3): 485-490.

Cease, A.J., Lutterschmidt, D.I., and Mason, R.T. 2007. Corticosterone and the transition from courtship behavior to dispersal in male red-sided garter snakes (*Thamnophis sirtalis parietalis*) General and Comparative Endocrinology 150(1): 124-131.

Gregory, P.T. 1974. Patterns of spring emergence of red-sided garter snake (*Thamnophis sirtalis parietalis*) in Interlake region of Manitoba. Canadian Journal of Zoology 52(8): 1063-1069.

Gregory, P.T. 1977. Life history parameters of the red-sided garter snake, (*Thamnophis sirtalis parietalis*) in an extreme environment in the Interlake region of Manitoba. National Museum of Canada Publications in Zoology 13: 1-44.

Gregory, P.T., and Stewart, K.W. 1975. Long-distance dispersal and feeding strategy of red-sided garter snake (*Thamnophis sirtalis parietalis*) in Interlake, Manitoba. Canadian Journal of Zoology 53(3): 238-245.

Hawley, A.W.L., and Aleksiuk, M. 1975. Thermal regulation of spring mating behavior in red-sided garter snake (*Thamnophis sirtalis parietalis*). Canadian Journal of Zoology 53(6): 768-776.

Hawley, A.W.L., and Aleksiuk, M. 1976. Influence of photoperiod and temperature on seasonal testicular recrudescence in red-sided garter snake (*Thamnophis sirtalis parietalis*). Comparative Biochemistry and Physiology A 53(2): 215-221.

Hawley, A.W.L., and Aleksiuk, M. 1976. Sexual receptivity in female red-sided garter snake (*Thamnophis sirtalis parietalis*). Copeia 1976(2): 401-404.

Langkilde, T., Shine, R., and Mason, R.T. 2004. Predatory attacks to the head vs. body modify behavioral responses of garter snakes. Ethology 110(12): 937-947.

- LeMaster, M.P., and Mason, R.T. 2001. Evidence for a female sex pheromone mediating male trailing behavior in the red-sided garter snake, *Thamnophis sirtalis parietalis*. *Chemoecology* 11(3): 149-152.
- LeMaster, M.P., and Mason, R.T. 2001. Annual and seasonal variation in the female sexual attractiveness pheromone of the red-sided garter snake, *Thamnophis sirtalis parietalis*. *Chemical Signals in Vertebrates* 9(9): 369-376.
- LeMaster, M.P., and Mason, R.T. 2002. Variation in a female sexual attractiveness pheromone controls male mate choice in garter snakes. *Journal of Chemical Ecology* 28(6): 1269-1285.
- LeMaster, M.P., and Mason, R.T. 2003. Pheromonally mediated sexual isolation among denning populations of red-sided garter snakes, *Thamnophis sirtalis parietalis*. *Journal of Chemical Ecology* 29(4): 1027-1043.
- LeMaster, M.P., Moore, I.T., and Mason, R.T. 2001. Conspecific trailing behaviour of red-sided garter snakes, *Thamnophis sirtalis parietalis*, in the natural environment. *Animal Behaviour* 61: 827-833.
- LeMaster, M.P., Uhrig, E., and Mason, R.T. 2009. Temporal variation in the female sexual attractiveness pheromone of the red-sided garter snake, *Thamnophis sirtalis parietalis*. *Integrative and Comparative Biology* 49: E261-E261.
- Lutterschmidt, D.I., and Mason, R.T. 2008. Geographic variation in timekeeping systems among three populations of garter snakes (*Thamnophis sirtalis*) in a common garden. *Physiological and Biochemical Zoology* 81(6): 810- 825.
- Lutterschmidt, D.I., LeMaster, M.P., and Mason, R.T. 2004. Effects of melatonin on the behavioral and hormonal responses of red-sided garter snakes (*Thamnophis sirtalis parietalis*) to exogenous corticosterone. *Hormones and Behavior* 46(5): 692-702.
- Lutterschmidt, D.I., LeMaster, M.P., and Mason, R.T. 2006. Minimal overwintering temperatures of red-sided garter snakes (*Thamnophis sirtalis parietalis*): a possible cue for emergence? *Canadian Journal of Zoology* 84(5): 771-777.
- Lutterschmidt, D.I., and Mason, R.T. 2009. Endocrine mechanisms mediating temperature-induced reproductive behavior in red-sided garter snakes (*Thamnophis sirtalis parietalis*). *Journal of Experimental Biology* 212(19): 3108-3118.
- Mason, R.T. 1993. Chemical ecology of the red-sided garter snake, *Thamnophis sirtalis parietalis*. *Brain Behavior and Evolution* 41(3-5): 261-268.
- Mason, R.T., and Crews, D. 1985. Female mimicry in garter snakes. *Nature* 316(6023): 59-60.
- Mason, R.T., Jones, T.H., Fales, H.M., Pannell, L.K., and Crews, D. 1990. Characterization, synthesis, and behavioral responses to sex attractiveness pheromones of red-sided garter snakes (*Thamnophis sirtalis parietalis*). *Journal of Chemical Ecology* 16(7): 2353-2369.

