COSEWIC
Assessment and Status Report

on the

Eastern Ribbonsnake
Thamnophis sauritus

in Canada

THREATENED – Atlantic population
SPECIAL CONCERN – Great Lakes population
2002

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE IN
CANADA

COSEPAC
COMITÉ SUR LA SITUATION DES
ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

Please note: Persons wishing to cite data in the report should refer to the report (and cite the author(s)); persons wishing to cite the COSEWIC status will refer to the assessment (and cite COSEWIC). A production note will be provided if additional information on the status report history is required.

COSEWIC 2002. COSEWIC assessment and status report on the eastern ribbonsnake *Thamnophis sauritus.* Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 24 pp.

Smith, K. 2002. COSEWIC status report on the eastern ribbonsnake *Thamnophis sauritus* in Canada, *in* COSEWIC assessment and status report on the eastern ribbonsnake *Thamnophis sauritus*. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-24 pp.

Production note:
The northern ribbonsnake (*Thamnophis sauritus septentrionalis*) that is discussed in this report is the only subspecies of the eastern ribbonsnake (*Thamnophis sauritus*) that occurs in Canada. For purposes of COSEWIC, which designates only species that occur in Canada, these two names should be regarded as synonymous.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: (819) 997-4991 / (819) 953-3215
Fax: (819) 994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur la situation de la couleuvre mince (population des Grands Lacs) (*Thamnophis sauritus*) au Canada

Cover illustration:
Eastern ribbonsnake — Joseph Crowley, Powassan, Ontario.

Catalogue No. CW69-14/297-2003-IN
ISBN 0-662-34209-7

COSEWIC
Assessment Summary

Assessment Summary – May 2002

Common name
Eastern ribbonsnake – Atlantic population

Scientific name
Thamnophis sauritus

Status
Threatened

Reason for designation
This ribbonsnake population is a small, isolated postglacial relict confined to a small area in Nova Scotia. As such, it is unique and susceptible to demographic and environmental fluctuations. In addition, shoreline development poses a threat.

Occurrence
Nova Scotia

Status history
Designated Threatened in May 2002. Assessment based on a new status report.

Assessment Summary – May 2002

Common name
Eastern ribbonsnake – Great Lakes population

Scientific name
Thamnophis sauritus

Status
Special Concern

Reason for designation
There are few quantitative data on ribbonsnakes in Ontario, where this species suffers from extreme loss of its wetland habitats. Modification of shoreline habitat may be particularly problematic for ribbonsnakes. In addition, ribbonsnakes are highly susceptible to mortality on roads through wetland areas.

Occurrence
Ontario

Status history
Designated Special Concern in May 2002. Assessment based on a new status report.

COSEWIC
Executive Summary

Eastern Ribbonsnake
Thamnophis sauritus

Species information

In Canada, the Eastern Ribbonsnake (*Thamnophis sauritus*) is represented by a single subspecies, the Northern Ribbonsnake (*Thamnophis sauritus septentrionalis*). The Northern Ribbonsnake has three yellow longitudinal stripes on a dark dorsal background, and bears a strong resemblance to the closely related Common Gartersnake (*Thamnophis sirtalis*). The Northern Ribbonsnake can be distinguished from the Common Gartersnake by close examination of the stripes; those of the ribbonsnake fall on scale rows 3 and 4, whereas those of the gartersnake are on scale rows 2 and 3.

Distribution

Of the four recognized subspecies of Eastern Ribbonsnake, only the Northern Ribbonsnake reaches Canada. Its North American distribution is centred around the Great Lakes, and Canadian populations occur in Ontario and Nova Scotia. The Ontario population is spread along the southern edge of the Canadian Shield. The Nova Scotia population is disjunct and thought to be a relict from when a milder climate existed in North America approximately 5000 years ago.

Habitat

The Northern Ribbonsnake is semi-aquatic and most frequently found along wetland edges. Quiet, shallow water with low surrounding cover is preferred, although areas with good exposure to sunlight are also required. Gravid females may move away from water before nesting, as females and juveniles are occasionally found in upland areas.

Biology

Northern Ribbonsnakes feed primarily on amphibians, particularly frogs. Females give birth to live young in early fall, and litter size commonly ranges from 5 to 12. Preferred body temperatures range between 20°C and 30°C. Hibernation occurs from October to April in animal burrows or rock crevices. Ribbonsnakes are very active, but timid. They are gregarious and generally docile.

Population sizes and trends

Little information is available on population size, distribution and trends in Canada; however, the Northern Ribbonsnake is not considered a common species anywhere in this country. The Nova Scotia population has been estimated at between 1000-3000 individuals. Some populations in Ontario probably have disappeared from highly developed areas.

Limiting factors and threats

Threats to the Northern Ribbonsnake include habitat loss, collecting, road kill and predation by domestic animals.

Special significance of the species

Snakes are potentially useful indicator species, as they occur in a wide variety of habitats (terrestrial and aquatic) and are generally the top carnivores in their habitat. For example, Ribbonsnakes were used to assess radiocesium concentrations from contaminated and uncontaminated habitats in South Carolina. Northern Ribbonsnakes reach the northern limit of their distribution in Canada, and may be genetically distinct from more southern populations.

Existing protection or other status designations

The Northern Ribbonsnake is not listed as a “specially protected reptile” (Schedule 9) in Ontario under the 1997 Fish and Wildlife Conservation Act. Ribbonsnakes occur in some protected areas such as Rondeau and other Provincial Parks and in some National Parks. In Nova Scotia, Northern Ribbonsnakes are protected under the Nova Scotia Wildlife Act (1987). In its range in the U.S.A., the Northern Ribbonsnake is listed at some level of risk in 4 of the 10 states in which this subspecies occurs. At the species level, the Eastern Ribbonsnake (*T. sauritus*) is listed at risk in 9 of 18 states in which it occurs (Natureserve, 2002).

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.
** Formerly described as “Not In Any Category”, or “No Designation Required.”
*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list.

Environment Canada | Environnement Canada
Canadian Wildlife Service | Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Eastern Ribbonsnake
Thamnophis sauritus

in Canada

Kim Smith[1]

2002

[1]94 Hyde park Ave.
Hamilton, ON.
L8P 4M7

TABLE OF CONTENTS

List of figures

List of tables

SPECIES INFORMATION

Name and classification

The Northern Ribbonsnake, *Thamnophis sauritus septentrionalis*, is one of four subspecies of the Eastern Ribbonsnake, along with *T. s. sauritus* (common), *T. s. sackenii* (peninsula) and *T. s. nitae* (blue-stripe). Only the Northern Ribbonsnake is found in Canada. The zone of intergradation between eastern and Northern Ribbonsnakes has not been precisely established in all areas where the two subspecies come together (McCoy, 1982; Harding, 1997). The subspecific name of the Northern Ribbonsnake is from the Latin *septentrionalis*, which means “of the north” (Rossman, 1963, 1970).

In this report, “ribbonsnake” will be used in instances where an author cited does not specify which subspecies is under discussion. There are also some instances in which authors referred to ribbonsnakes within the range of the northern subspecies as Eastern Ribbonsnakes: these will simply be called “ribbonsnakes” in this paper. “Northern Ribbonsnake” will be used only when an author has specified *T. s. septentrionalis*.

Description

The Northern Ribbonsnake bears such a strong resemblance to the closely related Common Gartersnake (*Thamnophis sirtalis sirtalis*) that the two species are often misidentified (Morris, 1974; Hunter et al., 1992). Both species have three longitudinal yellow stripes on a dark background. It is only on close inspection that one can observe that the stripes occur on different scale rows: counting up from the belly, the yellow side stripe is on rows two and three on gartersnakes versus rows three and four on ribbonsnakes (McBride, 1961). Below the yellow side stripe, the ribbonsnake has a brown stripe on rows one and two (Harding, 1997). On some ribbonsnakes, the middorsal stripe has an orange or greenish tinge (Schmidt and Davis, 1941; Conant and Collins, 1991). Ribbonsnakes are noticeably more slender than gartersnakes and have longer tails (Hunter et al, 1992). In both species, the anal plate is single (Behler and King, 1996).

