COSEWIC
Assessment and Status Report

on the

Butler's Gartersnake
Thamnophis butleri

in Canada

ENDANGERED
2010

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:

COSEWIC. 2010. COSEWIC assessment and status report on the Butler's Gartersnake *Thamnophis butler* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 51 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Previous report(s):

COSEWIC. 2001. COSEWIC assessment and status on report on Butler's Gartersnake *Thamnophis butleri* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 20 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

Sandilands, A.P. 2001. COSEWIC status report on the Butler's Gartersnake *Thamnophis butleri* in Canada, *in* COSEWIC assessment and status on report on Butler's Gartersnake *Thamnophis butleri* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-20 pp.

Sandilands, A.P. 1999. COSEWIC assessment and status on report on Butler's Gartersnake *Thamnophis butleri* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-20 pp.

Production note:
COSEWIC would like to acknowledge Jonathan Choquette and Daniel Noble for writing the status report on the Butler's Gartersnake (*Thamnophis butleri*) in Canada, prepared under contract with Environment Canada. This report was overseen and edited by Dr. Ronald J. Brooks, Co-chair of the COSEWIC Amphibians and Reptiles Specialist Subcommittee.

For additional copies contact:

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

Tel.: 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 couleuvre à petite tête (*Thamnophis butleri*) au Canada.

Cover illustration/photo:
Butler's Gartersnake — ©Daniel W.A. Noble.

Catalogue No. CW69-14/613-2011E-PDF
ISBN 978-1-100-18554-5

Recycled paper

COSEWIC
Assessment Summary

Assessment Summary – November 2010

Common name
Butler's Gartersnake

Scientific name
Thamnophis butleri

Status
Endangered

Reason for designation
Most populations of this species occur in small, scattered habitat remnants. Most are isolated so they are threatened by the negative genetic effects of small population size and by demographic stochasticity. Recent surveys have not detected the species at several sites where they were formerly known. Road mortality, ongoing habitat loss and fragmentation are also threats to this small specialized snake.

Occurrence
Ontario

Status history
Designated Special Concern in April 1999. Status re-examined and designated Threatened in November 2001. Status re-examined and designated Endangered in November 2010.

COSEWIC
Executive Summary

Butler's Gartersnake
Thamnophis butleri

Wildlife species information

Butler's Gartersnake (*Thamnophis butleri*) is a small, non-aggressive gartersnake with three distinct longitudinal yellow stripes on its dark brown back. This snake was first described in 1889 by E.D. Cope. Like most other small Canadian snakes, this species has been poorly studied. It is often confused with two other *Thamnophis* species coexisting in its range, the Eastern Gartersnake, *T. sirtalis,* and the Eastern Ribbonsnake, *T. sauritus*. Butler's Gartersnake, however, is shorter in total length (38-51 cm), is much more docile and possesses a unique pattern and position of side stripes. The latter facilitates its identification.

Distribution

Butler's Gartersnake has one of the most restricted global distributions of any snake in North America. This distribution is patchy and confined to southwestern Ontario, and parts of four U.S. states in the Great Lakes Region (Wisconsin, Ohio, Indiana and Michigan). In Ontario, it occurs in western Essex and Lambton counties from Amherstburg to Errol with disjunct locations at Skunk's Misery (Lambton and Middlesex counties), Parkhill (Middlesex County) and Luther Marsh (Dufferin and Wellington counties). The Canadian distribution of Butler's Gartersnake occupies approximately 16% of its global distribution.

Habitat

Characteristic habitat of Butler's Gartersnake includes old fields, disturbed sites, urban and industrial sites and Tallgrass Prairie. Essential habitat components include a dense cover of grasses or herbs with a heavy thatch layer and an abundance of earthworms as prey. This snake can be found near small bodies of water (including seasonally dry marshes and swales) in a small number of vacant urban lots (including industrial lands) and parks and in Tallgrass Prairie remnants. The species is difficult to find in its preferred habitat outside of the mating season and is then more frequently observed under rocks and debris. Although overwintering sites have not been directly observed in Canada, it is assumed that this snake hibernates in small mammal burrows, ant mounds, loose fill and/or crayfish burrows.

Habitat loss has occurred in the Windsor-Sarnia region in the last 3 decades due to urbanization and agriculture. Skunk's Misery has lost *T. butleri* habitat due to agriculture and forest succession, whereas habitat at Luther Marsh may have increased.

Biology

In southwestern Ontario, Butler's Gartersnakes generally are active from April to October. Mating occurs in early spring and 8-10 young are born live from June to September. Sexual maturity is estimated at 2 years and generation time is estimated to be 4 years. This snake feeds primarily on earthworms, which raises some questions as this food source did not occur in its current range until after European settlement. Predators of Butler's Gartersnake, although unrecorded, are presumably the same as those of other *Thamnophis* species.

The majority of Butler's Gartersnakes in a population exhibit fairly limited movements. Maximum activity range is less than 1 ha and mean movement distance is 300 m. A small percentage of individuals have been observed moving much farther.

Population sizes and trends

Butler's Gartersnake occurs in four 'regions' and occasionally appears to be locally abundant as it is readily observed at a few of its historic locations. In the largest region, Windsor-Sarnia, 32% of locations, including the largest population (Location 18) have been lost or have not produced reliable *T. butleri* sightings in at least a decade. An overall decline in the number of *T. butleri* localities in this region is presumed, despite the discovery of 'new' locations. In 2009, population sizes were estimated at two locations: 105 adults at Location 22 in Windsor and 240 adults at Location 41 in Sarnia. Major developments are proposed for both sites and are likely to have negative impacts on the snakes. At Luther Marsh, increased searches have expanded the area known to be occupied by this snake. At Skunk's Misery, it appears that habitat has been severely reduced and this species has not been recorded there in more than 2 decades, despite several targeted searches and being common historically. At Parkhill, the only record of Butler's Gartersnake was reported in 1992. In a fifth region, Rondeau Provincial Park, the species has not been recorded in over 60 years and it no longer occurs there.

Limiting factors and threats

The current disjunct distribution of Butler's Gartersnake suggests a much wider historical range. Agricultural practices and increased urbanization are the major limits to the species and have contributed to the loss of most potential habitat of Butler's Gartersnake in Canada. Available habitat is still decreasing and becoming more fragmented into small, isolated patches. This ongoing habitat loss and fragmentation are the major threats. Illegal collection for the pet trade probably occurs in some areas. This species is not commonly available in the pet trade, but is captured for personal collections. The severity of this threat is unknown. Multiple roadkill records exist in Ontario, but population level effects have not been assessed.

Special significance of the species

The entire Canadian distribution of Butler's Gartersnake is limited to four regions within Ontario, which represent 16% of its global range. There are unique morphological variants of this species observed in Ontario that are unrecorded in American populations. The close similarities between *T. butleri*, the Short-headed Gartersnake *(T. brachystoma*) and the Plains Gartersnake (*T. radix*) suggest ongoing speciation events.

Butler's Gartersnake is one of three species of the genus *Thamnophis* coexisting in southern Ontario. There are no other areas in Canada, east of Saskatchewan, where three or more closely related snake species are found in the same region. For this reason, the faunal assemblage is of particular interest both for its diversity and for its demonstration of the ecological principles of habitat and resource partitioning. The dietary specialization of Butler's Gartersnakes raises interesting evolutionary and ecological questions

Existing protection or other status designations

Butler's Gartersnake is assessed as 'Endangered' by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and as 'Threatened' by the Committee on the Status of Species at Risk in Ontario (COSSARO). It was listed as Threatened under the federal *Species at Risk Act* in 2003. In 2007, it was listed as Threatened by the Ontario Ministry of Natural Resources (OMNR). *Thamnophis butleri* has species' protection, but not habitat protection under Ontario's *Endangered Species Act, 2007* (ESA) in 2008. Habitat regulation will come into effect in 2013 under Ontario's *Endangered Species Act, 2007*. Hunting and trapping of this species is regulated under Ontario's *Fish and Wildlife Conservation Act*. As of 2009, approximately 40% of Butler's Gartersnake habitat in Ontario is found within areas with varying degrees of protection, although development is proceeding in surrounding areas, further fragmenting populations.

In the United States, Butler's Gartersnake is considered 'Critically Imperilled' in Indiana, 'Vulnerable' in Wisconsin, 'Apparently Secure' in Michigan' and unranked in Ohio. Globally, Butler's Gartersnake is ranked G4 (secure).

TECHNICAL SUMMARY

Thamnophis butleri
Butler's Gartersnake Couleuvre à petite tête
Range of occurrence in Canada (province/territory/ocean): Ontario

Demographic Information

Generation time: GT = Age at Maturity + 1/ annual adult mortality rate. *GT = 2 + 1/0.5 = 4 years.*	4 years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals? *Populations have recently been extirpated or are declining, and ongoing and projected loss of habitat to development suggest that loss of habitat and declines of mature individuals will continue into the future.*	Yes, observed, inferred and projected
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations]	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations].	Unknown
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations].	Unknown, but reduction highly probable
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future.	Unknown, but likely to be reduction as loss and fragmentation of habitat patches to development continues.
Are the causes of the decline clearly reversible and understood and ceased?	Understood, but not ceased and probably not reversible.
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	10,248 km²
Index of area of occupancy (IAO)	360 km²
Is the total population severely fragmented? *More than 50% of the population occurs in small isolated populations with reduced probability of persistence because of small numbers and numerous threats*	Yes
Number of "locations∗" *There are ~ 44 "locations" of which several are probably extirpated. All of them are small, many are highly isolated and almost all are threatened by ongoing industrial, urban and/or agricultural development.*	Four "regions" (41 locations in the Windsor-Sarnia region)
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	Projected
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	Observed and projected
Is there an [observed, inferred, or projected] continuing decline in number of populations?	Observed and projected
Is there an [observed, inferred, or projected] continuing decline in number of locations?	Observed and projected

∗ See definition of location in Table 1.

Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat?	Observed and projected
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations∗?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each region)

Population	**N Mature Individuals**
Windsor-Sarnia: ? Location 22: 100, Location 41: 240 Parkhill: Only one Butler's Gartersnake has ever been reported from here. Skunk's Misery: 0 ? There are no confirmed records in the past 20 years and none were found in 2009. Luther Marsh: ?	Unknown
Total	Unknown

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	NA

Threats (actual or imminent, to populations or habitats)

1. Loss and fragmentation of habitat to urbanization and agriculture
2. Roadkill occurs but its impact is unknown
3. Most populations are small and isolated and therefore vulnerable to genetic and demographic stochasticity
4. Collection for pet trade may be a local threat

Rescue Effect (immigration from outside Canada)

Status of outside population(s)?:S1 IN: S3 WI: S4 MI: Not ranked OH	
Is immigration known or possible?	Possible from Michigan, along Detroit River, St. Clair River and St. Clair River Delta
Would immigrants be adapted to survive in Canada?	Probably, they exist in the same climatic region
Is there sufficient habitat for immigrants in Canada?	Probably, potential habitat corridors exist connecting inland habitats to landing sites along the shoreline
Is rescue from outside populations likely?	Probably not, due to strong river currents, lack of shoreline habitat and roads severing shoreline from inland habitat.

∗ See definition of location in Table 1.

Current Status

COSEWIC: Endangered (November 2010)

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Endangered	B2ab(i,ii,iii,iv,v)
Reasons for designation: Most populations of this species occur in small, scattered habitat remnants. Most are isolated so they are threatened by the negative genetic effects of small population size and by demographic stochasticity. Recent surveys have not detected the species at several sites where they were formerly known. Road mortality, ongoing habitat loss and fragmentation are also threats to this small specialized snake.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable as the number of mature individuals is unknown.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Endangered under B2ab(i,ii,iii,iv,v) as the IAO (360 km^2) is below the threshold for Endangered, the species habitat is estimated to be severely fragmented, and there is continuing decline in b(i,ii,iii,iv,v).
Criterion C (Small and Declining Number of Mature Individuals): Not applicable as the total number of mature individuals is unknown.
Criterion D (Very Small or Restricted Total Population): Not applicable as the number of mature individuals is unknown, the IAO is larger than 20 km^2 and there are more than five locations.
Criterion E (Quantitative Analysis): Not performed.

PREFACE

Butler's Gartersnake (*Thamnophis butleri*) is a small, docile gartersnake with one of the most restricted distributions of any North American snake. It is unique to the Great Lakes Region of North America and, in Canada, it is found only in southwestern Ontario. This species is relatively unfamiliar to Canadian herpetologists and is often misidentified as one of the more common *Thamnophis* species. Knowledge of its current and historic distribution as well as much of its biology and demography is consequently incomplete. Butler's Gartersnake was last assessed as Threatened by COSEWIC and COSSARO in 2001. In 2009, as a part of the preparation of this Update Report, a survey across the species' Ontario range sought to substantiate the continued presence of historic populations and to establish the full extent of the species' current distribution. Although Butler's Gartersnake is still present at several localities, many of the sites listed in 2001 have either been developed, are proposed for development or produced no specimens. Major threats to the persistence of Butler's Gartersnake and its habitat are similar to those in the 2001 report. These threats include agricultural expansion and intensification, urban and industrial development and the negative effects, such as inbreeding depression and environmental and demographic stochasticity, associated with existing primarily in small isolated populations.
Ten years after being assessed as Threatened by COSEWIC and COSSARO, Butler's Gartersnake still has no recovery team in Ontario or at the federal level, and no Recovery Strategy has been developed.

COSEWIC HISTORY

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. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2010)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* 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. Definition of the (DD) category revised in 2006.

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

Butler's Gartersnake

Thamnophis butleri

in Canada

2010

TABLE OF CONTENTS

List of Figures

List of Tables

List of Appendices

WILDLIFE SPECIES INFORMATION

Name and classification

Class:	Sauropsida
Order:	Squamata
Family:	Colubridae
Genus:	*Thamnophis*
Species:	*Thamnophis butleri* (Cope 1889)
Common Name:	English: Butler's Gartersnake
	French: Couleuvre à petite tête

Butler's Gartersnake, couleuvre à petite tête, (*Thamnophis butleri*) was first described as a distinct species by E.D. Cope (1889) and named in honour of the early Indiana naturalist Amos Butler (Cope 1889, Conant and Collins 1991, see also Appendix 4). Subsequently, Boulenger (1893) considered it to be a variety of the Eastern Gartersnake, *Thamnophis sirtalis*. Cope (1900) restored it to a full species as *Eutaenia butlerii*, and Ruthven (1908) used *Thamnophis* as the genus. Smith (1949) reduced it to a subspecies of the Plains Gartersnake (*Thamnophis radix)*, but Conant (1950) restored it to full species status. No subspecies of *T. butleri* are recognized.

Its genus (*thamn* = bushes; *ophi* = snake: Johnson 1989) is in the subfamily Natricinae, the watersnakes, with 28 genera distributed over North America, Africa and Eurasia, of the family Colubridae. *Thamnophis* contains approximately 30 recognized species that are characteristically longitudinally striped (de Queiroz *et al*. 2002). These species occur in North and Central America from Canada to Costa Rica (Conant and Collins 1991, Rossman *et al*. 1996).

Morphological description

Thamnophis butleri is a small, short-headed gartersnake with three yellowish stripes, one dorsal and two lateral (total length 25-57 cm, record 69.2 cm: Wright and Wright 1957, Burghardt 1968, Conant and Collins 1991). The dorsal stripe may also be white to cream in colour. The lateral stripes are centred on the third scale row up from the ventral scale, spilling onto half of the second and fourth scale rows. In some regions, the lateral stripes may be centred on the third scale row and only encompass half of the second row. All three stripes are clean with defined edges. The lateral stripe is divided from the whitish underbelly by a broad chestnut-coloured stripe along the first lateral scale row and the upper edges of the ventral scales. The dorsum ranges from black to brown to olive brown and may have dark checkering along the borders of its dorsal and lateral stripes (see Logier 1958 for detailed illustration).

Two other *Thamnophis* occur within *T. butleri*'s range and are easily confused with this species: the Eastern Gartersnake (*T. sirtalis*) and the Eastern Ribbonsnake (*T. sauritus)*. The lateral stripes are on rows 3 and 4 on *T. sauritus* and rows 2 and 3 on *T. sirtalis*. *Thamnophis sauritu*s is more slender than the other two species, has a characteristic white spot in front of each eye and has a markedly longer tail. *Thamnophis sirtalis* has a larger head and a more variable pattern than *T. butleri* (for example, *T. sirtalis* do not always possess a clear dorsal stripe, whereas all *T. butleri* possess this feature).