Moore, I.T., and Mason, R.T. 2001. Behavioral and hormonal responses to corticosterone in the male red-sided garter snake, *Thamnophis sirtalis parietalis*. *Physiology & Behavior* 72(5): 669-674.

Moore, I.T., Greene, M.J., and Mason, R.T. 2001. Environmental and seasonal adaptations of the adrenocortical and gonadal responses to capture stress in two populations of the male garter snake, *Thamnophis sirtalis*. *Journal of Experimental Zoology* 289(2): 99-108.

Moore, I.T., LeMaster, M.P., and Mason, R.T. 2001. Behavioural and hormonal responses to capture stress in the male red-sided garter snake, *Thamnophis sirtalis parietalis*. *Animal Behaviour* 59: 529-534.

Nelson, R.J., Mason, R.T., Krohmer, R.W., and Crews, D. 1987. Pinealectomy blocks vernal courtship behavior in red-sided garter snakes. *Physiology & Behavior* 39(2): 231-233.

O'Donnell, R.P., and Mason, R.T. 2007. Mating is correlated with a reduced risk of predation in female red-sided garter snakes, *Thamnophis sirtalis parietalis*. *American Midland Naturalist* 157(1): 235-238.

O'Donnell, R.P., Ford, N.B., Shine, R., and Mason, R.T. 2004. Male red-sided garter snakes, *Thamnophis sirtalis parietalis*, determine female mating status from pheromone trails. *Animal Behaviour* 68: 677-683.

O'Donnell, R.P., Shine, R., and Mason, R.T. 2004. Seasonal anorexia in the male red-sided garter snake, *Thamnophis sirtalis parietalis*. *Behavioral Ecology and Sociobiology* 56(5): 413-419.

Parker, M.R., and Mason, R.T. 2009. Low temperature dormancy affects the quantity and quality of the female sexual attractiveness pheromone in red-sided garter snakes. *Journal of Chemical Ecology* 35(10): 1234-1241.

Shine, R., and Mason, R.T. 2001. Courting male garter snakes (*Thamnophis sirtalis parietalis*) use multiple cues to identify potential mates. *Behavioral Ecology and Sociobiology* 49(6): 465-473.

Shine, R., and Mason, R.T. 2004. Patterns of mortality in a cold-climate population of garter snakes (*Thamnophis sirtalis parietalis*). *Biological Conservation* 120(2): 201-210.

Shine, R., and Mason, R.T. 2005. Do a male garter snake's energy stores limit his reproductive effort? *Canadian Journal of Zoology* 83(10): 1265-1270.

Shine, R., and Mason, R.T. 2005. Does large body size in males evolve to facilitate forcible insemination? A study on garter snakes. *Evolution* 59(11): 2426-2432.

Shine, R., Elphick, M.J., Harlow, P.S., Moore, I.T., LeMaster, M.P., and Mason, R.T. 2001. Movements, mating, and dispersal of red-sided gartersnakes (*Thamnophis sirtalis parietalis*) from a communal den in Manitoba. *Copeia* 2001(1): 82-91.

Shine, R., Harlow, P., LeMaster, M.P., Moore, I.T., and Mason, R.T. 2000. The transvestite serpent: why do male garter snakes court (some) other males? *Animal Behaviour* 59: 349-359.