The dorsal ground colour of the ribbonsnake ranges from dark brown to black (Cochran and Goin, 1970) and appears almost velvety as a result of the strongly keeled scales (Ditmars, 1907). The chin and throat are pure white to fawn coloured (Wright and Wright, 1957), while the unmarked belly is pale green, yellow or white (Harding, 1997). The head has been described as lizard-like in appearance (Froom, 1972), and is divided from the body by a distinct “neck” (Strickland and Rutter, 1992). The iris is reddish with darker suffusion and the tongue is pale red with darker tips (Minton, 1972). Newborns bear the same coloration and pattern as adults (ibid.).

The number of scale rows is usually 19, decreasing to 17 posteriorly (Ernst and Barbour, 1989). Total adult length ranges from 460 mm to 862 mm, and females are

generally slightly larger and thicker-bodied than males (Harding, 1997). Tail length accounts for one-third or more of the total length (Wright and Wright, 1957).

DISTRIBUTION

Global range

The range of the Northern Ribbonsnake in North America is concentrated around the southern Great Lakes, east of Lake Michigan (Figure 1). This snake occurs contiguously throughout Ontario and Michigan, Indiana, Illinois, Ohio, Pennsylvania, New York, Vermont, New Hampshire and Maine. Isolated populations occur in southern Nova Scotia (Gilhen, 1984) and eastern and southern Wisconsin (Harding, 1997). Intergradation with Common Ribbonsnakes occurs in all states except Michigan and Wisconsin (Conant and Collins, 1991).

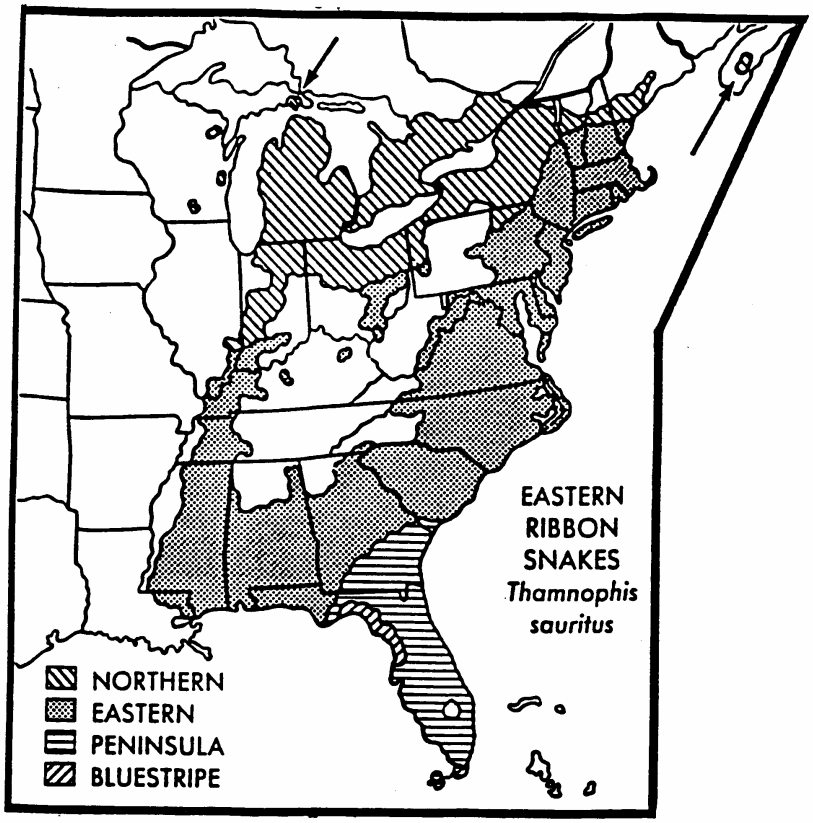

Figure 1. Distribution of the Eastern Ribbonsnake (*Thamnophis sauritus*) in North America. From Conant and Collins, 1991.

Canadian range

The Canadian range of the Northern Ribbonsnake is concentrated in Ontario (Figure 2), roughly following the southern edge of the Canadian Shield (Oldham and Weller, 1989). The most persistent sightings occur in the Georgian Bay region, particularly Bruce County (Weller and Gregory, 1965; Cebek, 1971; Oldham, unpubl. data, OHS). A disjunct population of Northern Ribbonsnakes occurs in Nova Scotia (Cook, 1977) (Figure 3). This population is limited to three watersheds (Mersey River, Medway River and Pleasant River) in the southern portion of the province (John Gilhen, pers. comm.).

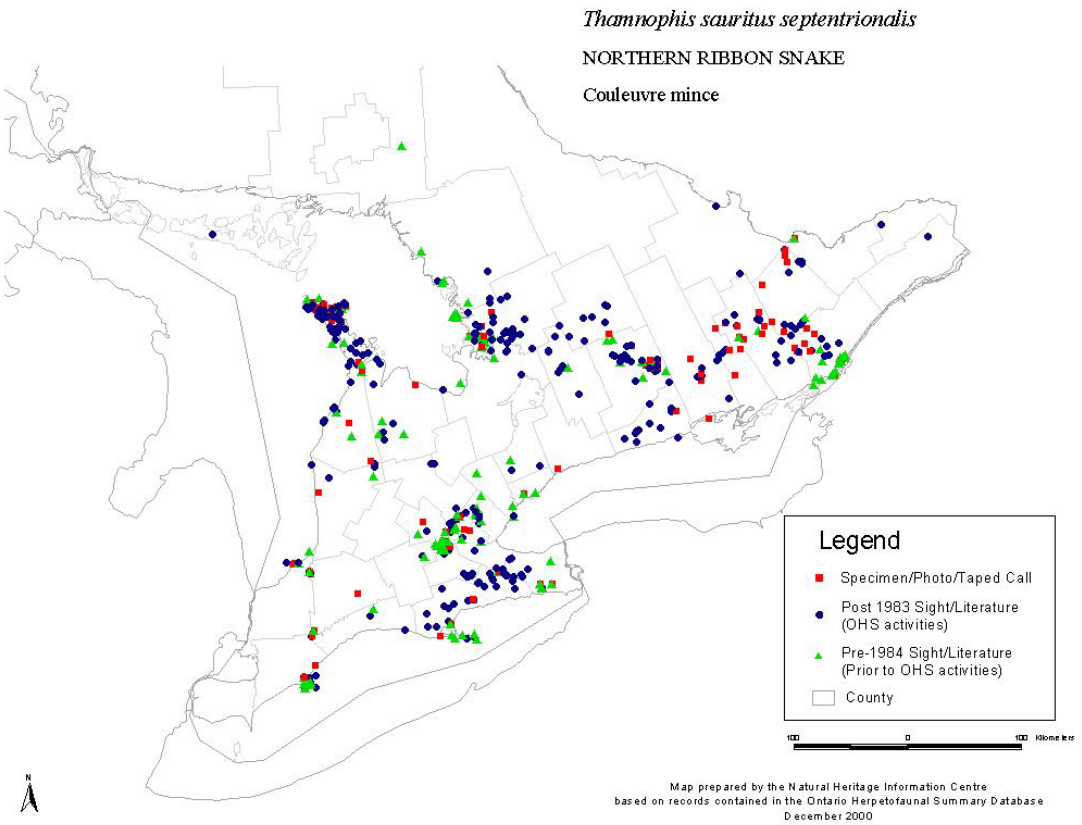

Figure 2. Distribution of the Northern Ribbonsnake (*Thamnophis sauritus septentrionalis*) in Ontario. Courtesy of Micheal J. Oldham, NHIC.