Unique morphological variants of this species have been noted in Ontario. These include: melanism (recorded only from Amherstburg: Catling and Freedman 1977, J. Larson pers. comm. 2009), albinism (recorded from Windsor: Reid 1985, P. Pratt pers. obs. 1985), wide variations in scale counts in the Windsor-Sarnia region (Planck and Planck 1977), and individuals at Luther Marsh with scale counts consistent with the Short-headed Gartersnake (*Thamnophis brachystoma)* (Schueler and Westell 1975). The Short-headed Gartersnake has a tiny global distribution being found only in northwest Pennsylvania and southwestern New York (Harding 1997). Like *T. butleri,* it feeds almost exclusively on earthworms.

Thamnophis butleri is part of a North American complex that includes two other closely related species: the Plains Gartersnake (*T. radix*) and the Short-headed Gartersnake (*T. brachystoma*)*. Thamnophis butleri* is in the geographic centre of this complex. These three species form an east to west series of increasing range area, body size, dorsal spotting, vividness of dorsal stripes, scale numbers, and relative head size (Ruthven 1908, Smith 1945, 1949, Conant 1950, Conant and Collins 1991, Rossman *et al*. 1996). Some of these trends are also expressed within populations of *T. radix* and *T. butleri* (Ruthven 1904, 1908; Davis 1932), as has been described from snakes at Luther Marsh (see section on **Designatable units**).

Schmidt (1938) postulated that *T. butleri* was a derivative of *T. radix*, which had an eastward extension in the interglacial period that preceded the Wisconsin glaciation. This theory is supported by Rossman *et al*. (1996), who states that *T. butleri* was probably ancestral to *T. brachystoma*. Using four mitochondrial DNA genes, de Queiroz *et al*. (2002) showed that *T. radix* and *T. butleri* are most closely related to each other and, together, these are sister to *T. brachystoma.* The data indicate that these three species form a well-supported clade (de Queiroz *et al*. 2002) (see **Genetic description***).*

Genetic description

Two genetic studies of *T. butleri* were underway as of 2010, one on its range-wide phylogeographic history (J. Placyk pers. comm. 2009), and the other on the genetic structure of the Canadian populations (Noble, Choquette, and Brooks, unpublished data). The first study has identified a total of 36 unique mitochondrial NADH dehydrogenase (ND2) haplotypes throughout the U.S. range of *T. butleri,* four of which are represented only in Michigan specimens (J. Placyk pers. comm. 2009).

The Canadian study was initiated to determine whether morphological variation in Luther Marsh indicates the presence of the closely related species *Thamnophis brachystoma* (Schueler and Westell 1975; Planck and Planck 1977; Harding 1997). Preliminary genetic data do not support this hypothesis; individuals found in 2009 consistent with *T. brachystoma* scale counts all contain a single ND2 mitochondrial DNA haplotype that is identical in all *T. butleri* examined throughout the rest of Ontario. It corresponds to one of the haplotypes (#33) found by Placyk's team. In their U.S. study, this haplotype only occurred in eastern Michigan and northern Ohio. It appears that *T. butleri*, *T. radix* and *T. brachystoma* are a clade, with their haplotypes occurring as three groups: *T. butleri* in Ontario and Michigan; all other *T. butleri, T. radix* and their hybrids; and *T. brachystoma* (J. Placyk unpublished data).

Seven microsatellite DNA loci were also used to examine the possibility of mitochondrial DNA introgression between *T. butleri* and *T. brachystoma,* and to understand better the genetic structure across Ontario. Analyzing these data using Bayesian assignment tests provides no support for the hypothesis that the snakes in Luther Marsh represent two species. If *T. brachystoma* exists in Luther Marsh then two genetically distinct clusters should be present there. However, the microsatellite data suggest that all individuals from Luther Marsh represent a single population, genetically distinct from *T. butleri* in the rest of Canada. Therefore, the nuclear DNA data indicate some genetic structure in the Ontario populations of *T. butleri* (D. Noble, J. Choquette unpublished data). Preliminary analyses support the hypothesis that there are at least 3-4 genetically distinct populations. The Luther Marsh population appears quite distinct, whereas snakes from the Windsor and Sarnia areas although different from one another often have admixed genomes.

Designatable units

Luther Marsh represents an area of interest in many respects, particularly with respect to the issue of designatable units. There are data signifying that the snakes in Luther Marsh constitute a separate DU from those in the Windsor-Sarnia area. This possibility is based on Luther Marsh's isolation from other populations, the unique genetics and morphology of *T. butleri* in Luther Marsh, and that Luther Marsh is located in a different ecoregion from locations in the rest of Ontario. Luther Marsh is separated by 128-175 km from the more southern populations in Parkhill, Windsor and Sarnia. Therefore, it is highly unlikely that dispersal between these southern populations and Luther Marsh occurs. This lack of dispersal presumably explains the morphological and genetic differences between Luther Marsh and the rest of the Ontario populations.

Prior to 2009, there were data suggesting that the snakes in Luther Marsh were morphologically different from Butler's Gartersnakes elsewhere else in Canada (Harding 1997). This suggestion is particularly intriguing because some Luther Marsh individuals were thought to have morphology consistent with the closely related Short-headed Gartersnake (*T. brachystoma*), which is found only in New York and Pennsylvania. *Thamnophis brachystoma* is diagnosed by its lower numbers of infralabial (6) and mid-body scale row counts (17-17-17; anterior-mid-dorsal-posterior) (Smith, 1945). The Luther Marsh snakes' unique morphology has been noted by numerous authors (Schueler and Westell 1975, Sandilands 1984, Oldham and Sandilands 1986, Harding 1997) and is important because it blurs the distinction between these two species. Although scale count variation exists in other parts of Ontario, it is more common in Luther Marsh than elsewhere. For example, 75 specimens from Luther Marsh were analyzed by Campbell and Sandilands (unpubl. data, date unknown) including 45 adults and 30 young. Based on dorsal scale counts, 44% of adults (60% of juveniles) were consistent with *T. butleri*, 16% of adults (7% of juveniles) were typical of *T. brachystoma*, and 40% of adults (33% of juveniles) were intermediate (combined data for adults and juveniles indicate: 51% *T. butleri*, 12% *T. brachystoma* and 37% intermediates. Noble and Choquette (unpublished data 2010) found similar variation in scale counts.

There was also significant variation among regions in nuclear DNA markers (D. Noble, J. Choquette unpublished data). Using seven microsatellite DNA loci, Bayesian assignment tests clearly differentiate individuals from the Luther Marsh population with highly significant F_{ST} values between Luther Marsh and Windsor-Sarnia populations ranging from 0.15-0.20 (Noble *et al*. unpublished data 2010). Furthermore, Luther Marsh contains a large number of private alleles (1-5 alleles per locus) at five out of these seven loci. Although there are fairly large differences in nuclear DNA, there is no mitochondrial variation among individuals across Ontario (see **Genetic description**). This difference between microsatellites and mtDNA could indicate rapid colonization of Ontario after the glaciers last retreated. A similar pattern is found in the U,S, populations where little mitochondrial variation exists in much of Michigan (Placyk *et al*. 2010, submitted for review).

To summarize: Butler's Gartersnakes in Luther Marsh are completely isolated from all other extant populations in Ontario, and occupy a different ecoregion on the Amphibians and Reptiles Ecoregion Map (Great Lakes/St. Lawrence vs Carolinian for the rest of the species). The snakes in Luther Marsh have unique microsatellite DNA alleles and unique morphology (i.e., different scale counts, from snakes in Windsor-Sarnia). Furthermore, these two ecoregions are subject to different threats (see **Limiting Factors and Threats**). In contrast, both regions are in the Great Lakes Plains Ecoregion of COSEWIC's National Ecological Areas, there is no variation in mtDNA across Ontario and scale counts do not appear definitively unique to Luther Marsh. Based on these conflicting indicators, the Butler's Gartersnake is considered to be a single DU, until more evidence can clarify the issue.

DISTRIBUTION

Global range

Thamnophis butleri is restricted to North America, where it is found only in southern Ontario, southeastern Wisconsin, Indiana, Ohio and the Lower Peninsula of Michigan (Figure 1). The global range of this species is estimated at 20 000 to 200 000 km^2 (Nature Serve 2009). Throughout this range, it is irregularly distributed, but sometimes locally abundant (Conant 1951; Conant and Collins 1991; Rossman *et al*. 1996). The patchy distribution of this species has been cited as an indication that it occupies remnants of a prairie corridor which was thought to have existed in the Great Lakes region and possibly to the east in the Hypsithermal period 5000 to 7000 years ago (Schmidt 1938; Smith 1957; Bleakney 1958).

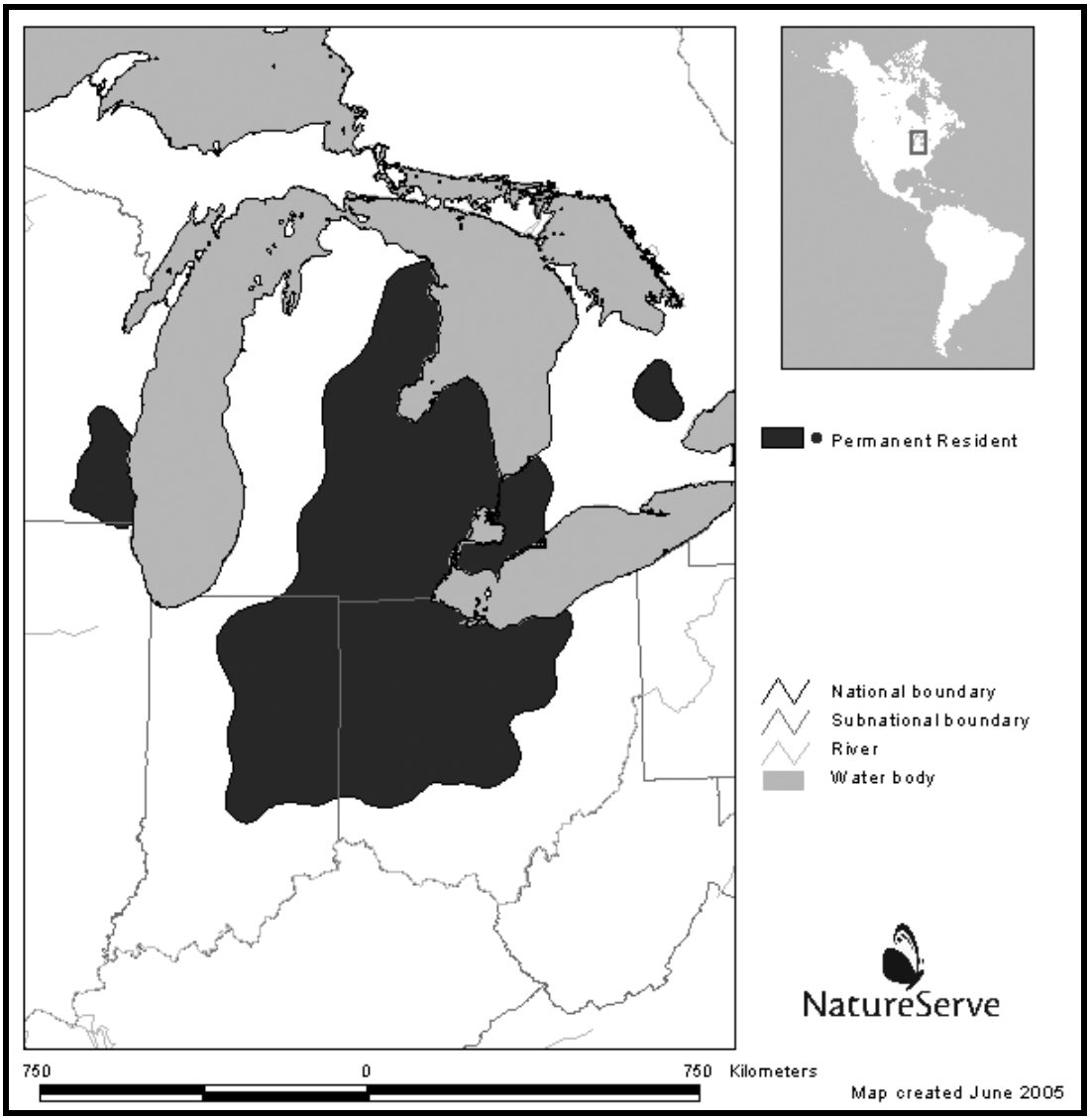

Figure 1. Global distribution of Butler's Gartersnake, *Thamnophis butleri* (NatureServe 2009).

Canadian range

The entire Canadian range of extant *T. butleri* is restricted to two to four geographically isolated regions of southwestern Ontario (Figure 2, Table 1). Note that there are a number of contested or unsubstantiated records for *T. butleri* outside these regions or at particular locations within these regions. Decisions to accept or decline these records as part of this species' Canadian range are based on the evidence provided in **Appendix 2**. One of the accepted locations outside the extant regions is Rondeau Provincial Park. It appears that specimens of Butler's Gartersnakes were collected there in 1940, but none have been reported since. Certainly, the species is no longer extant at Rondeau, and in this report *T. butleri* is considered extirpated at that site (see **Appendix 5**, map 1).

The Extent of Occurrence (EO) was calculated, using a convex polygon that included all known locations where the species may still be present, as 10,248 km². The Index of Area of Occupancy (IAO) was determined by summing the area under 90 2x2-km^2 grids overlain on all accepted locations. This IAO was 360 km^2. The Canadian distribution of *T. butleri* occupies an estimated 16% (+/- 15%, **Appendix 3**) of its total global range. Details for each region are as follows:

Windsor-Sarnia (Essex, Chatham-Kent, Lambton counties)

This region is composed of scattered *T. butleri* locations within 10 km of the Detroit River, Lake St. Clair, the St. Clair River, and Lake Huron from Amherst Point to Errol. The species was first reported here by Campbell (1971a) and extensive studies across the region were conducted in the 1970s (Planck and Planck 1977; Freedman and Catling 1978). The IAO for this region is 292 km^2. Note that most populations between Windsor and Sarnia have been lost (see **Appendix 5**).

Skunk's Misery (Middlesex and Lambton counties)

This region is composed of numerous collection sites within a forest-wetland complex between Chatham and London. The species was reported here in 1938 (Logier 1939a) as the first *T. butleri* for the province (although a misidentified specimen was reported elsewhere in Ontario previously; refer to discussion in **Appendix 2***).* The IAO for this region is 28 km^2, assuming Butler's Gartersnake is still extant there.

Luther Marsh (Dufferin and Wellington counties)

This region is composed of numerous collection sites within a marsh wetland complex north of Guelph. Localities are designated by some observers as West Luther Marsh and by others as East Luther Marsh and have been pooled here*. T. butleri* was first reported in this region by Schueler and Westell (1975). The IAO for this region is 36 km^2.

Parkhill (Middlesex County)

The region is composed of one collection site northwest of the town of Parkhill where a single snake was reported in 1992. The IAO for this region is 4 km^2.