- Shine, R., Harlow, P.S., Elphick, M.J., Olsson, M.M., and Mason, R.T. 2000. Conflicts between courtship and thermoregulation: The thermal ecology of amorous male garter snakes (*Thamnophis sirtalis parietalis*, Colubridae). *Physiological and Biochemical Zoology* 73(4): 508-516.
- Shine, R., Langkilde, T., and Mason, R.T. 2003. Confusion within 'mating balls' of garter snakes: does misdirected courtship impose selection on male tactics? *Animal Behaviour* 66: 1011-1017.
- Shine, R., Langkilde, T., and Mason, R.T. 2003. The opportunistic serpent: Male garter snakes adjust courtship tactics to mating opportunities. *Behaviour* 140: 1509-1526.
- Shine, R., Langkilde, T., and Mason, R.T. 2004. Courtship tactics in garter snakes: how do a male's morphology and behaviour influence his mating success? *Animal Behaviour* 67: 477-483.
- Shine, R., Langkilde, T., Wall, M., and Mason, R.T. 2005. The fitness correlates of scalation asymmetry in garter snakes *Thamnophis sirtalis parietalis*. *Functional Ecology* 19(2): 306-314.
- Shine, R., Langkilde, T., Wall, M., and Mason, R.T. 2005. Alternative male mating tactics in garter snakes, *Thamnophis sirtalis parietalis*. *Animal Behaviour* 70: 387-396.
- Shine, R., Langkilde, T., Wall, M., and Mason, R.T. 2006. Temporal dynamics of emergence and dispersal of garter snakes from a communal den in Manitoba. *Wildlife Research* 33(2): 103-111.
- Shine, R., LeMaster, M.P., Moore, I.T., Olsson, M.M., and Mason, R.T. 2001. Bumpus in the snake den: Effects of sex, size, and body condition on mortality of red-sided garter snakes. *Evolution* 55(3): 598-604.
- Shine, R., LeMaster, M., Wall, M., Langkilde, T., and Mason, R. 2004. Why did the snake cross the road? Effects of roads on movement and location of mates by garter snakes (*Thamnophis sirtalis parietalis*). *Ecology and Society* 9(1): 1195-5449.
- Shine, R., O'Connor, D., and Mason, R.T. 2000. Sexual conflict in the snake den. *Behavioral Ecology and Sociobiology* 48(5): 392-401.
- Shine, R., O'Connor, D., and Mason, R.T. 2000. The problem with courting a cylindrical object: How does an amorous male snake determine which end is which? *Behaviour* 137: 727-739.
- Shine, R., O'Connor, D., and Mason, R.T. 2000. Female mimicry in garter snakes: behavioural tactics of "she-males" and the males that court them. *Canadian Journal of Zoology* 78(8): 1391-1396.
- Shine, R., O'Connor, D., LeMaster, M.P., Mason, R.T. 2001. Pick on someone your own size: ontogenetic shifts in mate choice by male garter snakes result in size-assortative mating. *Animal Behaviour* 61: 1133-1141.
- Shine, R., O'Donnell, R.P., Langkilde, T., Wall, M.D., and Mason, R.T. 2005. Snakes in search of sex: the relation between mate-locating ability and mating success in male garter snakes. *Animal Behaviour* 69: 1251-1258.

- Shine, R., Olsson, M.M., LeMaster, M.P., Moore, I.T., and Mason, R.T. 2000. Effects of sex, body size, temperature, and location on the antipredator tactics of free-ranging gartersnakes (*Thamnophis sirtalis*, Colubridae). *Behavioral Ecology* 11(3): 239-245.
- Shine, R., Olsson, M.M., and Mason, R.T. 2000. Chastity belts in gartersnakes: the functional significance of mating plugs. *Biological Journal of the Linnean Society* 70(3): 377-390.
- Shine, R., Olsson, M.M., LeMaster, M.P., Moore, I.T., and Mason, R.T. 2000. Are snakes right-handed? Asymmetry in hemipenis size and usage in gartersnakes (*Thamnophis sirtalis*). *Behavioral Ecology* 11(4): 411-415.
- Shine, R., Phillips, B., Wayne, H., LeMaster, M., and Mason, R.T. 2001. Benefits of female mimicry in snakes. *Nature* 414(6861): 267.
- Shine, R., Phillips, B., Wayne, H., LeMaster, M., and Mason, R.T. 2003. Chemosensory cues allow courting male garter snakes to assess body length and body condition of potential mates. *Behavioral Ecology and Sociobiology* 54(2): 162-166.
- Shine, R., Phillips, B., Wayne, H., LeMaster, M., and Mason, R.T. 2003. The lexicon of love: what cues cause size-assortative courtship by male garter snakes? *Behavioral Ecology and Sociobiology* 53(4): 234-237.
- Shine, R., Phillips, B., Wayne, H., and Mason, R.T. 2003. Behavioral shifts associated with reproduction in garter snakes. *Behavioral Ecology* 14(2): 251-256.
- Shine, R., Phillips, B., Wayne, H., and Mason, R.T. 2003. Small-scale geographic variation in antipredator tactics of garter snakes. *Herpetologica* 59(3): 333-339.
- Shine, R., Phillips, B., Langkilde, T., Lutterschmidt, D.I., Wayne, H., and Mason, R.T. 2004. Mechanisms and consequences of sexual conflict in garter snakes (*Thamnophis sirtalis*, Colubridae). *Behavioral Ecology* 15(4): 654-660.
- Shine, R., Phillips, B., Wayne, H., LeMaster, M., Mason, R.T. 2004. Species-isolating mechanisms in a mating system with male mate choice (garter snakes, *Thamnophis* spp.). *Canadian Journal of Zoology* 82(7): 1091-1098.
- Shine, R., Wall, M., Langkilde, T., and Mason, R.T. 2005. Scaling the heights: thermally driven arboreality in garter snakes. *Journal of Thermal Biology* 30(3): 179-185.
- Shine, R., Wall, M., Langkilde, T., and Mason, R.T. 2005. Do female garter snakes evade males to avoid harassment or to enhance mate quality? *American Naturalist* 165(6): 660-668.
- Shine, R., Wall, M., Langkilde, T., and Mason, R.T. 2005. Battle of the sexes: forcibly inseminating male garter snakes target courtship to more vulnerable females. *Animal Behaviour* 70: 1133-1140.