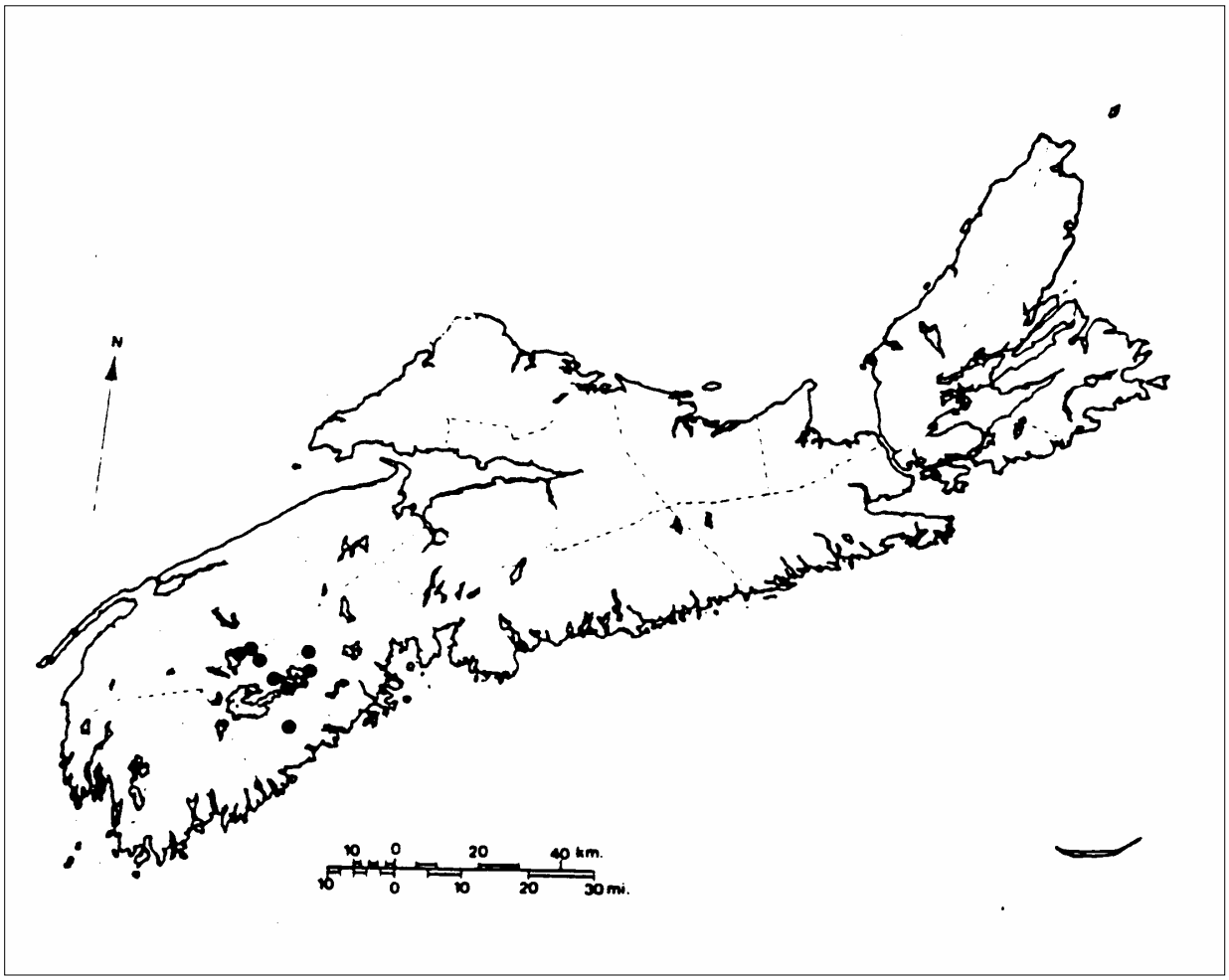

Figure 3. Distribution of the Northern Ribbonsnake (*Thamnophis sauritus septentrionalis*) in Nova Scotia. From Gilhen, 1984.

HABITAT

Habitat requirements

The Northern Ribbonsnake is semi-aquatic, frequenting the edges of ponds, streams, marshes, swamps or bogs (Lamond, 1994). It prefers quiet, shallow water bordered by low dense vegetation (Minton, 1972). Abundant sunlit basking areas are cited by several authors (Minton, 1972; Degraaf and Rudis, 1983; Harding, 1997) as an additional habitat preference. Adult female and juvenile Northern Ribbonsnakes are occasionally found in atypical habitats, such as upland areas far from any wetlands (Lamond, 1994). Gravid females may move short distances away from the water prior to giving birth (Harding, 1997).

Trends

As a semi-aquatic species, Northern Ribbonsnakes may be highly susceptible to any actions that degrade water quality (Hunter et al., 1992). Although many authors have cited habitat destruction as a potential threat to ribbonsnakes (Weller, 1983; Harding, 1997), there have been no long term studies in Canada dealing with specific examples where habitat alteration has led to a decline in ribbonsnake numbers. In Nova Scotia, there is some concern about threats to Northern Ribbonsnake habitat where lakeshores within the snake's range are being altered as more cottages are built around the lakes (John Gilhen, pers. comm.).

Protection/ownership

Although Northern Ribbonsnakes do occur in a number of protected areas, the populations are not necessarily large enough to be considered stable. The population at Long Point is protected, but it is not considered a common species there (Adams and Clark, 1958). There may or may not be a population of Northern Ribbonsnakes in Algonquin Park; only one confirmed sighting exists, from 1962 (Strickland and Rutter, 1992). Even though no ribbonsnakes have been reported in Rondeau Provincial Park in the past 11 years of the Ontario Herpetofaunal Database (Mike Oldham, unpubl. data, OHS), a recent study found Northern Ribbonsnakes to be numerous there (Gillingwater and Brooks, 2002).

The following protected areas also have at least one Northern Ribbonsnake sighting in the Ontario Herpetofaunal Survey (OHS): Bruce Peninsula National Park, MacGregor Point Provincial Park, Georgian Bay Islands National Park, Rondeau Provincial Park, St. Lawrence Islands National Park, Algonquin Provincial Park, Pinehurst Conservation Area, Fathom Five Provincial Park, Iroquois Beach Provincial Park, Big Creek Marsh, Hilton Falls Conservation Authority, Long Point Provincial Park, Turkey Point Provincial Park, Royal Botanical Gardens, Charleston Lake Provincial Park, Ipperwash Provincial Park, Pinery Provincial Park, Murphy's Point Provincial Park, Presqu'ile Provincial Park, Killbear Provincial Park, Petroglyphs Provincial Park and Puslinch Lake Conservation Area.

On the basis of records contained in the OHS, it remains highly speculative whether any of the aforementioned populations are stable, or even still in existence. There is not enough information on the status of Northern Ribbonsnakes in protected areas to determine if these areas are contributing sufficiently to the conservation of the species.

In Nova Scotia, Northern Ribbonsnakes are occasionally sighted in Kejimkujik National Park (John Gilhen, pers. comm.; Mike Oldham, pers. comm.). There are no reported sightings in other protected areas of the province.