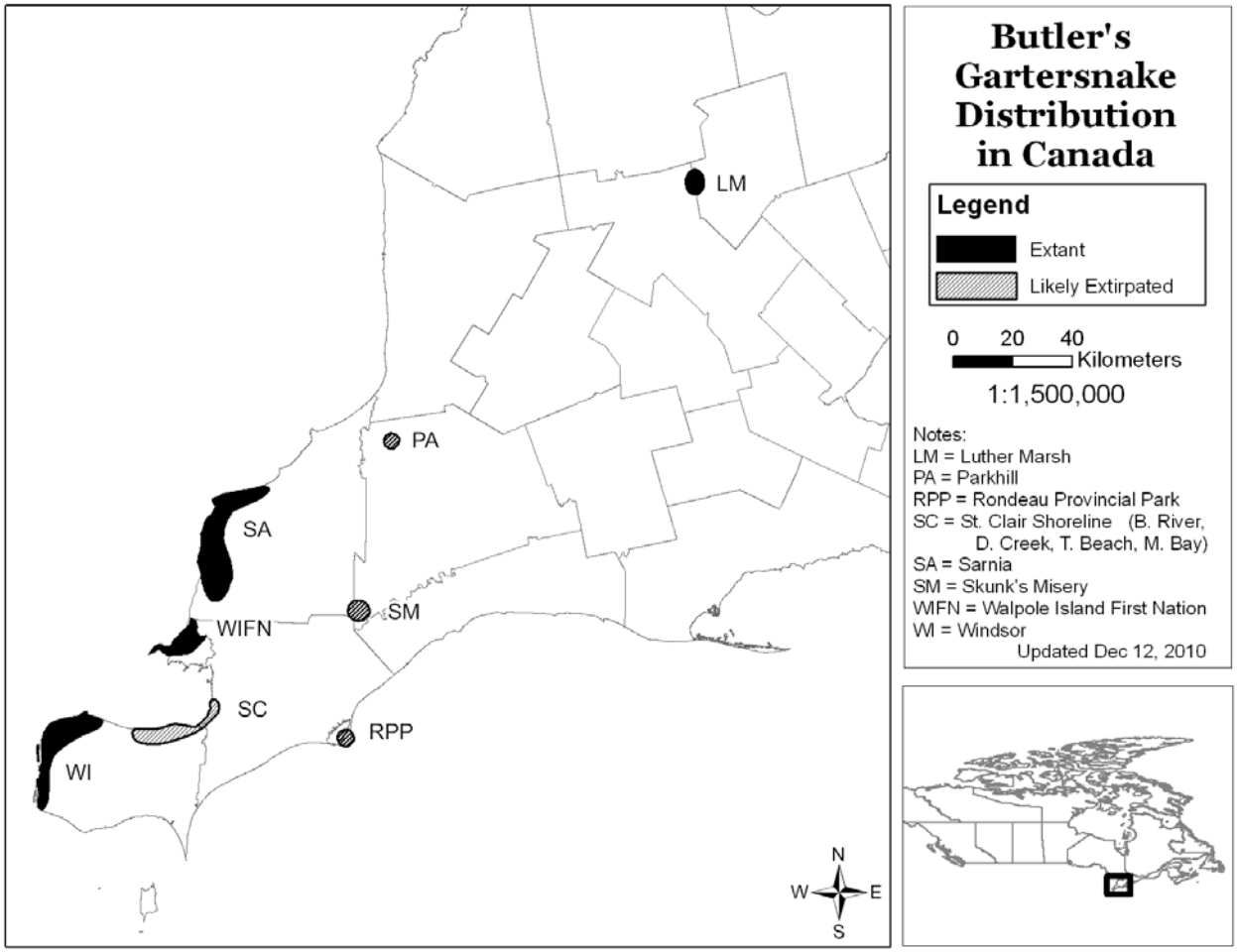

Figure 2. Distribution of Butler's Gartersnake, *Thamnophis butleri*, in Canada. Regions in solid black have scattered extant locations/collecting sites (Windsor, Sarnia, Luther Marsh) or likely are extant although no Butler's Gartersnakes were encountered in 2009 searches (WIFN). Butler's Gartersnake is extirpated from Rondeau Provincial Park (RPP), and several sites between Windsor and Sarnia have been lost along the Lake St. Clair shoreline. Similarly, there are locations within the extant portions of Windsor and Sarnia that have been lost to development. No snakes have been encountered at Skunk's Misery from 1989 to 2009 despite several targeted searches. Parkhill has yielded only one snake (1992), but was not searched in 2009. (Permission to reproduce granted by J. Choquette and D. Noble, 2010.)

Table 1. Butler's Gartersnake (*Thamnophis butleri*) localities throughout southern Ontario. Site visits were conducted in 2009 by J. Choquette and D. Noble. References for each location can be found in Appendix 1. Abbreviations are as follows: ANSI = Area of Natural and Scientific Interest, CA = Conservation Area, ENE = East North-East, ESA = Environmentally Sensitive Area, SW = South-West, S= South.**

This table contains specific location information that may be requested by contacting the COSEWIC Secretariat.

Windsor- Sarnia

Location (County)		Last verified record prior to JDC/DWN field work	Visited 2009	*T. butleri* recorded (07-09)
Location 1.	(ESSEX)	2006	X	X
Location 2.	(ESSEX)	1992	X	X
Location 3.	(ESSEX) *	2006	X	X
Location 4.	(ESSEX)	2008		X
Location 5.	(ESSEX)	1985	X	X
Location 6.	(ESSEX)	1988	X	X
Location 7.	(ESSEX)	1976	X	
Location 8.	(ESSEX)	1986	X†	
Location 9.	(ESSEX)	1984	X	
Location 10.	(ESSEX)	1977	X	X
Location 11.	(ESSEX)	1996		
Location 12.	(ESSEX)	1986	†	
Location 13.	(ESSEX)	1996	X	
Location 14.	(ESSEX)	1996	X	
Location 15.	(ESSEX)	2006	X	X
Location 16.	(ESSEX)	2007	X	X
Location 17.	(ESSEX)	1977	X†	
Location 18.	(ESSEX)	1977	X†	
Location 19.	(ESSEX)*	2009	X	X
Location 20.	(ESSEX)*	2009		X
Location 21.	(ESSEX)	2008	X	X
Location 22.	(ESSEX)*	2008		X
Location 23.	(ESSEX)*	2009		X
Location 24.	(ESSEX)*	2007		X
Location 25.	(ESSEX)	1987	X	X
Location 26.	(ESSEX)	1987	X	X
Location 27.	(ESSEX)	1986	X	X
Location 28.	(ESSEX)	2008	X	X
Location 29.	(KENT)	1881		
Location 30.	(LAMBTON)	1977	X	X
Location 31.	(LAMBTON)	1982	X	X
Location 32.	(LAMBTON)	2008	X	X
Location 33.	(LAMBTON)	1986		
Location 34.	(LAMBTON)*	2008		X
Location 35.	(LAMBTON)	1986	X	X
Location 36.	(LAMBTON)	1977	†	
Location 37.	(LAMBTON)	1977	†	
Location 38.	(LAMBTON)	1982	X	
Location 39.	(LAMBTON)	1982	†	
Location 40.	(LAMBTON)	2001		
Location 41.	(LAMBTON)	2008	X	X
Location 42.	(LAMBTON)	1982	†	
Location 43.	(LAMBTON)	1986		
Location 44.	(LAMBTON)	1990	X	
Skunk's Misery Location 45.	(MIDDLESEX/LAMBTON)	1989	X	
Luther Marsh Location 46.	(WELLINGTON/DUFFERIN)	2006	X	X
Parkhill Location 47.	(3.8km NNW of Parkhill)	1992		

* Indicates new locations that were not previously recorded in the literature

† Indicates locations that no longer contain habitat (i.e., have become urbanized) to support *T. butleri* based on aerial photography or site visits, or have had a significant portion of habitat destroyed

**The enumeration of occurrences shown in Table 1 is based on the definition of 'location' by the International Union for the Conservation of Nature (IUCN 2010) which defines 'location' as a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. In addition to threats, distance, geographical separation and perceived habitat connectivity between clusters of collecting sites (a collection site is defined as a specific place where a snake was seen or collected and is based on OHS/NHIC data and species' expert observations) were considered. This method of enumeration was chosen because it provides a more comprehensive view of current threats and possible extirpations than does the 'Element Occurrence' method.

HABITAT

Characteristic habitat

Butler's Gartersnake habitat has been described as "chiefly ... open prairie-like areas" with dense grasses, including Tallgrass Prairie, along drainage swales, seasonally dry marshes, or other small bodies of water (Logier 1939a, Planck and Planck 1977, Conant and Collins 1991, DRIC 2008, Logier 1939a, F.W. Schueler unpubl. data). At Luther Marsh and Parkhill, *T. butleri* is found in old fields that have become overgrown with shrubs and saplings (C. Campbell and A. Sandilands unpubl. data). In the Windsor-Sarnia region, *T. butleri* occurs in small parks and abandoned sites in urban areas. (See Wright and Wright (1957) and Rossman *et al*. (1996) for a summary of *T. butleri* habitat across its range.)

During the 2009 Choquette and Noble survey, almost half of the Windsor-Sarnia localities (9/19, 47%) where *T. butleri* was found were considered industrial/urban (vacant industrial lands, quarry operations and waste storage sites, vacant/active rail corridors, or dredging sites). The remainder were either classified as rural/agricultural (5/19, 26%) or Tallgrass Prairie (5/19, 26%). Across all regions, the majority of actual *T. butleri* encounters occurred within industrial/urban localities (106/180, 59%),whereas fewer occurred within Tallgrass Prairie/meadow/marshland (56/180, 31%) and rural/agricultural (18/180, 10%) sites. Although equal search effort (101.87, 111.48, and 97.81 person-hours, respectively) was afforded each of these three types of habitat, it is possible that search effort was more efficient in industrial sites due to increased presence of cover objects. Also, snakes are much more difficult to capture in Tallgrass Prairie sites with thick vegetation and a deep layer of thatch.

The placement of artificial cover increases the probability of *T. butleri* encounters (Sandilands 1988b, Johnson 1989). *Thamnophis butleri* are readily found individually or in small groups under various types of materials including rocks, concrete, plywood boards, roofing shingles, metal tins, old carpet, rubber, cardboard, and fibreglass sheets. Planck and Planck (1977) achieved higher capture rates in Windsor by placing shingles out as cover, noting that snakes bask on top of shingles and crawl underneath to forage for earthworms. In Amherstburg, the snakes were found under rock and rubble in an old quarry site (Catling and Freedman 1980b). After spring emergence, these snakes are virtually impossible to find in their preferred habitat without the presence of debris.

Although the presence of natural and artificial debris enhances the probability of finding *T. butleri*, these features are not an essential component of its habitat as the species often occurs in areas without large amounts of debris. What appears to be essential is dense grass/herb cover with a heavy thatch layer of dead vegetation from previous years. The species may have originally been associated with prairies dominated by Big Bluestem (*Schizachyrium scoparium*) and Little Bluestem (*Andropogon scoparius*), and is still common in these remnant habitats in southwestern Ontario. Native grasses, however, do not seem to be a limiting habitat feature. At Luther Marsh, the snake was common in areas dominated by Smooth Brome (*Bromus inermis*) (Sandilands 2001). Also, in many of the Windsor-Sarnia locations, *T. butleri* were abundant in areas dominated by un-mowed non-native grasses (Choquette and Noble pers. obs. 2009, J. Kamstra pers. comm. 2009). An extensive survey of the vegetation associated with this species was conducted by Ecologistics Limited LGL (1976) at Location 18. In addition to thick grass and heavy thatch, *T. butleri* also require suitable over-wintering habitat.

Hibernation sites have not been recorded in Ontario. In Windsor, work was initiated in 2009 to investigate the relationship between crayfish burrow density and seasonal *T. butleri* captures. The goal was to determine if *T. butleri* are overwintering in fields with high burrow densities (W. King pers. comm. 2009). In Michigan, *T. butleri* hibernates in sites utilized by other snakes, such as small mammal burrows, ant mounds, and possibly the burrows of crayfish (Carpenter 1953). *Thamnophis butleri* were recorded from 35.6-68.6 cm depth from an excavated ant mound (Carpenter 1953). Sixty-six percent of these snakes were found at a depth of 50.8-58.4 cm. In Wisconsin, *T. butleri* overwintered on the south face of an earth bluff. In Ohio, *T. butleri* has been found denning in rocky dikes along the shoreline of Lake Erie with *T. sirtalis*, Northern Watersnakes (*Nerodia sipedon*), and Eastern Foxsnakes (*Pantherophis gloydi*) (Rossman *et al*. 1996).

Trends

Historically, Tallgrass Prairies and Oak Savannah encompassed 90 million ha of land from the central United States to southern Ontario and Manitoba, Canada. Presently, it occupies 1.5 million ha of its former distribution (Tallgrass Ontario 2009). In Ontario, Tallgrass Prairies and savannahs once covered 1000 km^2 (Tallgrass Ontario 2009). This area has been reduced to 30 km^2 (3% of historical area) of small patches isolated by urbanization, agriculture, and mismanagement (Tallgrass Ontario 2009). Tallgrass Prairie and Oak Savannah habitats are therefore critically imperilled in Ontario (Bakowsky 1995). In Figure 3, the estimated historical extent of Tallgrass Prairie and savannah is depicted with existing remnants shown. All known locations of Butler's Gartersnake coincide with these remnants, except Luther Marsh which lies to the west of the original prairie (see Figure 2 for location of Luther Marsh).

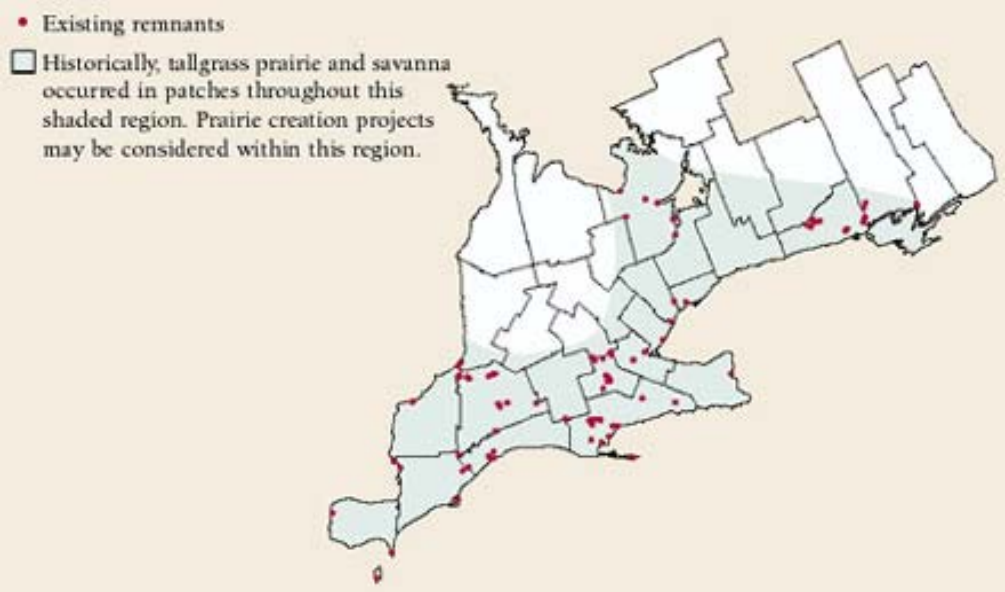

Figure 3. Range of Tallgrass Prairie and Oak Savanna in Southern Ontario. Note that Luther Marsh (see Figure 2 for location of Luther Marsh) is west of the shaded area of putative Tallgrass Prairie. Source: Modified from Bakowsky 1993, Environment Canada.

In southwestern Ontario, remnant Tallgrass Prairie and oak savannah habitat have been increasingly replaced or isolated by residential development over the last 3 decades, providing evidence for a decline in the quantity of *T. butleri* habitat since the mid-1970s. Out of 28 known Essex County locations of Butler's Gartersnake, four (14%) have been lost to development (Locations 8, 12, 17, 18) (Table 1), three (11%) are directly threatened by proposed development (Locations 14, 22, 28; Table 1) and six (21%) will likely be further isolated by future surrounding development (Locations 11, 15, 19, 20, 21, 23; Table 1). The result is the loss, projected loss or degradation of a large fraction (46%) of known *T. butleri* locations in Essex County within the next 10-20 years. The three largest protected locations in the area (Location 21, Location 15, Location 19) are all experiencing development or proposed developments within surrounding unprotected habitat, resulting in further attrition and isolation of suitable habitat patches. For example, significant *T. butleri* habitat is expected to be removed from an area surrounding Location 21 to allow for a multilane parkway expansion and new bridge in the City of Windsor (Detroit River International Crossing, DRIC).

Similar habitat declines have been witnessed in Lambton County. *Thamnophis butleri* habitat used to be widespread and common across the City of Sarnia as late as the 1970s (H. Casbourn, C. Campbell, A. Harris, and R. Ferguson pers. comms. 2009). Of 15 known Lambton County locations, four (27 %) have been destroyed by development since that time (Table 1: Locations 36, 37, 39, 40) and one (7%) is directly threatened by proposed development (Site 41; Table 1). The result is the loss and projected loss of 34 % of known *T. butleri* Lambton County locations within the next 5-10 years.

In Location 44, savannah and prairie habitat is still present but is declining in both quality and extent (Bowles 2005). From 1972 to 1998, prairie habitat in WIFN has declined from 730 to 470 ha (Crow *et al* 2003). Loss of prairie and savannah in WIFN is from expansion of agriculture and housing and from succession to forest because of lack of regular fires.

It is possible that in some urban areas, new habitat may be created as forests are converted into open grassy habitat and abandoned industrial sites are allowed to naturalize. In Windsor, for example, an old rail corridor (now a walking path) and adjacent naturalized industrial sites provide habitat for *T. butleri*. Also, new *T. butleri* locations that were previously unknown may be found in the future, effectively 'increasing' apparent habitat. For example, in Essex county, 6 (21%) locations were considered 'new' in 2009 compared to 2001 (Table 1). Most of these locations were small (4-12 ha, and none was larger than 100 ha).