Shine, R., Webb, J.K., Lane, A., and Mason, R.T. 2005. Mate location tactics in garter snakes: effects of rival males, interrupted trails and non-pheromonal cues. *Functional Ecology* 19(6): 1017-1024.

Shine, R., Webb, J.K., Lane, A., and Mason, R.T. 2006. Flexible mate choice: a male snake's preference for larger females is modified by the sizes of females encountered. *Animal Behaviour* 71: 203-209.

Smith, M.T., and Mason, R.T. 1997. Gonadotropin antagonist modulates courtship behavior in male red-sided garter snakes, *Thamnophis sirtalis parietalis*. *Physiology & Behavior* 61(1): 137-143.

Whittier, J.M., and Mason, R.T. 1996. Plasma triglyceride and beta-hydroxybutyric acid levels in red-sided garter snakes (*Thamnophis sirtalis parietalis*) at emergence from hibernation. *Experientia* 52(2): 145-148.

Whittier, J.M., Mason, R.T., and Crews, D. 1983. Effects of mating on sexual behavior of male and female garter snakes, *Thamnophis sirtalis parietalis*. *American Zoologist* 23(4): 895-895.

Whittier, J.M., Mason, R.T., and Crews, D. 1985. Mating in the red-sided garter snake, *Thamnophis sirtalis parietalis* - Differential effects on male and female sexual behavior. *Behavioral Ecology and Sociobiology* 16(3): 257-261.

Whittier, J.M., Mason, R.T., and Crews, D. 1987. Plasma steroid hormone levels of female red-sided garter snakes, *Thamnophis sirtalis parietalis* - Relationship to mating and gestation. *General and Comparative Endocrinology* 67(1): 33-43.

Whittier, J.M., Mason, R.T., Crews, D., and Licht, P. 1987. Role of light and temperature in the regulation of reproduction in the red-sided garter snake, *Thamnophis sirtalis parietalis*. *Canadian Journal of Zoology* 65(8): 2090-2096.

## **Reference List**

Bilecki, L.C. 2003. Bat hibernacula in the karst landscape of Central Manitoba: protecting critical wildlife habitat while managing for resource development. MNRM thesis, University of Manitoba.

COSEWIC. 2009. COSEWIC assessment and update status report on the Northern Leopard Frog *Lithobates pipiens*, Rocky Mountain population, Western Boreal/Prairie populations and Eastern populations in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii +69 pp.

Gossling, S. 1999. Ecotourism: a means to safeguard biodiversity and ecosystem functions? *Ecological Economics* 29: 303-320.

Manitoba Conservation Website. Online at:  
<http://www.gov.mb.ca/conservation/wildlife/managing/snakes.html>. Accessed from May/09 to Aug/09.

Mason, R. Professor from Oregon State University (Personal Communications as well as Literature - 2009).

Roberts, D. Conservation Officer/ NWMA Biologist for 22 years (Personal Communications - 2009).

Shine, R. Elphick, M.J., Harlow, P.S., Moore, I.T., LeMaster, M.P., and Mason, R.T. 2001. Movements, mating, and dispersal of Red-Sided Gartersnakes (*Thamnophis sirtalis parietalis*) from a communal den in Manitoba. *Copeia* 2001: 82-91.