BIOLOGY

Feeding habits

The Northern Ribbonsnake feeds in the morning or early evening, and prey is detected both by olfaction and by vision (Ernst and Barbour, 1989). Many authors have commented on the absence of earthworms in the diet of this species (Ditmars, 1907; Toner, 1935; Logier, 1958; Froom, 1972; Minton, 1972; Lazell, 1976; Harding, 1997), unlike most other members of the genus. Carpenter (1952a) examined the food preferences of 547 Michigan ribbonsnakes, in both field and laboratory. Amphibians comprised 90% of prey items taken in the wild. Two fish and two caterpillars were also recovered from ribbonsnakes, with the remainder of food items consisting of unidentified material. In laboratory feeding trials, many of the prey items offered were not consumed, including small gartersnakes (*Thamnophis* spp.), hairy caterpillars, soft bodied caterpillars (which were consumed in the field), spiders, ants, grasshoppers, beetles, leeches and earthworms. Conversely, several prey items not found in wild-caught ribbonsnakes were accepted in the laboratory: these included Jefferson's Salamanders (*Ambystoma jeffersonianum*), American Toads (*Bufo americanus*), minnows and chopped fish. Carpenter (1952a) believed that the scarcity of fish as prey in the wild snakes' diet was probably due to the difficulty the snakes have in capturing them, because fish were readily eaten in the laboratory.

Brown (1979) examined the stomach contents of 21 Northern Ribbonsnakes from Michigan and New York. All 27 food items found were amphibian and 93% were anurans. Small Leopard Frogs (*Rana pipiens*) comprised 18 of the 27 food items. Other species consumed in smaller numbers were Spring Peepers (*Pseudacris crucifer*), newts (*Notophthalmus* spp.), a Green Frog (*R. clamitans*), a very small American toad (*Bufo americanus*) and (probably) a Pickerel Frog (*R. palustris*). Only three of the 21 stomachs examined contained more than one food item. Betz (1981) made observations on the feeding preferences of a captive Northern Ribbonsnake from the Bruce Peninsula, Ontario. The snake refused every frog offered to it, feeding instead chiefly on Redback Salamanders (*Plethodon cinereus*). Minnows and goldfish were also consumed occasionally.

Evans (1942) describes the fishing method used by two ribbonsnakes in Missouri. The snakes swam with mouths fully open and upon contact with a fish the mouth immediately closed, thus capturing the prey. Carpenter (1952a) watched an adult female ribbonsnake chasing frogs along the shoreline of a pool in Michigan. Over a period of 45 minutes, the snake chased and missed eight frogs.

As might be expected, there are also stray reports of atypical prey taken by ribbonsnakes. Hamilton and Pollack (1956) reported a large lycosid spider as the only prey item in the stomach of an Eastern Ribbonsnake. Young ribbonsnakes may consume insects on a more regular basis (Froom, 1972).

Reproduction

Ribbonsnakes are viviparous, with a small average litter size ranging from 5 to 12 (Froom, 1972), and a maximum of 20 (Logier, 1958; Johnson, 1989). Milnes (1946) reported a brood of 10 born in captivity on 5 September, while Gilhen (1984) reported a litter of seven, also born on 5 September, in Nova Scotia. It is believed that Northern Ribbonsnakes have reproductive strategies similar to Eastern Ribbonsnakes (Hunter et al., 1992). In the Great Lakes region, some Northern Ribbonsnakes mature by their second year, whereas the remainder mature in their third year (Harding, 1997). Although growth slows for both sexes after maturity, females appear to continue growing at a faster rate than males (ibid.). Brood size is significantly correlated with snout-to-vent length in Western Ribbonsnakes (*Thamnophis proximus*) (Clark, 1974); this is likely the same in Northern Ribbonsnakes.

Burt (1928) studied the relation of size to maturity in Michigan Eastern Ribbonsnakes. She determined that females are able to reproduce at a minimum total length of 600 mm. Seven of 13 mature females in her study did not produce young, a possible indication of low reproductive output for this species. It has been previously noted that ribbonsnakes produce fewer young than the majority of other species of the same genus (Ditmars, 1907; Swanson, 1952).

Courtship and mating generally occur in early spring, soon after emergence, but fall mating may also occur (Harding, 1997). Johnson (1989) described the aquatic courtship of a pair of Ontario ribbonsnakes in April. The male approached by circling the female repeatedly, then dipping his head and entwining the female's body as she swam. He swam away from her for brief periods, during which time the female would circle back if he strayed too far away. This behaviour continued for 10 minutes, after which time the male tongue-flicked the female and aligned his body with hers.

Physiology

Carpenter (1956) studied the relationship between cloacal and environmental temperatures in a Michigan population of Eastern Ribbonsnakes. Cloacal temperatures were correlated more strongly with ground surface temperatures than with air or soil temperatures. More than 70% of cloacal temperatures were between 20º C and 30º C, thus indicating the preferred body temperature range for these snakes. During cold weather, cloacal temperatures were above the immediate environmental temperature; conversely, during hot weather cloacal temperatures were below the immediate environmental temperature.

Snake lungs appear to be common sites for parasitic infection. Chu (1936) examined ribbonsnakes from Michigan and West Virginia, and found them all to contain the nematode worm *Rhabdias fuscovenosa catanensis*, with average burdens of 7.4 and 48, respectively. Goodman (1951) also noted the tendency for “practically all gartersnakes” to be heavily parasitized by trematodes when collected in nature. He did not believe that these parasites greatly affected the health of their hosts.

Growth and survivorship

Newborn Northern Ribbonsnakes range in size from 160-240 mm total length (Harding, 1997). Total adult length averages 429.2 mm for males and 498.0 mm for females in Indiana (Minton, 1972).

Carpenter (1952b) studied the growth of Michigan ribbonsnakes in some detail, using a mark-recapture method. He found that smaller snakes grew more rapidly than larger individuals. Over a period of approximately five months, small ribbonsnakes increased in length by 13-25%, compared to an increase of 0.43-2% seen in larger specimens. Carpenter also found that the growth rate of males decreased more rapidly than the growth rate of females, and thus for any group of cohorts, females were larger than males, on average. Growth rates for specific age classes could not be determined because individual variation in growth obscured distinct size classes for snakes of the same age.

Information on survivorship is limited. Willis et al. (1982) studied tail loss patterns in ribbonsnakes and found that injured snakes less than 300 mm long (snout-vent) were never recaptured. They hypothesized that although the injuries were not immediately fatal, they created enough physiological stress during hibernation to kill small individuals. In Ontario, recruitment of young individuals might be low; of 71 ribbonsnakes found during the Hamilton Herpetofaunal Atlas, only one was a juvenile (Lamond, 1994).

Hibernation

In Ontario, the extreme recorded dates of Northern Ribbonsnake activity are from 28 March to 6 December (Mike Oldham, unpubl. data, OHS). In most years, however, the period of activity is from April to October (Lamond, 1994; Harding, 1997). In Nova Scotia, the extreme dates are 23 April to 2 October (Gilhen, 1984). During mild spells in winter and early spring, gartersnakes (*genus Thamnophis*) are known to come out of hibernation for short periods to sun themselves (Carpenter, 1956).

Carpenter (1953) examined the hibernacula and hibernating associations of snakes and amphibians in Michigan. An ant mound, a meadow vole tunnel and a crayfish burrow were excavated in search of hibernating reptiles and amphibians. Eleven Eastern Ribbonsnakes were found in the ant mound, five in the meadow vole tunnel, and none in the crayfish burrow. The uppermost ribbonsnake in the ant mound was dead, apparently frozen. It is believed that Ontario ribbonsnakes hibernate in animal burrows or rock crevices (Lamond, 1994). Because snakes must use hibernacula created by other animals or geologic events, their abundance may be limited by shortage of suitable overwintering sites (Carpenter, 1953).

Behaviour

The adjectives most often associated with ribbonsnake behaviour are “active” (Ditmars, 1907; Morris, 1974; Lazell Jr., 1976; Martof et al., 1980; Johnson, 1989; Harding, 1997) and “timid” and/or “nervous” (Conant, 1938b; Morris, 1974; Froom, 1972; Strickland and Rutter, 1992). Ribbonsnakes generally do not attempt to bite when handled (Ernst and Barbour, 1989; Froom, 1972; Martof et al., 1980; Lewis, 1991). Antipredator response in ribbonsnakes has been the focus of several studies. Scribner and Weatherhead (1995) found that ribbonsnakes rely more heavily on crypsis than on locomotion for escape from predators. Conversely, Bowers et al. (1993) found that ribbonsnakes often fled in response to predatory threat, occasionally striking as they moved away.