At Skunk's Misery, habitat succession toward mature forest has likely progressed since early collections. The historic habitat was described by Logier (1939a) as "... flat and covered largely with second growth hardwood and brush, with some clearings and pasture meadows." As of 2009, the landscape was characterized by a large complex of protected forest habitat (1200+ ha; NCC 2009) surrounded by a matrix of intensive agriculture and smaller forest patches. It is likely that local forest succession is causing a significant reduction in *T. butleri* habitat in this location. Within the vicinity of historic collection sites, habitat remains largely in the form of narrow naturalized areas along roadsides, rail corridors, a shooting range and the edges of agricultural drains (J. Choquette and D. Noble pers. obs. 2009). There appear be few or no patches large enough to function as *T. butleri* habitat (i.e., successional lands, meadows, herbaceous forest edges). Also, it is common for the farm field-forest transition to be very abrupt, with no grassy areas. Finally, the removal of debris and cover objects at Skunk's Misery from 1981 onwards (F.W. Schueler pers. comm. 2009) and lack of areas of appropriate habitat (J. Choquette pers. obs. 2009) has made searching for *T. butleri* there in the last decade difficult and unproductive.

Parkhill was not searched by Choquette and Noble in 2009 and no details on habitat trends are reported here. The single (1992) NHIC record from this region lists 'old field' as the habitat in which the lone specimen was encountered.

Of all four regions, Luther Marsh is unique in that available old field habitat for *T. butleri* has increased since acquisition of the surrounding agricultural land by the Grand River Conservation Commission in the early 1950s. Prior to the impoundment of the Grand River and the creation of the 475 ha Luther Lake, the area was primarily boggy fen and shrub thicket swamp surrounded by agricultural land (M. Oldham pers. comm. 2010). There are "literally thousands of hectares of potentially suitable habitat" (A. Sandilands pers. comm. 2009) with an abundance of open meadow and shrubland which are actively managed to promote game birds (Grand River Conservation Authority 2007). Many old farmhouses and stone barn foundations were left scattered throughout the conservation area creating numerous potential hibernation sites.

Also, prescribed burns are conducted annually on islands in the marsh to encourage open habitat, and farmland is continuing to be restored (R. Bell pers. comm. 2009). These practices are likely increasing habitat for *T. butleri* in the area. Despite the latter, incomplete data on the local distribution of this species (refer to '**Abundance**' section) and 'patchiness' of observed occurrences weaken any attempt to directly associate the presence of potential habitat at Luther Marsh with the presence or abundance of *T. butleri.*

Protection/ownership

Protection of *T. butleri* habitat is greatest at Luther Marsh, which is a Conservation Area and Provincial Wildlife Management Area managed by the Grand River Conservation Authority and the Ontario Ministry of Natural Resources (OMNR). The maintenance of open habitat preferred by *T. butleri* is encouraged at Luther Marsh as part of waterfowl management. The known IAO at Luther Marsh is 36 km^2 (10% of total IAO – 360 km^2). However, Luther Lake makes up a large part of the Management Area, and the management plan is largely concerned with creating habitat for ducks and other avian game species (Grand River Conservation Authority 2007).

At Skunk's Misery, the majority of the forest-wetland complex is under public ownership by the County of Middlesex (managed by the OMNR) and the Lower Thames Valley Conservation Authority. Management goals there, however, are focused on developing interior forest conditions, which are not beneficial to *T. butleri* habitat. Open habitat preferred by *T. butleri* will likely be dependent on the maintenance of open areas on adjacent private lands (rail corridors, roadsides and clearings for residential, recreational or agricultural purposes). The IAO at Skunk's Misery is 28 km^2 (7.8% of total IAO) and is based on historic records because recent surveys (2001, 2006 and others) in this region were unsuccessful (F.W. Schueler pers. comm. 2009, Choquette and Noble 2009).

At Parkhill, ownership and habitat quality are unknown and IAO is 4 km^2 (1.1% of total IAO).

The Windsor-Sarnia region covers the largest geographic area of all four regions with an IAO of 292 km^2 (81.1% of total IAO). A number of protected locations with *T. butleri* habitat exist in this region: Location 21 is owned and managed by the City of Windsor and OMNR. Location 24, Riverside Park and Peche Island are owned by the City of Windsor. Location 5 is owned by BASF Corp. and designated a 'Wildlife Refuge'. Location 15 and Location 13 are owned by the Town of Lasalle. Location 3 is owned by the Essex Region Conservation Authority (ERCA). Location 32 is owned by the OMNR and Location 35 is owned by the City of Sarnia and maintained as a Tallgrass Prairie. Combined, the latter 10 locations account for an IAO of 64 km^2 (17.8% of total IAO). Location 44 and Location 43 are relatively undeveloped and rural and some of the existing prairie and open habitat have remained undeveloped for generations. These two locations account for an IAO of 52 km^2 (14.4% of total IAO). Three other locations in the Windsor-Sarnia region would appear to have some level of protection but no recent

T. butleri sightings: 1) Location 40 is owned by the City of Sarnia but *T. butleri* and its habitat at this site appear to be gone, 2) Location 17 is a woodlot owned by Essex Region Conservation Authority (ERCA), but adjacent *T. butleri* habitat that existed in the 1970s has been destroyed, and 3) Location 9 is a Conservation Area but appears to support little or no *T. butleri* habitat.

As of 2009, protected sites with remaining *T. butleri* habitat account for an IAO of 144 km^2 (40% of total IAO). Future habitat protection is planned in the form of development mitigation (habitat enhancement, purchase of unprotected habitat) to account for losses from the development of the Windsor-Essex Parkway (Location 22 and Location 21 [Spring Garden ANSI]) and Location 42 condominiums (Location 41). At Location 42, it is proposed that 2 ha of habitat will be created/augmented for every 1 ha of habitat destroyed (J. Kamstra pers. comm. 2009). Both habitat mitigation projects are currently directed by OMNR Aylmer staff and will be funded directly by both development groups. These initiatives are novel in concept, especially for this species, but their likelihood of success is unknown.

BIOLOGY

Life cycle and reproduction

Mating occurs in early spring (April) and the young are born between June and September (Logier 1939a, Wright and Wright 1957, Rossman *et al*. 1996). Mean brood size varies from 8 to 12 young, depending on region (Wright and Wright 1957, Burghardt 1968, Freedman and Catling1978, Rossman *et al*. 1996) and size of female (Ford and Killebrew 1983). The birthing of the entire brood generally occurs within a few hours but may span many days (Ruthven *et al.* 1912), and length of neonates ranges from 9.4 to 19 cm (Burghardt 1968, Conant and Collins 1991). Newborn growth rates are rapid prior to sexual maturity (Ruthven *et al.* 1912, Carpenter 1952a, W. King pers. comm. 2009). Sexual maturity may occur within 2 years for *T. butleri* (Carpenter 1952b). Longevity in wild populations is unknown and average captive lifespan ranges from 6 to 10 years, with a maximum of 14 (Dewey and Loup 2004). Using the IUCN (2010) 'guideline', Generation Time = GT = age at maturity + (1/ annual adult mortality rate). GT = 2 + 1/0.5 = 4 years, reasonable, but uncertain, given current knowledge.

Feeding/nutrition

Thamnophis butleri appears to be a prey specialist feeding predominantly on earthworms (Casbourn *et al*. 1976). Reynolds (1977) examined the gut contents of *T. butleri* collected in Essex and Lambton Counties, and identified three species of earthworm in those guts, *Allolobophora chlorotica*, *Aporrectodea tuberculata*, and *Lumbricus terrestris*. These were the first identifications of earthworm species from snake stomachs in North America (Reynolds 1977). A clear difference in feeding behaviour and prey species preference has been observed between the three southern

Ontario *Thamnophis* species, with *T. butleri* exhibiting a highly scent-oriented feeding behaviour (Casbourn *et al*. 1976). Extracts from worms, amphibians, fish, leeches, slugs, and mice were presented to newborn *T. butleri* by Burghardt (1968). Newborn *T. butleri* exhibited significantly elevated tongue flicking-attack scores towards all prey items except slugs, mice, and adult salamanders. The highest scores were observed when presented earthworms, particularly the Nightcrawler, *Lumbricus terrestris*.

Butler's Gartersnake occasionally feeds on leeches (Ruthven *et al*. 1912), small hylid frogs (*Pseudacris triseriata*, *Pseudacris crucifer*), insects, mice, salamanders, and fish. However, these prey are minor dietary items (Logier 1939, Conant 1951, Carpenter 1952a, Oliver 1955, Wright and Wright 1957; Casbourn *et al*. 1976, Catling and Freedman 1980a). *Thamnophis butleri* will eat small frogs (*Rana (Lithobates)* spp.) and fish in captivity (Conant 1951), but has not been documented capturing these in nature. In addition, *T. butleri* does not seem to consume *Philomycus*, a native slug, readily (in a short note from F.W. Schueler to C. Campbell 1982).

Predation

No direct observations of predation on *T. butleri* have been recorded. Predators are likely varied and similar to those of other *Thamnophis* species. These may include mice, voles, shrews, crows, hawks, owls, raccoons, skunks, foxes, weasels, dogs, cats, and other snakes [Eastern Milksnake (*Lampropeltis triangulum*) and Eastern Racer (*Coluber constrictor*)] (Harding 1997). Numerous individuals have extensive scarring and/or portions of the tail missing (D. Noble and J. Choquette pers. obs. 2009). In Luther Marsh, D. Noble and J. Choquette (pers. obs. 2009) observed a half eaten *T. butleri* next to a Meadow Vole (*Microtus pennsylvanicus*) under a survey board.

Dispersal/migration

Over the entire range of *T. butleri*, the time of emergence from hibernation is 29 March to 20 April, with an average date of 3 April (Conant 1951 [Ohio], Wright and Wright 1957). *Thamnophis butleri* is known to emerge from hibernation on warm winter days. The Ontario Herpetological Summary (OHS) database contains extreme observations from 10 March to 11 November in Essex County (Sandilands 1988b). In Ontario, *T. butleri* have been observed until mid-late October (OHS, J. Kamstra pers. obs. 2009; earlier dates are reported (Ruthven 1904, Wright and Wright 1957). The activity period of this species is likely much longer in the Windsor-Sarnia region than in Luther Marsh.

Periods of high activity by this species occur in the spring in Windsor enabling researchers to locate actively dispersing snakes more easily in early May (D. Noble and J. Choquette pers. obs. 2009). Snakes captured in mid-August in the same area were mostly found under cover objects. *Thamnophis butleri* seems to avoid the heat of the day in summer, and is most active in the evening (Logier 1939a). In Locations 41, 42, *T. butleri* was found mostly under cover regardless of the time of year or time of day (J. Kamstra pers. comm. 2009). Farther north, at Luther Marsh, snakes were found mostly under cover in early June (D. Noble and J. Choquette pers. obs. 2009). \

All mark-recapture studies to date indicate that *Thamnophis butleri* exhibits fairly limited movements. In Amherstburg, Freedman and Catling (1979) found 88% (n=24) of recaptures within 90 m of their initial capture sites, and 46% of those were found within 0-10 m. In southern Michigan, this species moved a maximum distance of 305 m and had an estimated activity range of 8100 m^2, or 0.8 ha (Carpenter 1952a; Oliver 1955). Similarly, in Locations 41, 42, the majority of recaptured snakes were observed moving short distances, or being repeatedly encountered under the same cover object (J. Kamstra pers. obs. 2009).

In addition to a cohort of relatively sedentary individuals, Freedman and Catling (1979) mention the possibility of a small percentage of a population consisting of transient individuals. One snake in Location 41 was recaptured 1200 m from its initial capture site (J. Kamstra pers. obs. 2009). This is a record distance for this species, but a clear outlier in comparison to all other recaptured snakes at this site. One reason for this behaviour may be a response to dry summer conditions and a lack of available food and/or aestivation sites. For example, at Amherstburg, 12% of recaptures (three individuals) were observed dispersing over 160 m (with a maximum of 515 m; Freedman and Catling 1979) to lower wetter areas during the dry midsummer months. These movements occurred in spite of the fact that 82% of snakes marked in the upland area (n=14) did not emigrate.

Dispersal events by transient individuals may result in emigration to uninhabited habitat patches and the creation of new ‘sedentary’ populations. Transient individuals would explain apparently recent and rapid colonizations of islands in the Detroit River and former industrial areas, some of which would have necessitated dispersal across inhospitable habitat, including open water and roads. *Thamnophis butleri* occupy numerous islands in the Detroit River, some of which are manmade (Crystal Bay: Leverette 1976), suggesting that this species is capable of traversing open water to colonize new habitat. In 2009, *T. butleri* were readily captured in Location 5 and Location 3. Furthermore, R. Jones (pers. obs. 2006) witnessed a *T. butleri* swimming across open water, 60 m offshore, in the middle of Crystal Bay. To date, no studies have considered swimming as a means of dispersal. Furthermore, *T. butleri* is known to inhabit former industrial lands, including ‘naturalized’ areas that were previously inhospitable habitat (e.g., former chemical disposal sites in Location 5: Leverette 1976; former stockpiling yards in Location 42: J. Kamstra pers. comm. 2010).

Road-killed *T. butleri* have been found across the species' range in Ontario: Sarnia (Campbell 1971a), Location 41 (J. Choquette pers. obs. 2009), Lambton County (Campbell 1971a), Oldham and Sutherland 1986, Skunk's Misery (F.W. Schueler pers. comm. 2009), Walpole Island (G. Allen pers. obs. 1985, P. Nadhee pers. comm. 2009), Location 21 (J. Choquette pers. obs. 2009, 2010), Luther Marsh (Sandilands 1984, Oldham and Sutherland 1986), and Amherst Point (J. Choquette, D. Noble, R. Jones pers. obs. 2009). *Thamnophis butleri* have also been observed basking on gravel roads on cool evenings at Skunk's Misery (C. Campbell and F.W. Schueler pers. comm. 2009) and basking along a walking/bicycle trail at Spring Garden ANSI in Windsor (S. Gillingwater pers. obs.). In a mark-recapture study, four road-killed snakes were found between April and September 2009 (J. Kamstra, J. Choquette pers. obs. 2009). Several studies have found road mortality poses a significant threat to population viability or connectivity in snakes (Row *et al*. 2007 and references therein).

Physiology

Thamnophis butleri is suggested to tolerate higher temperatures than *T. sirtalis* (Planck and Planck 1977). Carpenter (1952a) also reports more frequent heat-avoiding behaviour by *T. sirtalis* and *T. sauritus* when compared with *T. butleri*, suggesting that *T. butleri* can tolerate higher temperatures. No formal study has measured cloacal temperatures of individual *T. butleri*.

Behaviour

Thamnophis butleri is a non-aggressive snake that will rarely strike or bite when handled. It has a prehensile tail that often wraps around a finger when snakes are handled. In some circumstances, *T. butleri* will defecate on the hand of its captor, but to a lesser degree (in volume and vigour) than *T. sirtalis.* Many authors have noted that although *T. butleri* is swift and mobile in thick grass cover, it appears awkward in unvegetated areas where it proceeds with a characteristic thrashing (called slide-pushing or side-winding) which consumes a lot of energy for the forward motion it accomplishes (Logier 1939a, Carpenter 1952, Oliver 1955, Conant and Collins 1991). Some authors have suggested that this apparently inefficient locomotion is a good field identification characteristic (Conant and Collins 1991).

Adaptability

Thamnophis butleri's present reliance on earthworms as a prey source (more so than any other Canadian *Thamnophis*) is of interest because all earthworm species currently found in Ontario are considered to have been introduced with European settlement (Reynolds 1977, Schueler 1993). Almost all Ontario species of earthworms are native to Eurasia not North America (Reynolds 1977).Those species that are North American are confined to a few arboreta where they were presumably introduced with trees. It is presumed that Canadian *T. butleri* had a different diet (leeches) before settlement and switched to earthworms (Catling and Freedman 1980b), or have more recently expanded their range into Ontario after European settlement from regions

where native earthworms survived glaciation (Schueler 1993). The latter hypothesis has no evidence supporting it and contradicts virtually everything that has been written about the phylogeographic history of Butler's Gartersnake.

POPULATION SIZES AND TRENDS

Search effort

In 2009, J. Choquette and D. Noble conducted extensive surveys for *T. butleri* across its Canadian range to establish whether historic locations and accompanying habitat still exist (Table 1). A total of 334 person-hours of searching were conducted at historical and new locations across Ontario. A total of 180 *T. butleri* were encountered (cover objects were placed at only three sites). The most comprehensive survey of *T. butleri* in Ontario (Planck and Planck 1977) involved a total of 771 person-hours conducting opportunistic searches (not using cover objects), and a total of 136 *T. butleri* were encountered.