Shine, R. and Mason, R.T. 2004. Patterns of mortality in a cold-climate population of Garter Snakes (*Thamnophis sirtalis parietalis*). *Biological Conservation* 120: 201-210.

Vanasselt, W. 2000. Ecotourism and conservation: are they compatible? *World Resources* 2000–2001. Online at: <http://earthtrends.wri.org/text/biodiversity-protected/feature-29.html>. Accessed: July 23, 2009.

Figure 1: Location of Narcisse Wildlife Management Area (NWMA) within the Interlake Region of Manitoba (Google Maps).

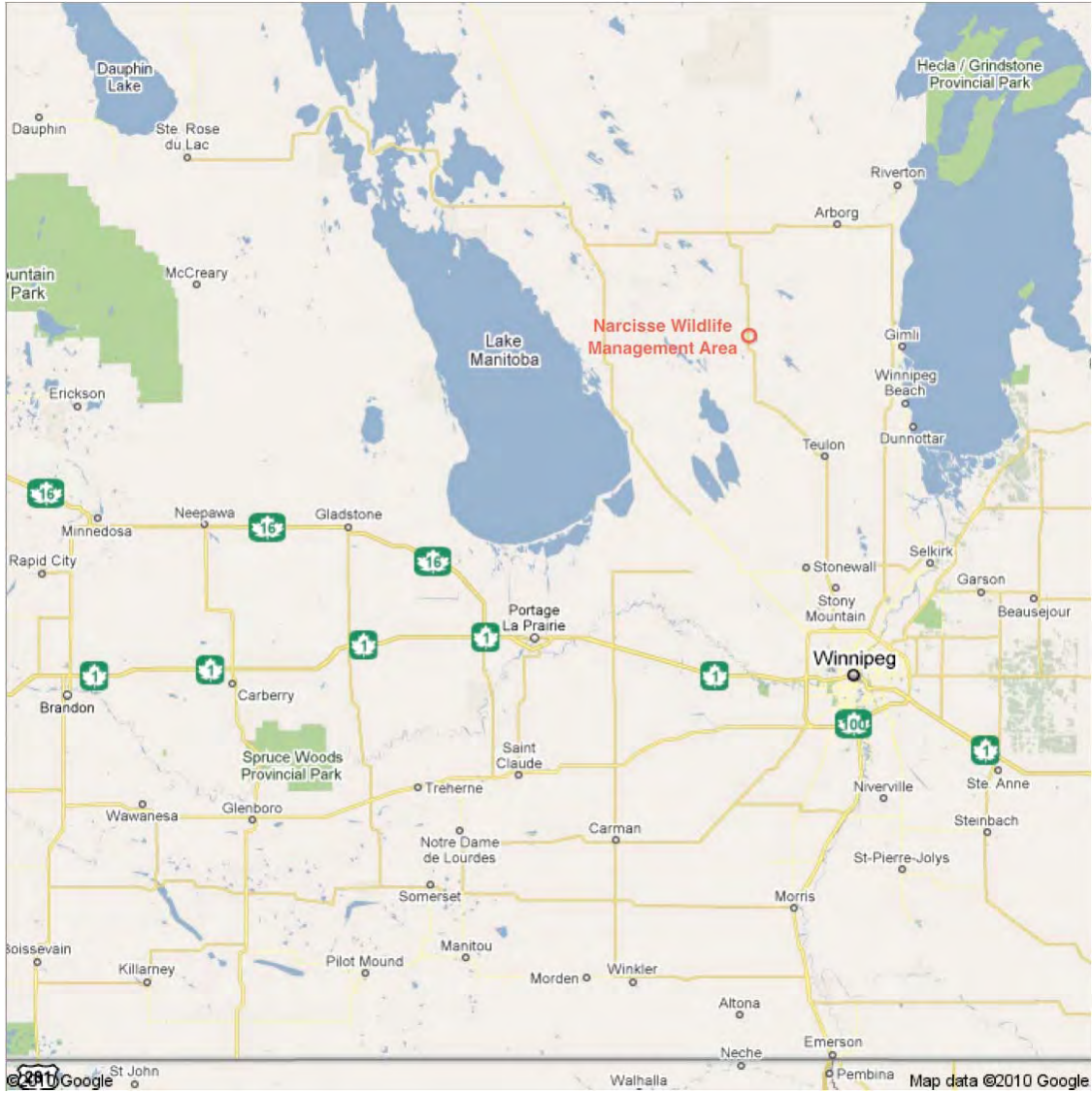


Figure 2: Map of the trail layout in NWMA (Manitoba Conservation Website: Accessed from May/09 to Aug/09. <http://www.gov.mb.ca/conservation/wildlife/managing/snakes.html>).