Ribbonsnakes are also well-known for their climbing ability (Logier, 1958; Cochran and Goin, 1970; Leviton, 1971), and have been observed as high as 2 m up in bushes (Carpenter, 1952a). Climbing and retreat into shade are behaviours associated with temperature regulation (Carpenter, 1956). During very hot and dry summers, ribbonsnakes may estivate for short periods (Ernst and Barbour, 1989).

Ribbonsnakes are predominantly diurnal, but they may forage at night during the frog breeding season (Ernst and Barbour, 1989). A gregarious species, three or four individuals are often found under a single board (Milnes, 1946). John Gilhen reported an aggregation of “some 40 or more adults, juveniles and young just lying about along the shore and on the surface in the shallows” (pers. comm.). He did qualify this observation, however, with the comment that he had never before or since witnessed an aggregation of this magnitude.

POPULATION SIZES AND TRENDS

Population size

As previously mentioned, the Canadian populations of Northern Ribbonsnakes are clearly divided with “one” in Ontario and one in Nova Scotia. In light of their independence from each other, populations in the two regions will be discussed separately.

Nova Scotia

Previously, the Northern Ribbonsnake has been regarded as “rare” in Nova Scotia (Bleakney, 1958). In the spring of 1998, a status assessment of reptiles and amphibians native to Nova Scotia was completed. Mark Elderkin of the Nova Scotia Department of Natural Resources provided a synopsis of the procedures involved and the conclusions regarding the Northern Ribbonsnake. Although the assigned status currently has no binding legal implication (due to a lack of provincial endangered species legislation), the conclusions of the ranking committee are particularly relevant to this paper. Eight criteria were used to assess species status: (1) Population Size, (2) Population Trend,

(3) Distribution Trend, (4) Geographic Distribution, (5) Number of Occurrences, (6) Threats to Populations, (7) Threats to Habitats and (8) Global Rank. Each of the first seven criteria was scored quantitatively with a letter ranging from A (most at risk of extinction or extirpation) to D (demonstrably secure and essentially ineradicable under present conditions). Following the assignment of scores for each criterion, a colour indicator of the species status was assigned by the working group. Much of the raw information for the assessment was provided by John Gilhen, widely regarded as the foremost provincial authority on Northern Ribbonsnakes.

Overall, the Northern Ribbonsnake was assigned a 'Yellow' status, based on the conclusion that it is a species that may be ecologically sensitive. Two assessment criteria are relevant to a discussion on population size: 'Number of Occurrences', which was scored a C and 'Population Size', which was scored a B. In terms of absolute numbers, population size was estimated at between 1000-3000 individuals, and the number of provincial occurrences probably less than 100. Most provincial reports are for single specimens (John Gilhen, pers. comm.).

Ontario

The first reported Northern Ribbonsnake in Ontario was in Toronto in 1858 (Ure, 1858, as cited in OHS). None have been found in this locality (York Township) since 1931. A "colony" of Northern Ribbonsnakes found in July 1972 at Mallorytown Landing, St. Lawrence Islands National Park in Leeds County indicated a possible range extension for the species, as this was the easternmost record to date (Woods and Cook, 1976).

Although there have been no studies in Ontario examining the size of Northern Ribbonsnake populations, sightings from the Ontario Herpetofaunal Summary (OHS) provide some means of estimation, despite lack of control over sampling times and locations (Oldham, 1988; Oldham and Sutherland, 1986; Oldham and Weller, 1989). Table 1, compiled from the OHS database, shows that 38 districts have reported at least one ribbonsnake sighting. However, in 6 of the 38 districts, ribbonsnakes have been reported only once, and 20 districts have fewer than 10 sightings. Additionally, ribbonsnakes have not been reported in the past 10 years from 16 districts.

Population trends

Northern Ribbonsnakes are often common where appropriate habitat is abundant, but uncommon to rare and local at the periphery of their range (Harding, 1997). It appears as though this snake has always been uncommon in Ontario (Nash, 1908; Mills, 1948; Cebek, 1971); however, recent reports suggest that populations are becoming increasingly localized, even extirpated, in areas where they were formerly widespread (Lamond, 1994). In Nova Scotia, the Northern Ribbonsnake is considered a relict, existing only in small numbers (Cook, 1970). In the assessment of Nova Scotia reptiles and amphibians, population trend was undetermined (M. Elderkin, pers. comm.). Elsewhere in the snake's North American range, it is cited as an elusive and rare species (Swanson, 1952; Degraaf and Rudis, 1983; Hunter et al., 1992).

Table 1. Northern Ribbonsnake sightings by district in Ontario (OHS database, 1998).

District	First Year Reported	Last Year Reported	Total # of Records
Durham	1968	1968	1
Ottawa-Carleton	1978	1978	2
Prince Edward	1979	1979	1
Sudbury	1982	1982	1
Manitoulin	1984	1984	1
York	1858	1984	8
Oxford	1940	1985	2
Kent	1958	1985	62
Elgin	1985	1988	2
Essex	1988	1988	1
Middlesex	1933	1988	8
Northumberland	1985	1988	13
Huron	1880	1989	7
Prescott & Russell	1989	1989	2
Parry Sound	1965	1989	14
Stormont, Dundas & Glengarry	1989	1989	1
Brant	1966	1990	26
Haliburton	1988	1990	6
Haldimand Norfolk	1933	1990	40
Leeds & Grenville	1944	1990	61
Lambton	1970	1990	12
Lanark	1954	1990	21
Peel	1969	1990	4
Renfrew	1990	1990	4
Wellington	1904	1990	27
Halton	1977	1991	13
Hamiton-Wentworth	1950	1991	13
Lennox & Addington	1954	1991	9
Muskoka	1959	1991	60
Niagara	1961	1991	34
Simcoe	1961	1991	9
Waterloo	1924	1991	16
Bruce	1960	1993	183
Frontenac	1930	1993	36
Grey	1938	1994	13
Hastings	1988	1994	7
Peterborough	1924	1994	28
Victoria	1982	1994	8

LIMITING FACTORS AND THREATS

Possibly the greatest threat to Northern Ribbonsnakes in Canada is that the lack of information pertaining to this species will prevent negative trends in population and habitat from being recognized. Given that almost all large snakes in Canada have undergone recent declines, it is reasonable to consider that ribbonsnakes have also declined, particularly because their shoreline habitat has greatly declined in quality and quantity. Knowledge gained from studies in the United States is not necessarily

applicable to Canadian populations (Gregory, 1977). In particular, the smaller and more local populations typical of Canadian snakes could experience entirely different population dynamics. For example, recruitment rates may be much lower in Canada because of decreased winter survival and lower reproductive output. This species has a smaller litter size than other species of *Thamnophis* (F. Cook, pers. comm.) and frequency of reproduction is unknown for Canadian populations. There remains an enormous potential for future research on the factors which determine the northern limit of the species' range (Cook, 1970).

Harding (1997) lists the following factors as possible threats to the Northern Ribbonsnake populations of the Great Lakes region:

1. Threats to the availability and health of wetland and littoral habitats,
2. Declines in amphibian prey,
3. Human activity resulting in degradation of shoreline vegetation,
4. Direct persecution,
5. Road kills.

Habitat destruction, collecting and road kills are cited by additional sources (Palmero, 1988; Stewart, 1974; Weller, 1983; Ernst and Barbour 1989) as factors contributing to the decline of many species of amphibians and reptiles, including ribbonsnakes. The greatest threat to the Northern Ribbonsnake in Nova Scotia is the increase in lakeshore cottages, combined with the effects of increased predation by the accompanying house cats (John Gilhen, pers. comm.). Recent studies of snake populations in Rondeau Provincial Park in Ontario found Northern Ribbonsnakes particularly susceptible to road kill with more than 200 snakes killed in the fall of 2001 (S. Gillingwater, pers. comm.).