The five locations with the greatest search effort (person-hours) during the 2009 surveys were: 1) Luther Marsh (61.1 h; 28 *T. butleri*); 2) Location 41 (18.2 h; 25 *T. butleri*); 3) Location 18 (16.5 h; 0 *T. butleri*); 4) Location 9 (11 h; 0 *T. butleri*); and 5) Skunk's Misery (7 h; 0 *T. butleri*). Search effort was directed at sites of historical occurrence as well as at those with potentially suitable habitat, but with no previous records of the species. Establishing the presence of *T. butleri* at some historical locations was accomplished relatively quickly (less than 1 person-hour). In 2009, searches were not conducted in areas between disjunct regions (i.e., between Skunk's Misery and Sarnia; although M.J. Oldham searched extensively in these areas for *T. butleri* with no success (M. Oldham pers. comm. 2009, survey year unknown). A small number of historical locations and recent anecdotal locations were not checked due to lack of information or time (refer to Table 1 and Appendix 2).

Abundance

Population sizes have been estimated for seven *T. butleri* locations in Ontario (it is unknown if similar estimation methods were used in all cases). On the basis of 61 recaptures, Planck and Planck (1977) estimated the 1976 population size, excluding young of the year, at three Windsor locations; 50 at Location 21, 100 at Location 17, and 250 at Location 18. Fewer data suggested a population of 11-16 at the Spring Garden site. At the Amherstburg site, Freedman and Catling (1978) estimated a 1977 population size, excluding young of the year, of 900 snakes, based on 26 recaptures. The standard errors on all of these estimates are large, due to the difficulty of obtaining large numbers of recaptures, and so the estimates should be viewed with caution. The total 1977 population size for these five Windsor-Sarnia locations is estimated at 1316 individuals.

In 2009, population sizes for Location 22 in Windsor were estimated at ~150 (+/- ~ 20 for 95% confidence limits; R. Brooks pers. comm. May 2010) including young of the year. At the Location 22, about 40% of the snakes were adult with a sex ratio of about four males: three females. The number of adult females was estimated to be 15-23 individuals (R. Brooks pers. comm. May 2010). At Location 41 in Sarnia, the population estimate was 240 adult individuals (J. Kamstra unpubl. data 2009). At Luther Marsh in 1988, A. Sandilands (pers. comm. 2009) captured 75 individuals (45 adults and 30 young). The study area was roughly 4 ha and no individuals were recaptured, suggesting a large population size. At Luther Marsh in 2009, J. Choquette and D. Noble captured 28 *T. butleri* (25 adults, 3 young) over a larger area and had two recaptures, but population size estimates were not made.

Population densities have been estimated at 23 snakes/ha (Amherstburg: Freedman and Catling 1978), 7.2 snakes/ha (Michigan: Carpenter 1952a), 18.75 snakes/ha minimum (Luther Marsh, A. Sandilands pers. comm. 2009), and 15.65 snakes/ha (Location 18: Planck and Planck 1977). The average population density of these four estimates is 16 snakes/ha. In Michigan, 86% of snakes captured were adults (Carpenter 1952a).

In some locations, *T. butleri* is locally abundant and may be the most common snake species found. At J. Kamstra's study site in Location 42, after two field seasons of bi-weekly *T. butleri* surveys (2008-09), only one *T. sirtalis* was found. This was despite the fact that both *T. sirtalis* and *T. butleri* were found in equal numbers in 2009 in a similar habitat 130 m away, across a heavily used recreation canal (J. Choquette, D. Noble pers. obs. 2009). *Thamnophis butleri* was the only snake found (22 individuals) along three separate rail corridors in the City of Windsor after 18 person-hours of searching (J. Choquette, pers. obs. 2009). In Sarnia, despite many hours of searching in the late 1960s, *T. butleri* was the only snake species found by A. Harris (pers. comm. 2009) in an old field near his house. On Location 3, in 6.75 person-hours, only one *T. sirtalis* and one *Storeria dekayi* were found while seven *T. butleri* were captured (J. Choquette, D. Noble pers. obs. 2009). A survey in Location 5 (May 6, 2009) revealed a remarkable abundance of this species. In less than 10 min, six snakes were captured and many more eluded capture. This location showed the greatest density of *T. butleri* during the 2009 surveys (D. Noble and J. Choquette pers. obs.). It is not known which factors influence the variability witnessed in the abundance of *T. butleri* across its range.

Fluctuations and trends

Thamnophis butleri was discovered in Canada relatively recently by Logier (1939a). Occurrences in all four regions were not documented until 1939 in Skunk's Misery (Logier 1939a), 1969 in Windsor-Sarnia (Campbell 1971a), 1975 in Luther Marsh (Schueler and Westell 1976) and 1992 in Parkhill (M. Oldham pers. obs. 1992). In a fifth region, Rondeau Provincial Park, *T. butleri* were collected in 1940, but have not been reported since, and are extirpated from this area (Gillingwater 2001, A. Woodliffe pers. comm. 2010). All four regions have been too poorly studied to provide reliable estimates

of trends in population size. Despite this shortcoming, fluctuations in the number of known localities (or sites) within each region may provide some insight.

In the late 1980s, it was thought that *T. butleri* was confined to one small site at Luther Marsh. Extensive opportunistic searches there resulted in only five records over a 7-year period (Sandilands 1988b). When approximately 50 shingles and pieces of debris were scattered around, 98 *T. butleri* were found on 15 visits (Sandilands 1988b). Later searches by C. Campbell, A. Sandilands (unpublished data), Coulson and Peluch (1984) and Choquette and Noble (pers. obs. 2009) have succeeded in increasing the number of known sites from one to six. The complete distribution at Luther Marsh is currently unknown, and future surveys, particularly to the west and south of the marsh, are needed. Since the discovery of *T. butleri* at Luther Marsh, the trend has been toward an increase in the number of known sites, and subsequently, in the Area of Occupancy. These increases are likely as a result of increased search scope and effort, not an actual expansion of the species' range.

At Skunk's Misery, Logier (1939a) and W.J. LeRay obtained 27 snakes in only 2 days in 1938 and F.W. Schueler and R.M. Rankin observed 12 snakes in 3 days in 1981. Despite such high capture rates historically, *T. butleri* has eluded capture in recent surveys (F. Schueler in 2001, 2006; J. Choquette and D. Noble in 2009). Forest succession has increased in the area encompassing historic collecting sites and it's plausible that *T. butleri* may be much less abundant or extirpated there but still persisting nearby. It is also possible that *T. butleri* is extirpated from the entire region of Skunk's Misery as there have been no confirmed records since 1989 despite targeted searches. Future surveys should expand beyond historic collection sites and should focus on spring emergence (2009 surveys were conducted in summer and fall). Trends at Skunk's Misery have been toward a decline in the number of known sites.

Within the Windsor-Sarnia region, there was an increase in the number of known sites shortly following the discovery of *T. butleri* there. The population at Location 18 attracted a great deal of media attention upon its discovery and, subsequently, plans for a new runway were halted (Ecologistics Limited 1976). At the time, this was one of the few known localities from this region and appeared to be the largest population in Ontario. Unfortunately, it has since been extirpated. Planck and Planck (1977) succeeded in identifying at least a dozen new sites in the late 1970s. The number of known extant plus historic sites continues to increase. In 2009, a total of seven 'new' locations (16%) were identified (Table 1) that were not in the literature. Although herpetologists have been struggling to fully understand the distribution of this cryptic species since its recent discovery in Canada, urbanization and agricultural development continue to compromise this endeavour. Research in 2009 in the Windsor-Sarnia region (Table 1) has identified eight previously known locations destroyed by development (18%) and 6 more failing to produce specimens (14%) (Figure 3). In total, 32% of locations have been lost or are in question. These data indicate an overall decline in the number of *T. butleri* localities in this region, despite the discovery of 'new' locations.

A similar analysis from an Element Occurrence classification scheme also infers a decline. “An Element Occurrence (EO) is an area of land and/or water in which an Element is, or was, present. One can consider an occurrence as being analogous to a population (more or less a group of non-regularly-interbreeding individuals of a species in a particular geographic area). With largely immobile plants we typically use a distance of 1 km to separate occurrences” (Natural Heritage Information Centre (NHIC) website 2010). Out of 22 Element Occurrences recorded in the NHIC, 18 were visited in preparation of this report. *Thamnophis butleri* were found at 12 (67%) and not found at 6 (33%). Although conclusions differ depending on the method of enumerating species’ occurrences, in both cases a large proportion (~33%) of collection sites failed to provide specimens.

This figure contains specific location information that may be requested by contacting the COSEWIC Secretariat.

Figure 4. Map of locations (from Table 1) that were searched in 2009 showing where *T. butleri* were observed and not observed. Locations that were not visited are also included (permission to reproduce granted by J. Choquette and D. Noble, 2010). Refer to Figure 3 to see location of Parkhill which was not visited.

Rescue effect

The possibility exists for snakes to repopulate Ontario from the United States. The rescue effect is likely dependent on the following: 1) The persistence of Michigan populations of *T. butleri* opposite Ontario populations, 2) Sufficient immigration and reproduction of individuals dispersing across the St. Clair or Detroit Rivers, and 3) Whether snakes arriving by water have access to suitable habitat inland.

Near Windsor, *T. butleri* exist on the majority of Detroit River islands, both Canadian and American. Prehistoric colonization is presumed to have occurred West to East, from Michigan into Canada (Noble, Choquette, and Brooks, unpublished data). It is apparent that *T. butleri* are capable of moving across water and colonizing islands from the mainland (see section on ‘**Dispersal/Migration**’). The time scale necessary for such colonizations, however, is unknown. It is also necessary for *T. butleri* to persist near shore on the American side to produce individuals capable of dispersing into Canada.

A preliminary analysis of satellite imagery was conducted to determine if large portions of habitat persisted opposite Canadian localities of *T. butleri* (J. Choquette pers. obs. 2009). With regards to Location 44, both sides of the border appear to provide suitable habitat, but the status of *T. butleri* on the American side is unclear. With regards to Location 42 and Location 43 near Sarnia, suitable habitat across the river from these locations appears non-existent or is functionally disconnected from the shoreline by roads. Also, the continued presence of *T. butleri* on the American side (in Port Huron) is uncertain, despite a record from the early 1970s (Campbell 1971a).

Near Windsor, the potential for the rescue effect may be greater. Habitat corridors appear to link the Canadian shoreline adjacent to three Detroit River islands inhabited by *T. butleri* (Location 3, Location 4 and Location 5) with known colonies in mainland Essex County. Despite this, it is uncertain how the strong Detroit River current would affect the trajectory of snake dispersal and subsequent landing sites. A snake dispersing from an island may land many kilometres downstream, making the flanking habitat link useless. Should a snake actually succeed in crossing and landing at an appropriate corridor, further dispersal would involve crossing a busy road, which might be impervious to snake movement. Furthermore, the previous scenario only accounts for individuals dispersing from islands, because the status of mainland Michigan populations in the area is unknown.

In summary, based on preliminary analysis, the lack of knowledge regarding the frequency of dispersal across open water, the effect of river currents on landing site, the presence of roads as barriers and the uncertainty surrounding the presence of necessary American colonies all reduce the reliability of a rescue effect to provide any measurable conservation benefit, at least in the short term.

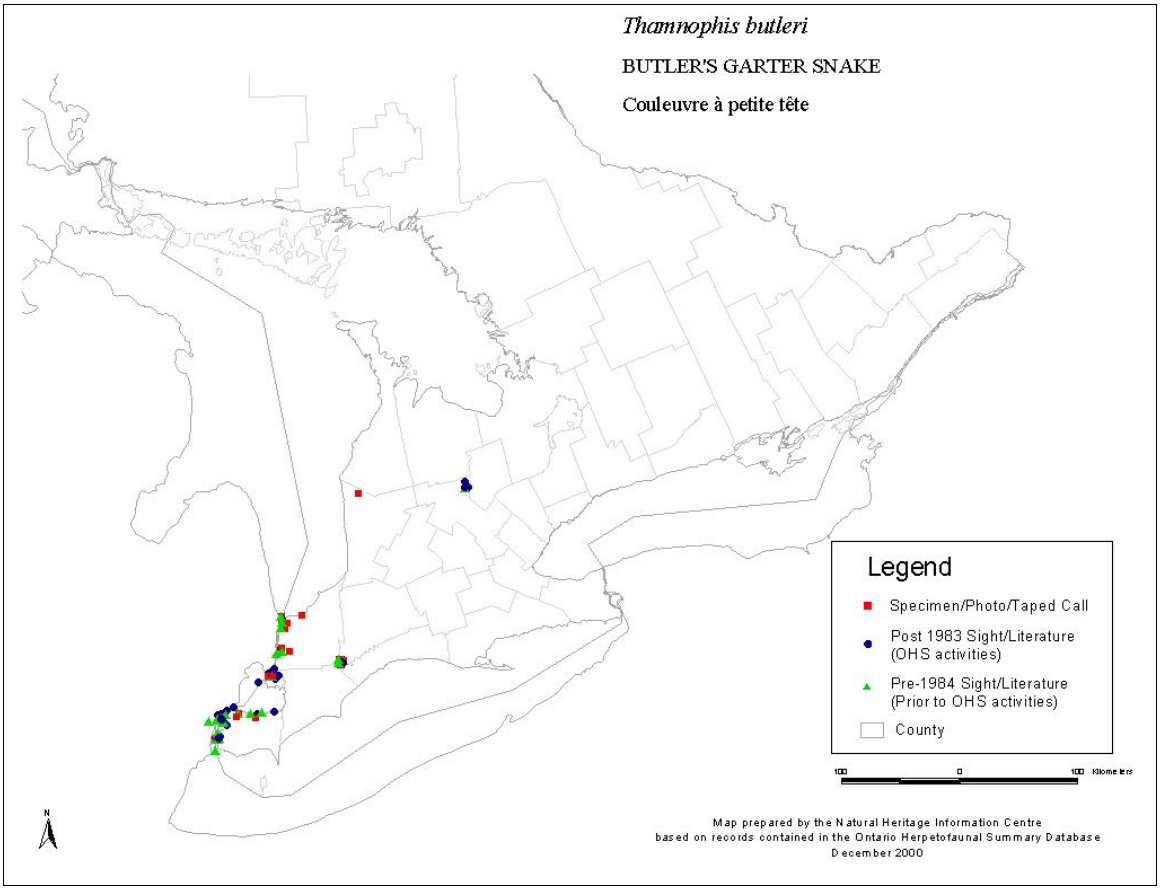

Figure 5. Records of Butler's Garter Snake from OHS Survey 1984-2000 (Oldham and Weller 2000). The specimen record (uppermost red square) to the west of Luther Marsh and adjacent Lake Huron has been rejected (see 'Lucknow', Appendix 2).

LIMITING FACTORS AND THREATS

Habitat destruction and fragmentation likely represent the greatest threats to the persistence of *T. butleri*, as is true of many other Canadian reptiles, particularly snakes. The present disjunct distribution of this species indicates that it occupied a much wider range in the past. Drainage of seasonal wetlands, particularly small ponds and marshes, urbanization and agricultural practices probably reduced its past distribution in Ontario.

Although *T. butleri* have demonstrated the ability to persist, and appear to be abundant, in some small, remnant habitat patches, vacant industrial lands and linear rail corridors in an urban landscape (Harding 1997, J. Choquette and D. Noble pers. obs. 2009), it is uncertain whether or not these sites provide habitat suitable for the long-term persistence of the species. The small size of occupied patches, and the multitude of threats associated with them (e.g., housing and industrial development, pesticide and herbicide application, frequent mowing, dogs and cats, isolation by roads) all make the long-term sustainability of these locations questionable and unpredictable. Harding (1997) noted that "it takes only a few minutes for a bulldozer to totally destroy a thriving colony [of *T. butleri*]". Urbanization is a widespread threat and has resulted in the documented loss of *T. butleri* locations in Michigan (T. Cox pers. comm. 2009) and Ontario (Table 1).

The fragmented nature of urban landscapes as a result of roads and highways is also a major concern. Although no detailed studies have investigated the effects of roads on *T. butleri*, road mortality has been observed across this species' range (Harding 1997; J. Choquette pers. obs. 2009). The presence of roadways separating suitable habitats may restrict snake movement via road aversion or may increase mortality due to road kills. It is not certain which process plays a stronger role with *T. butleri.* Regardless, the two scenarios result in increased isolation of colonies, and potential effects from small population size. These effects have been documented in Black Ratsnakes (*Elaphe obsoleta*) in Ontario (Row *et al.* 2007).