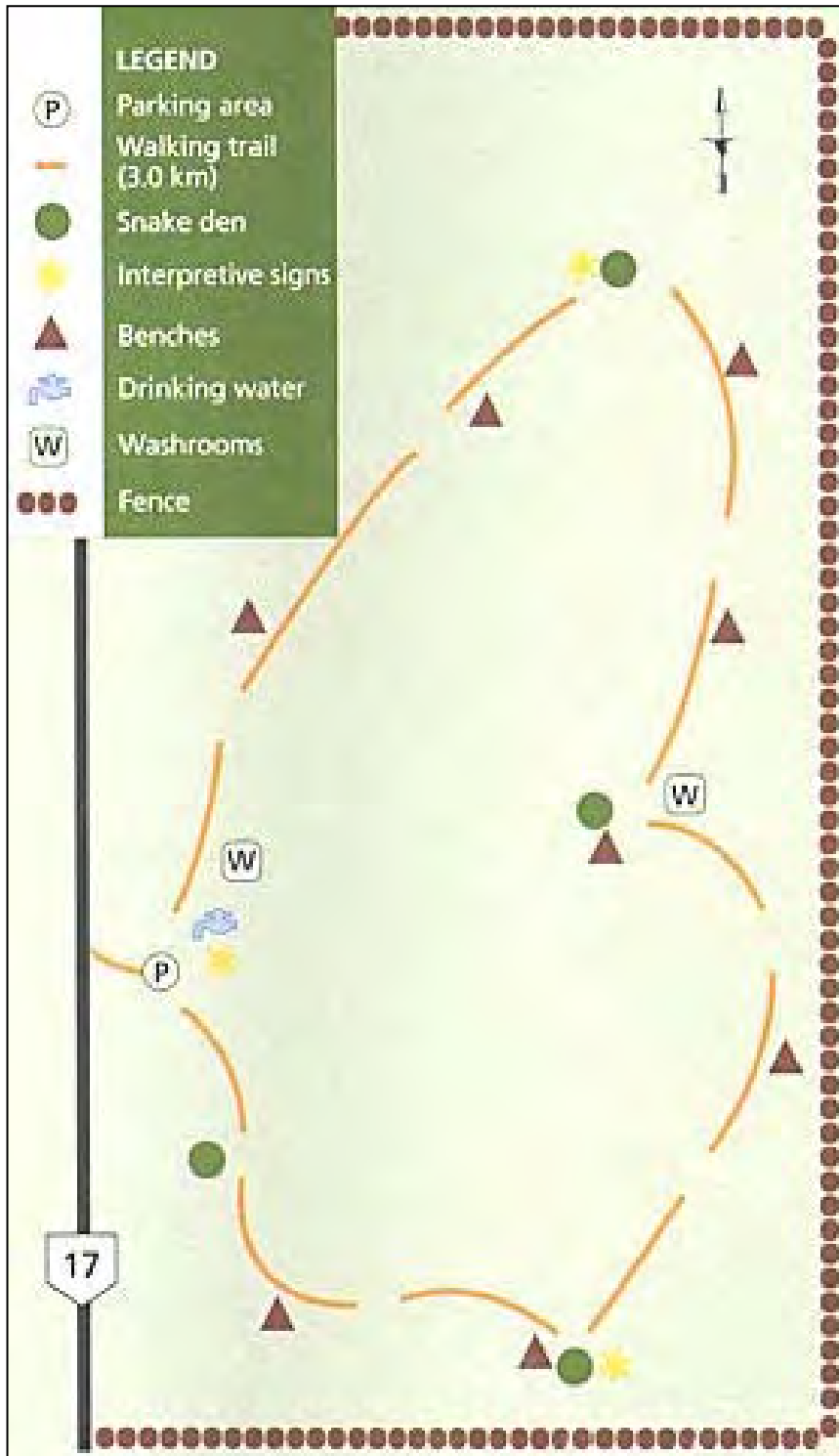


Figure 3: The NWMA and surrounding area (Roberts, D – Conservation Officer/ NWMA Biologist for 22 years, Personal Communication).