In addition to domestic pets, predators of Northern Ribbonsnakes include herons, hawks, mink, racoons and other snakes; juveniles may be additionally preyed upon by large fish and crayfish, frogs and turtles (Ernst and Barbour, 1989; Harding, 1997). Shrews may be significant predators of young, as well as of hibernating adults (Swanson, 1952; Harding, 1997).

In Canada, there is a growing realization that many species of amphibians are in decline (Bishop and Pettit, 1992). Ribbonsnake populations may be extremely sensitive to amphibian decline, as some American studies have shown that amphibians comprise 90% or more of the ribbonsnake diet (Carpenter, 1952a; Brown, 1979). However, there is no empirical evidence that such declines have affected ribbonsnakes.

SPECIAL SIGNIFICANCE OF THE SPECIES

The Northern Ribbonsnake, like most native Canadian reptiles, reaches the northern periphery of its range in Canada (Weller, 1982). Although Northern Ribbonsnakes are still globally common, the protection of locally rare species may be

critical to conserving ecosystem integrity at smaller scales (Hunter and Hutchinson, 1994). Because peripheral populations are often genetically divergent from central populations (Lesica and Allendorf, 1995), Canadian Northern Ribbonsnakes may comprise a significant proportion of the genetic variation of the species. Furthermore, herptile populations at the northern extent of their range have quite possibly undergone genetic changes enabling them to survive the colder climate (Cook, 1977).

Snakes are potentially useful as indicator species because they occur in a wide diversity of terrestrial and aquatic habitats, and are generally top carnivores in their respective habitats (Brisbin et al., 1974). Ribbonsnakes were used in this way in a study of radiocesium concentrations from contaminated and uncontaminated habitats of the AEC Savannah River Plant in South Carolina (ibid.).

EXISTING PROTECTION OR OTHER STATUS

The Northern Ribbonsnake is not listed as a "specifically protected reptile" (Schedule 9) in Ontario under the "Fish and Wildlife Conservation Act. In addition, Ribbonsnakes occur in some protected areas such as Rondeau and other Provincial Parks and in some National Parks. In Nova Scotia, Northern Ribbonsnakes are protected under the Nova Scotia Wildlife Act (1987). In its range in the U.S.A., the Northern Ribbonsnake is listed at some level of risk in 4 of the 10 states in which this subspecies occurs. At the species level, the Eastern Ribbonsnake (*T. sauritus*) is listed at risk in 9 of 18 states in which it occurs (Natureserve, 2002). In Maine, ribbonsnakes have been listed as a Species of Special Concern by the Maine Department of Inland Fisheries and Wildlife (Hunter et al., 1992). This status could change to Endangered or Threatened if more populations are not found (ibid.). Ribbonsnakes are an endangered species in Illinois (Brandon and Ballard, 1995). It is also endangered in Wisconsin and S2 in Vermont (Natureserve, 2002). Other subspecies are S2 in West Virginia and Delaware.

SUMMARY OF STATUS REPORT

Given the paucity of information on the Canadian populations of the Northern Ribbonsnake, it would be wise to manage the species prudently. The high degree of similarity between ribbonsnakes and gartersnakes make some sightings of the Northern Ribbonsnake unreliable. The distribution and abundance of this snake in Ontario could easily be overestimated or underestimated. There is a particular need for a widespread survey with the specific intent of determining ribbonsnake distribution and population size.

Current evidence suggests that the ribbonsnake has disappeared from some areas of its original range in Ontario. Of the 38 districts with at least one ribbonsnake reported to the OHS, six are known only from a single report, and 20 districts have fewer than 10 sightings. Additionally, ribbonsnakes have not been reported in the past 10 years from

almost half of these districts. It must be noted, however, that after the official collecting period of the OHS (1984-1990), observations of all species dropped off significantly, independent of populations trends (M. Oldham, pers. comm.).

Amphibian decline might become an indicator that ribbonsnakes may be at risk. Two separate effects are discernible: First, amphibian decline directly reduces the amount of prey available to ribbonsnakes. Second, habitat loss is a major cause of amphibian decline (Bishop and Pettit, 1992). Because ribbonsnakes inhabit the same areas as their prey, they too are likely suffering from the effects of habitat loss, particularly loss of wetlands and development of shorelines.

The Nova Scotia ribbonsnake population is particularly at risk because of its relatively small size, disjunct location and the loss of critical shoreline habitat to cottage and recreational development (M. Elderkin, pers. comm.). These two factors combined create potential for detrimental genetic impacts such as inbreeding depression. Estimated population size is fewer than 3000 individuals, and the number of provincial occurrences is fewer than 100. Small populations are susceptible to stochastic events that could potentially lead to their extirpation. The potential for natural recolonization after such an event would be negligible because of the species' remote location relative to other ribbonsnake populations. Provincial authorities in Nova Scotia have recently assigned the ribbonsnake 'Yellow' status because it is a species that may be ecologically sensitive.

Elsewhere throughout its range, the Northern Ribbonsnake has also received status. In Maine, it is listed as a Species of Special Concern (S3), in Vermont it is Threatened (S2), and in Illinois and Wisconsin, it is listed as Endangered (S1).

The Northern Ribbonsnake is a species at risk in Canada. It is uncommon and extremely localized throughout its range, as well as being threatened by several factors, particularly habitat loss and a decline in prey abundance. Considering these circumstances, the Northern Ribbonsnake in Ontario should be assigned the status of Special Concern. Additionally, given the small size and high degree of isolation of the Nova Scotia population, the improbability of recolonization, and loss of habitat to lakeshore development, this disjunct population should be given the status of Threatened.

TECHNICAL SUMMARY

Thamnophis sauritus septentrionalis
Northern Ribbonsnake — Couleuvre Mince
Ontario, Nova Scotia

Extent and Area information	
• *extent of occurrence (EO)(km²)*	Ontario 140,000km^2 Nova Scotia 400km^2
• *specify trend (decline, stable, increasing, unknown)*	Unknown
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	No
• *area of occupancy (AO) (km²)*	Ontario ~45,000km^2 Nova Scotia <400km^2
• *specify trend (decline, stable, increasing, unknown)*	Probably declining
• *are there extreme fluctuations in AO (> 1 order magnitude)?*	No
• *number of extant locations*	Unknown
• *specify trend in # locations (decline, stable, increasing, unknown)*	Nova Scotia: Stable Ontario: Declining
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	No
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Nova Scotia: Declining Ontario: likely declining
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	~ 6 years
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	Nova Scotia <3000 Ontario: Unknown
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	Nova Scotia: Unknown Ontario: Unknown, likely declining
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	--
• *are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?*	--
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?*	Nova Scotia: Yes Ontario: Unknown, but becoming more fragmented
• *list each population and the number of mature individuals in each*	N.S. <10 "populations" Ontario: Unknown
• *specify trend in number of populations (decline, stable, increasing, unknown)*	Nova Scotia: Unknown Ontario: Probable decline
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	No
Threats (actual or imminent threats to populations or habitats)	
- loss/drainage of wetland habitat, loss of shoreline habitat, cottage development - road kill, deliberate killing by humans, domestic cats/dogs - low reproductive output (small litters, do not reproduce annually) - collection for pet trade (possible) - declining amphibian prey (possible)	

• *does species exist elsewhere (in Canada or outside)?*	Yes, in USA
• *status of the outside population(s)?*	Unknown
• *is immigration known or possible?*	Possible (not N.S)
• *would immigrants be adapted to survive here?*	Probably
• *is there sufficient habitat for immigrants here?*	Unknown
Quantitative Analysis	

ACKNOWLEDGEMENTS

For information pertaining to the Nova Scotia ribbonsnake population, I am indebted to Mark Elderkin, John Gilhen, Andrew Hebda and Tom Herman. I would like to especially thank Mike Oldham for providing me with a wealth of information pertaining to the Ontario population, including the distribution map. Ron Brooks and Glenn Barrett provided additional suggestions and assistance. Funding was provided by the Canadian Wildlife Service, Environment Canada.