The prevalence of intensive agricultural practices in southwestern Ontario prohibits the establishment of *T. butleri* habitat. Continued disturbance, through tilling and ploughing, prevent the establishment of grasses and thatch. Planck and Planck (1977) noted that the use of pesticides and herbicides could negatively affect *T. butleri* because of their negative effects on earthworm abundance. The correlation between earthworms and *T. butleri* density (Casbourn *et al*. 1976) and the fact that *T. butleri* feeds almost exclusively on earthworms makes this conclusion likely if pesticides/herbicides do indeed negatively affect earthworms (Casbourn *et al*. 1976; Planck and Planck 1977). Furthermore, the conversion of snake habitat into new arable land has been documented as a cause of decline. Location 18, which was known at the time as one of the largest *T. butleri* populations in Ontario (Planck and Planck 1977), was completely destroyed when it was bulldozed for agriculture in the early 1980s.

Given the degree of development, the prevalence of roads and the highly fragmented nature of most of the Butler's Gartersnake extent of occurrence (i.e., Windsor-Sarnia), another major threat to the species is that it is distributed in small mostly isolated populations. As such, these populations are subject to inbreeding depression, and genetic bottlenecks with a consequent loss of genetic variation and increased vulnerability to genetic and ecological stochasticity (Schaffer 1981, Reed *et al*. 2003, Traill *et al*. 2007). Recent assessments suggest that vertebrate populations need to be on the order of a few thousand individuals to have long-term survival and not be subject to reduced genetic diversity (Traill *et al*. 2007). None of the Butler's Gartersnake populations are likely to be this large, and outside, possibly, Luther Marsh, none are bigger than a few hundred adults. Thus, this species qualifies as severely fragmented.

Collection of *T. butleri* is not thought to be an important threat. Scientific collecting has been negligible; museums have only small samples and voucher specimens spaced over localities and time. Collection for the pet trade, however, was raised as a possible threat by Campbell (1971a). At the time, the concern was based upon his knowledge of three collectors seeking *T. butleri* specimens from Ontario. It is not known whether or not collections did occur. Similar concerns regarding collectors were raised at a study site in Windsor in 2009 after suspicious persons were encountered flipping boards at the location. A capture rate of 30-50 *T. butleri* per survey was "reduced to zero overnight" while *T. sirtalis* and *S. dekayi* were still found (W. King pers. comm. 2009). A similar reduction occurred at this site in the previous year (W. King pers. comm. 2009). Scarcity of *T. butleri* in dry midsummer months has been reported by Planck and Planck (1977) and Freedman and Catling (1979) (perhaps to aestivate deeper in the soil) and the apparently abrupt reduction in capture rate witnessed in Windsor may be the result of a biological phenomenon as opposed to collectors.

A consultation in 2009 with the Wildlife Officer responsible for SARA-related issues suggests that there are no significant trade or enforcement-related issues involving *T. butleri* at either the federal or provincial level (L. Coote pers. comm. 2009). Furthermore, a 2.5-hour Internet search was conducted to determine the price and availability of *T. butleri* (J. Choquette pers. obs. 2010). Reptile classifieds and herpetoculture websites from North America and Europe were searched for references to 'Butler's Garter Snake'. Gartersnake.com (Accessed 27 March 2010) lists *T. butleri* as 'Sometimes Available' (2/5 stars), under the category 'Pet Trade Availability'. One adult female was found in a 2005 posting selling for $28.00 US (www.faunaclassifieds.com, accessed 27 March 2010), but no current sales were discovered. Overall, there is an increasing demand for a variety of *Thamnophis* species in North America and Europe, particularly novel colour morphs, but it seems *T. butleri* has yet to become readily available (www.donsgartersnakes.net, accessed 27 March, 2010). At least three people listed *T. butleri* as a part of their collections, and one forum member posted that "several members got babies last summer" (www.thamnophis.com, accessed 27 March 2010). No evidence was found of any active *T. butleri* breeders and captive specimens are presumed wild caught. As of 2010, however, no direct evidence exists to presume collection poses a significant threat to *T. butleri* in Canada.

SPECIAL SIGNIFICANCE OF THE SPECIES

Thamnophis butleri is part of a North American complex that includes two other closely related species: the Plains Gartersnake (*Thamnophis radix*) and the Short-headed Gartersnake (*Thamnophis brachystoma*). *Thamnophis radix* is the only other member of this group represented in Canada (from eastern Manitoba to western Alberta: Cook 1984).

In Ontario, *Thamnophis butleri* shares its range with two additional species in the same genus, the Eastern Gartersnake (*Thamnophis sirtalis)* and the Eastern Ribbonsnake (*Thamnophis sauritus*) (Cook 1984). This is the only area in Canada east of western Saskatchewan where three congeneric snakes occur in the same region (see maps in Cook 1984; Conant and Collins 1991). This makes the faunal assemblage of biological interest, both for its diversity and for ecological analysis of food and habitat partitioning between these species.

The Ontario populations represent a significant fraction of the total range of the species (16%, **Appendix 3**); they are not just the northern fringe of a wide distribution in the United States. These populations also contain unique morphological variants, such as melanism and aberrant scale counts, which have not been witnessed in the American populations (Schueler and Westell 1975, Catling and Freedman 1977, Planck and Planck 1977). As a result, all remaining populations in Canada must be preserved if a healthy representation of variation in the species is to be maintained (Planck and Planck 1977).

The questions surrounding the validity of *T. brachystoma* are also interesting. Research by D. Noble and J. Choquette (this report) indicate that snakes resembling *T. brachystoma* morphologically are identical to *T. butleri* genetically. Further genetic studies using nuclear DNA markers should clarify the relationships among the different regions of Ontario and the different populations across the range. Such information could help clarify when and how *T. butleri* invaded and spread in Canada and derived from its close congeners *T. brachystoma* and *T. radix.*

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Butler's Gartersnake is a 'Specially Protected Reptile' (Schedule 9) under the *Fish and Wildlife Conservation Act of Ontario*, 1997, which regulates hunting and trapping of this species. It is also currently listed as a 'Threatened Species' under 'Schedule 1' of the federal *Species at Risk Act*, 2002. Under the general prohibitions of SARA, it is unlawful to kill, harm, harass, or capture individuals on federal lands. Under Ontario's *Endangered Species Act, 2007,* this species is protected and habitat will be regulated in June 2013, and there are incentives for landowner stewardship. *Thamnophis butleri* was listed as 'Special Concern' by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1999, 'Threatened' in 2001 and 'Endangered' in 2010. In Canada, this species is listed as 'Imperilled' (N2) (NatureServe 2009).

Provincially, *T. butleri* is ranked 'Imperilled' (S2) (NatureServe 2009) and was listed as 'Vulnerable' by the Committee on the Status of Species at Risk in Ontario (COSSARO) in 1999 and elevated to 'Threatened' in 2001 (Oldham 2001). In Ontario, 40% of its habitat is in protected areas (see '**Habitat trends**' section).

In the United States, *T. butleri* is ranked 'Apparently Secure' (N4) (NatureServe 2009). Throughout its American range, *T. butleri* is listed and ranked as follows: 'Critically Imperilled' (S1) in Indiana, 'Vulnerable' (S3) in Wisconsin, 'Apparently Secure' (S4) in Michigan and unranked in Ohio (SNR) (Nature Serve 2009). Globally, *T. butleri* is 'Apparently Secure' (G4) and is listed as LR lc (Lower Risk least concern) by the International Union for the Conservation of Nature (IUCN).

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

This report could not have been updated without the valuable advice of past and present investigators, land owners, public servants, conservation authorities, museums and natural heritage centres. Municipal planning departments (Amherstburg, Lakeshore, LaSalle, London Middlesex and Windsor) were helpful in providing maps and landowner information. The report writers would like to thank the following individuals for sharing their knowledge, stories and sightings of Butler's Gartersnake:, J. Bowles, G.M. Burghardt, C. Campbell, H. Casbourn, G. Casper, P. Catling, A. Chartier, C. Crombie, R. Ferguson, J. Haggeman, J. Harding, A. Harris, S. Hodgkiss, W. Judd, J. Kamstra, W. King, A. Lake, J. Larson, T. Maness, S. Marks, D. Martin, P. Nadhee, J. Peck, J. Placyk, J. Planck, T. Roach, J. Rowell, D. Smith, G. Waldron, W. Weller, D. Wylie, A. Yagi. Other individuals representing required contacts and past authors are acknowledged for their contributions under the list of Authorities Contacted.

Thanks to those who helped the report writers access as many field sites as they did: K. Ash, R. Bell, J. Cowan, F. Delisle, M. Duben, A. Fryder, C. Jacobs, R. Jones, D. Laing, D. Lebedyk, M. Pindus, J. Reaume, P. Roberts, J. Spellman, R. Tymstra, and D. Ware. Thanks to Bonnie and Eddie Ehlers and Marissa and Daniel Labbe for providing food and lodging during the report writers' fieldwork.

The report writers would also like to thank D. Benn, M. Litman, and the Animal Care Committee at the University of Guelph for assistance with the Animal Utilization Protocol. We would like to thank M. Cairns, F, Circelli and P. Hache of MNR for their assistance with the permitting process. Thanks to R.J. Brooks and M. Goit for doing final edit and reformatting. The report writers are also extremely grateful to G. Blouin-Demers, R. Boles, C. Campbell, S. Gillingwater, J. Litzgus, M.J. Oldham, D.A. Sutherland and P.A. Woodliffe for collectively providing "the most extensive reviews" ever seen for a COSEWIC report. Finally, the report writers are particularly in debt to R.J. Brooks for his guidance, expertise, dry humour and red wine throughout the whole process. Ron, how will we ever repay you?

Funding for the preparation of this status report was provided by the Canadian Wildlife Service, Environment Canada.

Past acknowledgements

In the 2001 status report, A. Sandilands makes the following acknowledgments: “Fred Schueler and Francis Cook prepared earlier drafts of this status report. I am indebted to them for compiling most of the information. I would also like to thank Craig Campbell for his companionship in the field and for sharing his extensive knowledge of Butler's Gartersnakes with me. Francis Cook and Ross MacCulloch obtained museum loans of *T. butleri* and *T. brachystoma* for Craig and me. Ross also arranged for volunteers to conduct scale counts of hundreds of *T. butleri* and *T. brachystoma*.”

In the original version of this report (1994), F.W. Schueler and F.R. Cook make the following acknowledgements: “F.R. Cook is indebted to Colin Mills for conversations on the distribution of this species, to Richard C. Bothner, St. Bonaventure University, New York, and the late Charles F. Walker, University Michigan for specimen loans. Jon and Janet Planck, Craig Campbell, and the late Bruce McBride were particularly generous in sharing observations and information on this species over many years, and many others have helped with additional observations and records, particularly the Ontario Herpetofaunal Survey group (Ontario Field Herpetologists) including M.J. Oldham, W.F. Weller, M.E. Obbard. Mike Rankin, Canadian Museum of Nature, assisted in some of the fieldwork conducted by F.W. Schueler in southern Ontario and both F.W. Schueler and F.R. Cook are indebted to Jim and Jo Ellen Bogart, Guelph, for encouragement and accommodation in part for this work.”

Authorities contacted

Muriel Andreae
Biologist
St. Clair Region Conservation Authority
Strathroy, ON

Ronald J. Brooks.
Professor Emeritus
University of Guelph
Guelph, ON

Graham Buck
Guelph District Species at Risk Biologist
Ministry of Natural Resources
Guelph, ON

Francis Cook
Curator Emeritus
Canadian Museum of Nature
North Augusta, ON

Alain Filion
Scientific and Geomatics
Project Officer
Canadian Wildlife Service
Environment Canada
Ottawa, ON

Scott Gillingwater
Species at Risk Biologist
Upper Thames River Conservation Authority
London, ON

Ron Gould
Aylmer District Species at Risk Biologist
Ministry of Natural Resources
Aylmer, ON

Don Hector
Stewardship Kent Coordinator
Ministry of Natural Resources
Chatham, ON

Clint Jacobs
Natural Heritage Coordinator
Walpole Island Heritage Centre
Wallaceburg, ON

Dan Lebedyk
Conservation Biologist
Essex Region Conservation Authority
Essex, ON

Gloria Goulet
COSEWIC Secretariat
Canadian Wildlife Service
Environment Canada

Kathryn Leacock
Collections Manager
Buffalo Museum of Science
Buffalo, NY, USA

Ross MacCulloch
Curator of Reptiles and Amphibians
Royal Ontario Museum
Toronto, ON

Michael Nelson
Species at Risk Biologist
Essex Region Conservation Authority
Essex, ON

Michael J. Oldham
Botanist/Herpetologist
Natural Heritage Information Centre
Peterborough, ON

Paul Pratt
Naturalist
Ojibway Nature Centre
Windsor, ON

Tom Preney
Naturalist
Ojibway Nature Centre
Windsor, ON

Al Sandilands
Grey Owl Environmental
Guelph, ON

Frederick Schueler
Bishops Mills Natural History Centre
Bishops Mills, ON

Allen Woodliffe
Aylmer District Ecologist
Ministry of Natural Resources
Chatham, ON

Addison Wynn
Collection Manager
US National Museum
Suitland, MD, USA

Anthony Zammit
Ecologist
Grand River Conservation Authority
Cambridge, ON

BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Jonathan Choquette holds a B.Sc. in Biology from the University of Guelph and is a Master of Landscape Architecture Candidate from the same school. His interests include urban herpetology, landscape ecology and conservation biology.

Daniel Noble completed a B.Sc. and M.Sc. at the University of Guelph and is currently pursuing a PhD at Macquarie University in Sydney Australia. Daniel's interests are diverse but include sexual selection, sexual and agonistic signalling, and conservation biology of reptiles and amphibians.

INFORMATION SOURCES

Asplund, K.A. 1963. Ecological factors in the distribution of *Thamnophis brachystoma* (Cope). Herpetologica 19:128-132.

Bleakney, J.S. 1958. A zoogeographical study of the amphibians and reptiles of eastern Canada. National Museum of Canada Bulletin 155. 119 pages.

Bell, R. 2009. Pers. comm. to J. Choquette and D. Noble. Superintendent, Luther Marsh Wildlife Management Area.

Bakowsky, W.D. 1993. A review and assessment of prairie, oak savannah and woodland in Site Regions 7 and 6 (Southern Region). Draft report. Gore & Storrie Ltd. for Ontario Ministry of Natural Resources, Southern Region, Aurora. Available from Natural Heritage Information Centre, Ontario Ministry of Natural Resources, P.O. Box 7000, 300 Water Street, Peterborough, ON K9J 8M5.

Bakowsky, W. 1995. Community type S-ranks. Natural Heritage Information Centre. Ministry of Natural Resources. 11 pp.

Bakowsky, W., and J.L. Riley. 1992. A survey of the prairies and savannas of Southern Ontario. A vegetation analysis of tallgrass prairie in Southern Ontario. pages 7-16. In R.G. Wickett, P.D. Lewis, A. Woodliffe and P. Pratt. Editors. Proceedings of the Thirteenth North American Prairie Conference. Department of Parks and Recreation, Windsor, Ontario, Canada.

Bothner, R.C. 1967. Pers. comm. to F.R. Cook. St. Bonaventure University, New York, U.S.A.

Boulenger, G.A. 1893. Catalogue of the snakes in the British Museum (Natural History). Volume 1, London.

Buck, G. 2009. Pers. comm. to J. Choquette. Guelph District Species at Risk Biologist, Ontario Ministry of Natural Resources.

Bowles, J.M. 2005. Draft Walpole Island Ecosystem Recovery Strategy. Prepared for Walpole island Heritage Centre and Environment Canada. 50 pp.

Burghardt, G. 1968. Comparative prey-attack studies in newborn snakes of the genus Thamnophis. Behaviour. 33: 77-113.

Campbell, C. 1971a. Butler's garter snake in Canada: a review of previously recorded and newly recorded colonies. Canadian Amphibian and Reptile Conservation Society 9(5): 1-4

Campbell, C. 1971b. Reptile and amphibian survey, “Skunk's Misery” (Middlesex County Forest) near Newbury, Ontario. Cardinal 71: 4-7.

Campbell, C. 2009. Pers. comm. to J. Choquette. Ecological Consultant who conducted numerous surveys for *T.butleri* in the 1970s.