The executive summary, technical summary and final edits were completed by Ron Brooks and Melissa Cameron.

LITERATURE CITED

Adams, M.S. and H.F. Clark. 1958. A herpetofaunal survey of Long Point, Ontario, Canada. Herpetologica 14: 8-10.

Behler, J.L. and F.W. King. 1996. National Audubon Society Field Guide to North American Reptiles and Amphibians. Alfred A. Knopf, New York. 743 pp.

Betz, W.H. 1981. The harmful side effects resulting from urban Sprawl. Canadian Amphibian and Reptile Conservation Society Bulletin 18(4): 1-3. March-April 1981.

Bishop, C.A. and K.E. Pettit. 1992. Declines in Canadian amphibian populations: designing a national monitoring strategy. Canadian Wildlife Service Occasional Paper No. 76.

Bleakney, J.S. 1958. A zoogeographical study of the amphibian and reptiles of eastern Canada. National Museum of Canada Bulletin 155: 1-119.

Bowers, B.B., A.E. Bledsoe and G.M. Burghardt. 1993. Responses to escalating predatory threat in garter and ribbonsnakes (*Thamnophis*). Journal of Comparative Psychology 107(1): 25-33.

Brandon, R.A. and S.R. Ballard. 1995. *Thamnophis sauritus* (Eastern Ribbonsnake). Herpetological Review 26(3): 157.

Brisbin, I.L. Jr., M.A. Staton, J.E. Pinder, III and R.A. Geiger. 1974. Radiocesium concentrations of snakes from contaminated and non-contaminated habitats of the AEC Savannah River Plant. Copeia 2: 501-506.

Brown, E.E. 1979. Stray food records from New York and Michigan snakes. The American Midland Naturalist 102(1): 200-203.

Burt, M.D. 1928. The relation of size to maturity in the gartersnakes, *Thamnophis sirtalis sirtalis* (L.) and *T. sauritus sauritus* (L.). Copeia 1928 166: 8-12.

Campbell, C.A. and D.W. Perrin. 1979. A survey of the queen snake (*Regina septemvittata*) in southwestern Ontario. Wildlife Branch, Ontario Ministry of Natural Resources.

Carpenter, C.C. 1952a. Comparative ecology of the Common gartersnake (*Thamnophis s. sirtalis*), the Ribbonsnake (*Thamnophis s. sauritus*), and Butler's gartersnake (*Thamnophis butleri*) in mixed populations. Ecological Monographs 22(4): 235-258.

Carpenter, C.C. 1952b. Growth and maturity of the three species of *Thamnophis* in Michigan. Copeia 1952 4: 237-243.

Carpenter, C.C. 1953. A study of hibernacula and hibernating associations of snakes and amphibians in Michigan. Ecology 34(1): 74-80.
Carpenter, C.C. 1956. Body temperatures of three species of *Thamnophis*. Ecology 37(4): 732-735.
Cebek, J.E. 1971. The herpetofauna of the Georgian Bay region. Part I- the terrestrial reptiles. Canadian Amphibian and Reptile Conservation Society Bulletin 9(3): 1-4. May-June 1971.
Chu, T. 1936. A review of the status of the reptilian nematodes of the genus *Rhabdias* with a description of *Rhabdias fuscovenosa* var. *catanensis* (Rizzo, 1902) new rank. Journal of Parasitology 22: 130-139.
Clark, D.R. Jr. 1974. The Western Ribbonsnake (*Thamnophis proximus*): ecology of a Texas population. Herpetologica 30: 372-379.
Cochran, D.M. and C.J. Goin. 1970. The new field book of reptiles and amphibians. G.P. Putnam's Sons, New York. 359 pp.
Conant, R. 1938a. On the seasonal occurrence of reptiles in Lucas County, Ohio. Herpetologica 1: 137-144.
Conant, R. 1938b. The reptiles of Ohio. American Midland Naturalist 20: 1-200.
Conant, R. and J.T. Collins. 1991. Reptiles and Amphibians: Eastern and Central North America (3rd edition). Houghton Mifflin Company, New York. xxx+450 pp.
Cook, F.R. 1970. Rare or endangered Canadian amphibians and reptiles. The Canadian Field-Naturalist 84(1): 9-16.
Cook, F.R. 1977. Review of the Canadian herpetological scene. *In* Canada's threatened species and habitats: proceedings of the symposium on Canada's threatened species and habitats. Special Publication No. 6. Canadian Nature Federation. T. Mosquin and C. Suchal, *Eds*. 185 pp.
Crother, B.I. 2000. Scientific and standard English names of amphibians and reptiles of North America North of Mexico, with comments regarding confidence in our understanding. Society for the Study of Amphibians and Reptiles, Herpetological Circular No. 29. pp. 1-82.
DeGraaf, R.M. and Rudis, D.D. 1983. Amphibians and reptiles of New England: habitats and natural history. University of Massachusetts Press, Amherst: 85 pp.
Ditmars, R.L. 1907. The reptile book. Doubleday, Page and Company. 472 pp.
Elderkin, M. 1998. Personal communication, northern ribbon snake status report on the Nova Scotia population.
Ernst, C.H. and R.W. Barbour. 1989. Snakes of eastern North America. George Mason University Press, Fairfax, Virginia. 282 pp.
Evans, P.D. 1942. A method of fishing used by water snakes. The Chicago Field Naturalist 5(3): 53-55.
Froom, B. 1972. The snakes of Canada. McClelland and Stewart Limited, Toronto and Montreal. 128 pp.
Gibbons, J.W. and R.D. Semlitsch. 1991. Guide to reptiles and amphibians of the Savannah River Site. Athens: University of Georgia Press.
Gilhen, J. 1984. Amphibians and reptiles of Nova Scotia. Nova Scotia Museum, Halifax, Nova Scotia. 162 pp.
Gilhen, J. 1998. Personal communication, diverse information pertaining to northern ribbon snakes in Nova Scotia.

Gillingwater, S.D. and R.J. Brooks. 2002. A selective herpetofaunal survey, inventory and biological research study of Rondeau Provincial Park. Report to Endangered Species Recovery Fund and Int. Fund for Animal Welfare. 94 pp.
Goodman, J.D. 1951. Some aspects of the role of parasitology in herpetology. Herpetologica 7: 65-67.
Graves, B.M., M. Halpern and J.L. Friesen. 1991. Snake aggregation pheromones: source and chemosensory mediation in western ribbon snakes (*Thamnophis proximus*). Journal of Comparative Psychology 103(2): 140-144.
Gregory, P. 1977. Rare and threatened snake species of Canada, pp. 122-126 *In* Canada's Threatened Species and Habitats, T. Mosquin and C. Suchal, *Eds.* Special Publication No. 6. Canadian Nature Federation. 185 pp.
Harding, J.H. 1997. Amphibians and reptiles of the Great Lakes region. The University of Michigan Press, Ann Arbor. xvi + 378 pp.
Hamilton, W.J. Jr. and J.A. Pollack. 1956. The food of some colubrid snakes from Fort Benning, Georgia. Ecology 37(3): 519-526.
Hunter, M.L., J. Albright and J. Arbuckle. 1992. The amphibians and reptiles of Maine. Agricultural Experiment Station Bulletin 838: 188 pp.
Hunter, M.L. Jr. and A. Hutchinson. 1994. The virtues and shortcomings of parochialism: conserving species that are locally rare, but globally common. Conservation Biology 8(4): 1163-1165.
Johnson, B. 1989. Familiar amphibians and reptiles of Ontario. Natural Heritage/ Natural History Inc., Toronto. 168 pp.
Lamond, W.G. 1994. The reptiles and amphibians of the Hamilton area—an historical summary and the results of the Hamilton Herpetofaunal Atlas. Published by the Hamilton Naturalists' Club, Hamilton, Ontario. 174 pp.
Lazell, J.D. Jr. 1976. This broken archipelago: Cape Cod and the islands, amphibians and reptiles. New York Times Book Co., New York, N.Y.: 260 pp.
Lee, D.S. 1968. Herpetofauna associated with central Florida mammals. Herpetologica 24(1): 83-84.
Lesica, P. and F.W. Allendorf. 1995. When are peripheral populations valuable for conservation? Conservation Biology 9(4): 753-760.
Leviton, A.E. 1971. Reptiles and amphibians of North America. Doubleday and Company Inc., New York. 250 pp.
Lewis, J.C. 1991. Amphibians and reptiles. pp. 137-145 In J.C. Lewis (ed.), Guide to the Natural History of the Niagara Region. Welland Printing Company Limited, Welland, Ontario.
Logier, E.B.S. 1958. The reptiles of Ontario. Royal Ontario Museum of Zoology, Handbook No. 4. University of Toronto Press, Toronto, Ontario. 63 pp.
Logier, E.B.S. and G.C. Toner. 1942. Amphibians and reptiles of Canada. The Canadian Field-Naturalist 55(2): 15-16.
Martof, B.S., W.M. Palmer, J.R. Bailey and J.R. Harrison. 1980. Amphibians and reptiles of the Carolinas and Virginia. University of North Carolina Press, Chapel Hill: 264 pp.
McBride, B. 1961. The reptiles of southern Georgian Bay. Ontario Field Biologist 15(1): 19-21.

McCoy, C.J. 1982. Amphibians and reptiles in Pennsylvania. Carnegie Museum of Natural History Special Publication Number 6.
Milnes, H. 1946. Amphibians and reptiles of Oxford County, Ontario. The Canadian Field-Naturalist 60(1):1-4.
Mills, R.C. 1948. A check list of the reptiles and amphibians of Canada. Herpetologica 4: 1-15.
Minton, Jr. S.A. 1972. Amphibians and reptiles of Indiana. The Indiana Academy of Science, Indianapolis, Indiana: 346 pp.
Morris, P.A. 1974. An introduction to the reptiles and amphibians of the United States. Dover Publications, Inc., New York. 253 pp.
Nash, C.W. 1908. Batrachians and reptiles of Ontario. Pp. 11-15 *In* Manual of vertebrates of Ontario. Department of Education, Toronto, Ontario. L.K. Cameron, Toronto, Ontario. 229 pp.
Natureserve 2002. Association of Biodiversity Information. www.natureserve.org/ explorer/servelet.
Oldham, M.J. 1988. Ontario Herpetofaunal Summary 1985. World Wildlife Fund, Essex Region Conservation Authority and Ministry of Natural Resources. 206 pp.
Oldham, M.J. 1998. Personal communication, diverse Northern Ribbonsnake information.
Oldham, M.J. and D.A. Sutherland. 1986. Ontario Herpetofaunal Summary 1984. Essex Region Conservation Authority and World Wildlife Fund Canada. 214 pp.
Oldham, M.J. and W.F. Weller. 1989. Ontario Herpetofaunal Summary 1986- Technical Supplement. Ontario Field Herpetologists, Cambridge, Ontario. 197 pp.
Palermo, R.V. 1988. Ontario revisited: a view from the west. The Ontario Herpetological Society News (Number 14) March 1988: 7-14.
Plourde, S.A., E.L. Szepesi, J.L. Riley, M.J. Oldham and C. Campbell. 1989. Distribution and status of the herpetofauna of central region, OMNR. Parks and Recreational Areas Section, OMNR, Open File Ecological Report SR8903, Central Region, Richmond Hill, Ontario. 30 pp.
Rossman, D.A. 1963. The Colubrid snake genus *Thamnophis*: a revision of the *sauritus* group. Bull. Florida State Museum. Biological Sciences 7: 1-178.
Rossman, D.A. 1970. *Thamnophis sauritus*. IN Catalogue of American amphibians and reptiles: 99.
Schmidt, K.P. and D.D. Davis. 1941. Field book of snakes of the United States and Canada. G.P. Putnam's Sons, New York. 365 pp.
Scribner, S.J. and P.J. Weatherhead. 1995. Locomotion and antipredator behaviour in three species of semi-aquatic snakes. Canadian Journal of Zoology 73: 321-329.
Stewart, D. 1974. Canadian endangered species. Gage Publishing Limited, Toronto. 172 pp.
Strickland, D. and R.J. Rutter. 1992. Reptiles and amphibians of Algonquin Provincial Park. Ontario Ministry of Natural Resources.
Swanson, P.L. 1952. The reptiles of Venago County, Pennsylvania. American Midland Naturalist 47(1): 161-182.
Toner, G.C. 1935. Notes on the snakes of Leeds and Frontenac Counties, Ontario. Copeia 1935(1): 42-43.
Ure, G.P. 1858, *In* Handbook of Toronto. Lovell & Gibson, Toronto.

Warren, A.E. 1950. The fauna of the Royal Botanical Gardens, Hamilton, Ontario. The Canadian Field-Naturalist 64(4): 130-133.
Weller, W. 1982. Rare and endangered reptiles in Ontario- Part I. Canadian Amphibian and Reptile Conservation Society Bulletin 20(2): 1-8.
Weller, W. 1983. Rare and endangered reptiles in Ontario- Part II. 20(3): 1-4.
Weller, W.F. and P.T. Gregory. 1965. The reptiles of Sturgeon Bay area. Canadian Amphibian and Reptile Conservation Society Bulletin 4(3): 1-4.
Willis, L., S.T. Threlkeld and C.C. Carpenter. 1982. Tail loss patterns in *Thamnophis* (Reptilia: Colubridae) and the probable fate of injured individuals. Copeia 1982 1: 98-101.
Woods, J.G. and F.R. Cook. 1976. Range extension of the ribbon snake in eastern Ontario. Canadian Field-Naturalist 90(1): 69-70.
Wright, A.H. and A.A. Wright. 1957. Handbook of snakes of the United States and Canada, Vol. 2. Comstock Publishing Associates, a division of Cornell University Press, Ithaca, New York. 1105 pp.

BIOGRAPHICAL SUMMARY OF THE AUTHOR

Kim Smith completed her Honours B.Sc. at the University of Guelph in 1996, with a specialization in wildlife biology. From 1996 to 1998, she conducted field work on a variety of taxonomic groups, including marine invertebrates and sea ducks, marine fishes, reptiles, waterfowl and mammals. She is currently working toward a Masters degree with Dr. Ron Brooks at the University of Guelph. Additional COSEWIC status reports on the queen snake (*Regina septemvittata*) and the timber rattlesnake (*Crotalus horridus*) are in progress.

AUTHORITIES CONSULTED

Although there are currently no studies being conducted specifically on the Northern Ribbonsnake in Canada, the following people are knowledgeable about its status and very helpful:

Ontario
Mike Oldham
Botanist/ Herpetologist
Natural Heritage Information Centre (NHIC)
Ontario Ministry of Natural Resources
P.O. Box 7000
(2nd Floor, North Tower, 300 Water Street)
Peterborough, ON
K9J 8M5

Nova Scotia

John Gilhen
Museum of Natural History
1747 Summer Street
Halifax, NS
B3H 3A6
GILHENJA@gov.ns.ca

Mark Elderkin
History Biologist (Species at Risk)
Wildlife Division
136 Exhibition Street
Kentville, NS
B4N 4E5
ELDERKMF@gov.ns.ca