Carpenter, C.R.1952a. Comparative ecology of the common garter snake (*Thamnophis s. sirtalis*), the ribbon snake (*Thamnophis s. sauritus*) and Butler's garter snake (*Thamnophis butleri*) in mixed populations. Ecological Monographs 22: 235-258.

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

Carpenter, C.R. 1953.A study of hibernacula and hibernating associations of snakes and amphibians of Michigan. Ecology, 34: 74-80.

Casbourn, H., P. Dwyer, P. Francis, G. Fox, L. Gray, A. Lambert, F. McKillop, B. Ralph. 1976. Prey species and role of prey in limiting the local distribution of Butler's garter snake (*Thamnophis butleri*). Unpublished report, Ontario Ministry of the Environment. ix + 91 pages.

Casbourn, H. 2009. Pers. comm. to J. Choquette and D. Noble. Conducted past research on *T.butleri* with J. Planck.

Catling, P.M., and W. Freedman. 1977. Melanistic Butler's garter snakes (*Thamnophis butleri*) at Amherstburg, Ontario. Canadian Field-Naturalist 91: 397-399.

Catling, P.M., and B. Freedman.1980a. Food and feeding behaviour of sympatric snakes at Amherstburg, Ontario. Canadian Field-Naturalist 94: 28-33.

Catling, P.M., and B. Freedman.1980b. Variation in distribution and abundance of four sympatric species of snakes at Amherstburg, Ontario. Canadian Field-Naturalist 94: 19-27.

Conant, R. 1950. On the taxonomic status of *Thamnophis butleri* (Cope). Chicago Academy of Sciences Bulletin 9: 71-77.

Conant, R. 1951. The Reptiles of Ohio (second edition). University of Notre Dame Press, Notre Dame, Indiana. 284 pages.

Conant, R., and J.T. Collins. 1991. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Houghton Mifflin Co, Boston. xviii + 429 pages.

Conant, R., E.S. Thomas, and R.L. Rausch. 1945. The plains garter snake, *Thamnophis radix*, in Ohio. Copeia 1932: 61-68.

Cook, F.R. 1984. Introduction to Canadian Amphibians and Reptiles. National Museum of Canada, Ottawa, Ontario.

Cook, F.R. 2009. Pers. comm. to J. Choquette. Curator Emeritus, National Museum of Canada.

Coote, L. 2009. Pers. comm. with D. Noble. Acting Operations Manager , Central District, Wildlife Enforcement Division (WED) - Ontario Region, Environment Canada, Burlington.

Cope, E.D. 1889. On the Eutaeniae of southeastern Indiana. Proceedings of the U.S. National Museum 11(729): 399-401.

Cope, E.D. 1900. The crocodilians, lizards and snakes of North America. U.S. National Museum Report for 1898, pp.153-1270.

Coulson, D.P., and J.G. Peluch. 1984. *Thamnophis butleri* new to Wellington County. Ontario Field Biologist 38: 44.

Cox, T. 2009. Pers. comm. to J. Choquette. Previous Michigan resident with knowledge of *T.butleri* localities in Michigan.

Crow, C., J. Demelo, J. Hayes, J. Wells, and T. Hundey. 2003. Walpole Island land use change 1972-1998. Unpublished class report. Department of Geography, University of Western Ontario.

Davis, D.D. 1932. Occurrence of *Thamnophis butleri* Cope in Wisconsin. Copeia 1932: 113-118.

De Queiroz, A., R., Lawson, and J.A. Lemos-Espinal. 2002. Phylogenetic relationships of North American garter snakes (Thamnophis) based on four mitochondrial genes: How much DNA sequence is enough? Molecular Phylogenetics and Evolution 22: 315-329.

Dewey, T. and J. Loup. 2004. “Thamnophis butleri” (On-line), Animal Diversity Web. http://animaldiversity.ummz.umich.edu/site/accounts/information/Thamnophis_butleri. Accessed March 29, 2010

DRIC (Detroit River International Crossing Study) 2008. Draft Practical Alternatives Evaluation Working Paper: Natural Heritage. Draft April 2008. Research by LGL Ltd.

Ecologistics Limited. 1976. Windsor Airport Environmental Study. Prepared for Transport Canada. 110+ pp.

Fitzpatrick, B.J., G.S. Casper, J.S. Placyk Jr., M.L. Neimiller, D. Kirk and G.M. Burghardt. 2008. Analysis of the genetic status of populations in the zone of overlap between *Thamnophis butleri* and *Thamnophis radix* based on AFLP analysis. Report to the Wisconsin Department of natural Resources, pp 1-18.

Ford, N.B., and D.W. Killebrew. 1983. Reproductive tactics and female body size in Butler's garter snake, *Thamnophis butleri*. Journal of Herpetology 17: 271-275.

Freedman, W., and P.M. Catling. 1978. Population size and structure of four sympatric species of snakes at Amherstburg, Ontario. Canadian Field-Naturalist 92: 167-173.

Freedman, B., and P.M. Catling. 1979. Movements of sympatric species of snakes at Amherstburg, Ontario. Canadian Field-Naturalist 93: 399-404.

Ferguson, R. 2009. Pers. comm. to J. Choquette and D. Noble. Sarnia Resident.

Garnier, J.H. 1881. List of Reptilia of Ontario. Canadian Sportsman and Naturalist (Montreal) 1(5): 37-39.

Gillingwater, S. 2001. A Selective Herpetofaunal Survey Inventory and Biological Research Study of Rondeau Provincial Park. Unpublished report, University of Guelph.

Gillingwater, S. 2010. Pers. comm. to J. Choquette and D. Noble. Species at Risk Biologist, Upper Thames River Conservation Authority.

Grand River Conservation Authority. 2007. Luther Marsh Wildlife Management Area: 2007-2016 Draft Management Plan. 36 pp.

Harding, J. 1997. Amphibians and Reptiles of the Great Lakes Region. University of Michigan Press, pg 274-278.

Harris, A. 2009. Pers. comm. to J. Choquette and D. Noble. Principal, Northern Bioscience.

Johnson, B. 1989. Familiar amphibians and reptiles of Ontario, Natural Heritage/Natural History Inc, Toronto, Ontario. 168 pages.

IUCN. 2010. IUCN Red List Categories and Criteria: Version 8.0. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. ii + 85 pp.

Jones, R. 2009. Pers. comm. to J. Choquette and D. Noble. Naturalist and photographer with a keen interest in the herpetofauna of Essex County.

Kamstra, J. 2009. Pers. comm. to J. Choquette. Senior Terrestrial Ecologist conducting mark-recapture study on *T. butleri* in Point Edward, AECOM.

King, W. 2009. Pers. comm. to J.Choquette and D. Noble. Field Technician conducting mark-recapture study on *T. butleri* in Windsor, LGL LTD. Environmental Research Associates.

Klinger, D. 1957. A marking study of the short-headed garter snake in Pennsylvania. Herpetologica 13: 100.

Lamond, W.G. 1994. The Reptiles and Amphibians of the Hamilton area. An historical summary and the results of the Hamilton Herpetofaunal Atlas. Hamilton Naturalists' Club. 174 pages.

Larson, J. 2009. Pers. comm. to J. Choquette. Science Teacher with familiarity of Essex County herpetofauna, Amherst Secondary School.

Leacock, K. 2009. Pers. comm. to J. Choquette. Collections Manager, Buffalo Museum of Science, Buffalo, New York, U.S.A.

Leverette, C. E. 1976. Land Use History of the Canadian Detroit River Islands. Unpublished thesis. University of Western Ontario, 200pp.

Logier, E.B.S. 1939a. Butler's garter-snake, *Thamnophis butleri*, in Ontario. Copeia 1939: 20-23.

Logier, E.B.S. 1939b. The Reptiles of Ontario. Royal Ontario Museum of Zoology Handbook 4.

Logier, E.B.S. 1958. The Snakes of Ontario. Royal Ontario Museum. University of Toronto Press. Pp32-33.

Logier, E.B.S., and G.C. Toner. 1955. Check-list of the amphibians and reptiles of Canada and Alaska. Royal Ontario Museum of Zoology and Palaeontology Contribution 41: 1-88.

Logier, E.B.S., and G.C. Toner. 1961. Check list of the amphibians and reptiles of Canada and Alaska. Contribution, Life Sciences Division, Royal Ontario Museum 53: 1-92.

Martin, D. 2009. Pers. comm. to J. Choquette. Ecological Consultant practicing in Essex County.

MacCulloch, R. D. 2002. The ROM Field Guide to Amphibians and Reptiles of Ontario. A ROM science publication. Royal Ontario Museum and McClelland & Stewart Ltd. 168pp.

McBride, B. 1967. Notes on three rare Ontario snakes. Canadian Amphibian and Reptile Conservation Society Bulletin 5(6): 1-4.

Mills, R.C. 1948. A check list of the reptiles and amphibians of Canada. Herpetologica 4 (second supplement): 1-15.

Mills, R.C. 1966, 67. Pers. comm. to F.R. Cook. Author of “A check list of the reptiles and amphibians of Canada”.

Nadhee, P. 2009. Pers. comm. to J. Choquette. Species at Risk Reptile Specialist, Walpole Island Heritage Centre.

Nash, C.W. 1905. Batrachians and reptiles of Ontario *in* Check list of the vertebrates and catalogue of specimens in the biological section of the Provincial Museum. Department of Education, Toronto. 32 pages.

NCC (Nature Conservancy of Canada). 2009. Skunk's Misery: Southwestern Ontario. Available http://www.natureconservancy.ca/site/News2?page=NewsArticle&id=8553&news_iv_ctrl=0&abbr=on_ncc (Accessed: 20 April, 2010).

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: 20 April, 28 March, 2010).

Oldham, M.J. 2001. COSSARO Candidate V, T, E Species Evaluation Form for Butler's Garter Snake (*Thamnophis butleri).* Natural Heritage Information Centre, Ontario Ministry of Natural Resources, Peterborough, Ontario. 6pp. + appendices.

Oldham, M.J. 2010. Pers. comm. to J. Choquette and D. Noble. Botanist/Herpetologist with the Natural Heritage Information Centre,Ministry of Natural Resources, Peterborough, ON.

Oldham, M.J., and D.A. Sutherland. 1986. 1984 Ontario herpetofaunal summary. Essex Region Conservation Authority, Essex, and World Wildlife Fund Canada, Toronto, Ontario. 214 pages.

Oldham, M.J., and W.F. Weller. 1989. Ontario Herpetofaunal Summary 1986 Technical Supplement. Ontario Field Herpetologists, Cambridge, Ontario. 197 pages.

Oldham, M.J. and W.F. Weller. 2000. Ontario Herpetofaunal Atlas. Natural Heritage Information Centre, Ontario Ministry of Natural Resources. http://nhic.mnr.gov.on.ca/MNR/nhic/herps/ohs.html (updated 15-01-2010).

Oliver, J.A. 1955. The Natural History of North American Amphibians and Reptiles. D. Van Nostrand Company, Inc. Princeton, New Jersey. ix + 359 pages.

Peck, J. 2009. Pers. comm. to J. Choquette. Park Superintendant, Point Farms Provincial Park.

Placyk, J. 2009. Pers. comm. to D. Noble. Assistant Professor, Department of Biology, University of Texas.

Planck, R.J., and J.T. Planck. 1977. Ecology and status of the Butler's garter snake, *Thamnophis butleri* (Cope), in southwestern Ontario. Manuscript report, Department of Supply and Services, Canada. 139 pages.

Planck, R.J. 2009. Pers. comm. to J. Choquette and D. Noble. Ecological consultant who conducted past research on *T. butleri*, Ecologistics Limited.

Pratt. P. D. 2009. Pers. comm. to J. Choquette and D. Noble. Lead Naturalist, Ojibway Nature Centre.

Preney, T. 2009. Pers. comm. to J. Choquette and D. Noble. Staff Naturalist, Ojibway Nature Centre.

Reed, D.H., J.J. O'Grady, B.W. Brook, J.D. Ballou and R. Frankam. 2003. Estimates of minimum viable population sizes for vertebrates and factors influencing those estimates. Biological Conservation 113:23-34.

Reid, R. 1985. Exploring Canada's Deep South. Season's Magazine. Summer 1985, 25: 2. Pp22-23.

Reynolds, J. 1977. The Earthworms of Ontario. Royal Ontario Museum.

Rossman, D.A., N.B. Ford, and R.A. Seigel. 1996. The Garter Snakes: Evolution and Ecology. University of Oklahoma Press, Norman, Oklahoma. 332 pages.

Row, J. R., G. Blouin-Demers, and P. J. Weatherhead. 2007. Demographic effects of road mortality in Black Ratsnakes (*Elaphe obsoleta).* Biological Conservation, 137:`117-124.

Rowell, J. 2009. Pers. comm. to J. Choquette and D. Noble. Amateur naturalist and author writing a book entitled 'Snakes of Ontario'.

Ruthven, A.G. 1904. Butler's garter snake. Biological Bulletin 7: 289-299.

Ruthven, A.G. 1908. Variations and genetic relations of the garter snakes. United States National Museum Bulletin 61: vii + 201.

Ruthven, A. G., Thompson, C. and Thompson, H. 1912. The Herpetology of Michigan. Michigan Geological and Biological Survey 10:3. Issued as part of the annual report of the board of geological survey for 1911, Lansing, Michigan. Available Online: *www.archive.org/stream/herpetologyofmic00ruth/herpetologyofmic00ruth_djvu.txt*

Sandilands, A.P. 1984. Annotated checklist of the vascular plants and vertebrates of Luther Marsh, Ontario. Ontario Field Biologist, Special Publication 2, Toronto. 134 pages.

Sandilands, A. 1988a. Butler's garter snake (*Thamnophis butleri*). Pages 161-162 *in* 1985 Ontario herpetofaunal summary. Oldham, M.J., ed. Ontario Ministry of Natural Resources, London, Ontario. 206 pages.

Sandilands, A. 1988b. Butler's garter snake - Couleuvre à petite tête (*Thamnophis butleri*).Pages 126-128 *in* Ontario herpetofaunal summary 1986. Weller, W.F. and M.J. Oldham, eds. Ontario Field Herpetologists, Cambridge, Ontario. 221 pages.

Sandilands, A.P. 2001. COSEWIC status report on the Butler's garter snake *Thamnophis butleri* in Canada, in COSEWIC assessment and status on report on Butler's garter snake Thamnophis butleri in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-20 pp.

Sandilands, A. 2009. Pers. comm. to J. Choquette. Previous author, 2001 COSEWIC Status Report Update on the Butler's Gartersnake in Canada.

Seburn, D., Seburn, C. 2000. Conservation Priorities for the Amphibians and Reptiles of Canada. September 2000. Prepared for World Wildlife Fund and the Canadian Amphibian and Reptile Conservation Network. 92 pp.

Schaffer, M. L. 1981. Minimum population sizes for species conservation. BioScience 31: 131-134.

Schmidt. K. P. 1938. Herpetological evidence for the post-glacial extension of the steppe in North America. Ecology 19: 396-407.

Schueler, F.W, and P.A. Westell. 1975. Geographical distribution: *Thamnophis butleri* (Butler's garter snake). Herpetological Review 7(4): 180.

Schueler, F.W. 1993. Range of Butler's Gartersnake. Ontario Herpetofaunal Summary Newsletter, April 1993:3.

Schueler, F.W. 2009. Pers. comm. to J. Choquette and D. Noble. Previous author, original version of the COSEWIC Status Report on the Butler's Gartersnake in Canada

Smith, A.G. 1945. The status of *Thamnophis butleri* Cope and a redescription of *Thamnophis brachystoma* (Cope). Proceedings of the Biological Society of Washington 58: 147-154.

Smith, A.G. 1949. The subspecies of the plains garter snake, *Thamnophis radix*. Chicago Academy of Sciences Bulletin 8: 285-300.

Smith, P.W. 1957. An analysis of post-Wisconsin biogeography of the prairie peninsula region based on distributional phenomena among terrestrial vertebrate populations. Ecology 38: 207-218.

Tallgrass Ontario. Tallgrass and Savannah in Ontario. Online available [September 22, 2009]: http://www.tallgrassontario.org/TS_SAR.htm.

Town of Lasalle. 1996. Official Plan Review. Candidate Natural heritage area biological inventory and land use planning policy direction. Unpublished Report.

Traill, L.W., C.J.A. Bradshaw and B.W. Brook. 2007. Minimum viable population size: A meta-analysis of 30 years of published estimates. Biological Conservation 139: 159-166.

Waldron, G. 2009. Pers. comm. to J. Choquette. Ecological Consultant practicing in Essex County.

Weller, W.W., and M.J. Oldham, eds. 1988. Ontario herpetofaunal summary 1986. Ontario Field Herpetologists, Cambridge, Ontario. 221 pages.

Wormington, A. and D. Fraser. 1985. Wetland Data Record and Evaluation. Second Edition. August, 1985. Ontario Ministry of Natural Resources, Chatham.

Wright, A.H., and A.A. Wright. 1957. Handbook of Snakes of the United States and Canada. Volume II. Comstock Publishing Associates, Ithaca, New York. ix + 565-1105 pages.

Wynn, A. 2009. Pers. comm. to J. Choquette. Museum Specialist, Division of Amphibians and Reptiles, U.S. National Museum.

APPENDIX 1. References for the locations described in Table 1. The location numbers correspond to those in Table 1 (LSU= Louisiana State University, NMC= National Museum of Canada, OHS= Ontario Herpetofaunal Summary, ROM= Royal Ontario Museum, USNM= United States National Museum)

Location	References and Museum Specimens
1.	Planck and Planck 1977, R. Jones pers. obs. 2006
2.	OHS (25 records), NMC (17686, 21351, 22401, 25986, 30821), LSU (39653-57,39884), Catling and Freedman (1977, 1980b, 1980a), Freedman and Catling (1978, 1979, 1988a, 1988b), Oldham and Weller 1989 Oldham and Sutherland 1986
3.	D. Laing pers. obs. 2006
4.	OHS (1 record), P.D. Pratt pers. obs. 2008, Planck and Planck 1977; Sandilands 1988a
5.	OHS (1 record), Wormington and Fraser 1985
6.	OHS (3 records), Wormington and Fraser 1985, 1988
7.	OHS (1 record), NMC 30772, Oldham and Weller 1989; Planck and Planck 1977
8.	OHS (1 record), Oldham and Weller 1989
9.	OHS (1 record), Oldham and Sutherland 1986
10.	ROM (1 record), NMC 30771, Planck and Planck 1977
11.	Town of Lasalle 1996
12.	OHS (1 record)
13.	Town of Lasalle 1996, Planck and Planck 1977
14.	OHS (1 record), Town of Lasalle 1996
15.	OHS (4 records), Sandilands 1988a, Oldham and Weller 1989, Planck and Planck 1977, R. Jones pers. obs. 2006
16.	OHS (1 record), D. Wylie pers. obs. 2007; Weller and Oldham 1988
17.	Planck and Planck 1977
18.	Planck and Planck 1977
19.	T. Preney pers. obs. 2009
20.	T. Preney pers. obs. 2009
21.	OHS (15 records), ROM (2 records), NMC 29389, C. Campbell pers. obs. 1972, Oldham and Sutherland 1986; Sandilands 1988a; Oldham and Weller 1989, Planck and Planck 1977, R. Jones pers. obs. 2008
22.	DRIC 2008, W. King pers. obs. 2009
23.	DRIC 2008, D. Smith pers. obs. 2009
24.	A. Yagi pers. obs. 2007
25.	OHS (1 record)
26.	OHS (2 records)
27.	OHS (1 record), Planck and Planck 1977
28.	OHS (2 records), NMC (21234, 21337), Planck and Planck 1977, J. Choquette and D. Noble pers. obs. 2008
29.	USNM 10532, Garnier 1881
30.	Planck and Planck 1977
31.	OHS (1 record), NMC 22850
32.	OHS (2 records), NHIC (1 record), NMC 30668, Oldham and Weller 1989, Campbell 1971a, R. Gould pers. obs. 2008
33.	OHS (1 record)

Location	References and Museum Specimens
34.	NHIC (1 record), R. Gould pers. comm. 2009.
35.	OHS (1 record), ROM (1 record)
36.	Planck and Planck 1977
37.	Campbell 1971a; Planck and Planck 1977
38.	OHS (1 record), NMC 22959, A. Harris pers. obs. 1960s,; Planck and Planck 1977
39.	OHS (1 record), ROM (4 records), NMC (229671, 30667), P.D. Pratt pers. obs. 1960s, Campbell 1971a, Oldham and Weller 1989
40.	Seburn and Seburn 2000, A. Sandilands pers. obs. 2001
41.	OHS (1 record), NMC (22950, 22953), Planck and Planck 1977, J. Kamstra pers. obs. 2008,
42.	OHS (1 record)
43	OHS (1 record), NMC 30667, Oldham and Weller 1989
44.	OHS (31 records), ROM (H15670, 12464), NMC (16240, 22621), Schueler and Westell 1975; Oldham and Sutherland 1986; Sandilands 1988a; Oldham and Weller 1989
45	OHS (17 records), NMC (9561, 14839, 21254, 21359, 21377, 21393, 22853, 22914, 22918, 22921), Logier (1939a, 1939b), Logier and Toner (1955 [given as Essex Co. in error], 1961 [county designation corrected]), Mills 1948, McBride 1967, Campbell (1971a,b), Oldham and Sutherland 1986
46.	OHS (7 records), ROM (11 records), NMC (16464, 16812, 28191, 28192, 28193, 28194, 29389), Schueler and Westell 1975; Oldham and Sutherland 1986; Sandilands (1988a, 1988b) R. Bell pers. obs. 2006
47.	ROM (1 record), NHIC (1 record, coordinates written in error), NMC MJO#14174

APPENDIX 2. A list of accepted, rejected and unsubstantiated *T. butleri* records resulting in current conclusions regarding this species' Canadian range. The unsubstantiated records are at this time inconclusive and deserve further investigation in order to accept or reject them. Some of the latter, if accepted, would represent range extensions for this species; however, these were not specifically addressed or searched by J. Choquette and D. Noble in 2009.

Accepted Historic Localities:

a) **Kent County, Mitchell's Bay (1881):** John H. Garnier's specimen of Hoy's Gartersnake (Plains Gartersnake, *Thamnophis radix*) along the St. Clair flats (Garnier 1881; Mitchell's Bay, USMN 10532) was originally catalogued as *Eutaenia radix* and re-classified as *Thamnophis butleri* on 20 October, 1992 by P. Ostermeier, a museum visitor (A. Wynn pers. comm. 2009). Following a detailed examination of specimen photographs in 2009, (Courtesy of A. Wynn, USNM), J. Choquette and D. Noble agree with the 1992 re-classification (Interestingly, Campbell (1971b) noted that an old ROM record of *T. butleri* from the St. Clair flats had been unsubstantiated by specimens). Garnier notes in 1888 that "various specimens of *E. radix* have been obtained from the 'marshy augish lands' near Lake St. Clair." (J. Rowell pers. comm. 2009) and inclusion by Nash (1905) of *T. radix* with the remark that it occurred "not abundantly" in western Ontario was presumably based on the Garnier report (Campbell 1971a). The reclassification of the 1881 specimen from *Eutaenia radix* to *Thamnophis butleri* makes it the first record of *T. butleri* from Canada. Although erroneously labelled as *Thamnophis radix,* this was the closest species described at the time of Garnier's collection, as *T. butleri* had not yet been described (Cope 1889). This is significant in that it demonstrates the collection of *T. butleri* over half a century (57 years) prior to the currently established 'first' Canadian record (1939a). No recent records exist for the region surrounding Mitchell's Bay, and currently there appears to be a significant 'gap' along the East side of Lake St. Clair, between known occurrences of this species in the Sarnia and Windsor areas.

b) **Kent County, Rondeau Provincial Park (RPP) (1940)**: Logier and Toner (1955, 1961) listed this locality on the basis of a personal communication from F.C. Blanchard, University of Michigan. Two specimens in the University of Michigan's Museum of Zoology (UMMZ 90193) are labelled "Rondeau Provincial Park, near Blenheim, Ontario, Ruth Gilbreath and William Stickel, 23 July 1940". F.R. Cook examined these in 1966 and substantiated them as *T. butleri* (courtesy of C.F. Walker, UMMZ). Campbell (1971a) stated that "Stickel does not recall where in, or near, the park they took them, but guesses it was in lakeshore marshes under boards". Other UMMZ numbers in the same series are assigned to specimens from Long Point and north of there, from 7 miles E of Blenheim, and from Rondeau Provincial Park (RPP).

No other records of *T. butleri* have been produced from RPP. Field surveys at this location and vicinity by H. Milnes (1938, J. Rowell pers. comm. 2010), Campbell (1971a), Planck and Planck (1977), F.R. Cook, J.C. Cook, B. McBride, R.E. Roy, D.M. Scott, and F.D. Ross, found *T. sirtalis* and *T. sauritus* to be common there, but encountered no *T. butleri*. If the species were present in 2001, it would have likely been observed during an extensive herpetological study, employing cover boards and drift fence trapping, but it was not recorded (Gillingwater 2001). Based on multiple negative searches, it is assumed *T. butleri* does not currently exist at RPP and some doubt has been expressed regarding the validity of the historic records.

Two opposing views have emerged in response to the 1940 specimens. The first hypothesis is as follows: RPP is not an historic location for *T. butleri* and the specimens in question were not collected from RPP, but from Skunk's Misery and were later mislabelled as being from RPP. As the American collectors (Gilbreath and Stickel) travelled from RPP to Long Point, their route may have taken them past Skunk's Misery on Highway 2. They may have been aware of Logier's (1939a) report of *T. butleri* published in *Copeia* the year before. Collection at Skunk's Misery, followed by a labelling error made in the haste of field work, or in processing collections afterwards, would explain this view (C. Campbell pers. comm. 2009). The opposing view is that RPP is in fact an historic location for *T. butleri*. This species, however, has since been extirpated there due to extensive human disturbance within the park in the middle part of the century (A. Woodliffe pers. comm. 2010). Following an in-depth debate among herpetological experts and historic investigations, it was decided to include Rondeau Provincial Park as part of the historic range of Butler's Gartersnake. Futhermore, it was accepted that this species has been extirpated from this location.

Unsubstantiated localities:

a) **Brant County (2009):** This is the most recent unsubstantiated report of a new *T. butleri* locality. Reports exist from two separate locations from two separate sources. The first report is from Dr. Chris Crombie, a local veterinarian, who claims to have seen *T. butleri* in July and August along the banks of Kenny Creek, just east of Cathcart south of old Highway 53. The habitat is described as 'old marshy cow pasture'. The second report is from C. Campbell, who claims to have seen *T. butleri* near a quarry area, just off the Waterloo/Brant County Townline Road. A species-at-risk biologist (OMNR) describes the area as a 'large hayfield/meadow' (G. Buck pers. comm. 2009). This area should be investigated as the discovery of *T. butleri* persistence here would result in a significant range extension.

b) **Regional Municipality of Waterloo, Erbsville (1995):** C. Campbell observed a *Thamnophis* sp. near Erbsville, Regional Municipality of Waterloo that looked and behaved like *T. butleri*, but was unable to capture it to verify identification.

c) **Simcoe County, Canadian Forces Military Base Borden (1992):** Al Sandilands observed a *Thamnophis* sp. "side-winding" like a *T. butleri* across Simcoe Cty Road 20 near Canadian Forces Base Borden. This snake was not captured to confirm its identity (A. Sandilands pers. comm. 2009). C.F.B. Borden supports sand barren and savannah habitats (e.g., *Erynnis martialis, Tachysphex pechumani*) and the ROM contains specimen(s) of Five-lined Skink (*Eumeces fasciatus*) collected in adjoining Tosorontio (Adjala-Tosorontio) Twp., Simcoe Co (M. Oldham pers. comm. 2010.). No other reports of *T. butleri* exist for this area and a 2007 Species at Risk inventory by NHIC biologists did not uncover any *T. butleri* (M. Oldham pers. comm. 2010).

d) **Niagara Peninsula, Short Hills Provincial Park (1970s):** Photos of '*T. butleri*' by T. Beechy from the MNR were all identified as *T. sirtalis* by C. Campbell. Field surveys were conducted by C. Campbell and P.D. Pratt for a couple hours in the 1970s near Font Hill but no *T. butleri* were found, although suitable habitat was present (C. Campbell pers. comm. 2009). As of 2009, the website of the Friends of Short Hills Provincial Park lists the "Butler Snake" as one of the reptiles inhabiting the park (FSHP, 2009; http://www.friendsofshorthillspark.ca/natureframe.htm). It should be determined if this reference was made to the erroneous 1970s report or to a more recent sighting.

e) **Huron County, Point Farms Provincial Park (Year unknown, 1970s?):** C. Campbell (pers. comm. 2009) reported a *T. butleri* DOR just outside Point Farms Provincial Park. C. Campbell mentioned the presence of very grassy, meadow-like habitat just north of the park gates. Slides of the specimen in C. Campbell's collection were not available to be examined by J. Choquette and D. Noble in 2009; however, he insists the specimen was readily identified by field marks and that he knew the species well. The sighting pre-dated the OHS or NHIC, but was acknowledged by Harding (1997). General species surveys were conducted at the park in the 1960s and in 2008, but no *T. butleri* were recorded (J. Peck pers. comm. 2009). As of 2009, the area surrounding the park was characterized by successional farm field and meadow habitat (J. Peck pers. comm. 2009). It is assumed *T. butleri* have been extirpated from this area; however, it should be investigated as the discovery of *T. butleri* persistence here would result in a significant extension of the species' historical EO and IAO.

Rejected Localities:

a) **Huron County, Lucknow (1883-1893):** A series of 5 specimens from Lucknow held at the U.S. National Museum (1890-1893, USNM 56086-90, collected by J. Hurter), were originally labelled as '*T. butleri*' (1 record in ROM database). All 5 were later re-identified as *T. sirtalis* by museum staff and by J. Choquette and D. Noble via examination of specimen photographs (courtesy of A. Wynn, USNM). Dr. Garnier's original collection catalogue in the ROM (# 246) lists a specimen of

'*E. radix'* collected on August 23, 1883 from the "Environs of Lucknow" (J. Rowell pers. comm. 2009). Although Garnier's '*E. radix'* from Mitchell's Bay, Ontario was re-identified as *T. butleri* (USNM 10532), all Garnier's *Thamnophis spp.* from the Lucknow area were confirmed as *T. sirtalis* (R. MacCulloch pers. obs. 2009). This location is the most northwestern data point on the OHS map (see Fig. 4) and its rejection reduces the Extent of Occurrence of the species in Ontario.

b) **Regional Municipality of Hamilton-Wentworth, Dundas area (Mills 1948):** R.C. Mills (pers. comm. to F.R. Cook, 22 November 1966) wrote "we do run into it in the Hamilton District [...] I think the best place in the early spring is the Hamilton York Street Cemetery, as I have noticed large numbers of them mainly around the Mills Family Headstone, when the snow has partially melted [...]and I definitely think it can be obtained directly behind the large Hydro Station, which is close on the banks of the Desjardins Canal, which runs up to Dundas". Mills based his identification of *T. butleri* on the observation that the snakes had red colouration (R.C. Mills pers. comm. to F.R. Cook, 2 April 1967). *Thamnophis butleri* is reported to sometimes have orange lateral stripes (Conant and Collins 1991) but is not characterized by red, a trait more common in *T. sirtalis.* It is likely that the two species were confused. Mills failed to provide any specimens to NMC or ROM (Campbell 1971a) from the Dundas area. It was not until a 1966 visit to Skunk's Misery with R.C. Bothner that a valid specimen of *T. butleri* was produced by Mills.

Searches of the cemetery referred to by Mills on 3 April 1967 by F.R. Cook with R.C. Mills (unpublished data), by C.A. Campbell and P.D. Pratt in October 1971 (Campbell 1971a) and casually by F.W. Schueler in 1981 and 1994 (F.W. Schueler pers. comm. 2009) were without success. No *T. butleri* were found in the region during the intensive herpetofaunal atlas conducted over a nine-year period by the Hamilton Naturalists' Club. Lamond (1994), author of the Hamilton herpetofaunal atlas summary, and Logier and Toner (1955, 1961) omitted Mills' record and made no specific attempts to substantiate his sighting with field searches (F.R. Cook pers. comm. 2009). Some claim that more field-based evidence is needed to reject the Mills record (F.W. Schueler and F.R Cook pers. comm. 2009). Finally, due to lack of data, number of past surveys, and the likelihood of misidentification by Mills, this record is rejected.

c) **Middlesex County, City of London, (1966- 1971):** A personal letter from G. Waldron to C. Campbell states that a "breeding population" of Butler's Gartersnake was found in July of 1971 near Saunders Pond, during a botanical survey in the Westminster Ponds ESA, City of London. The colony seemed to "centre on a pile of cardboard and other rubbish" at the site (G. Waldron, pers. comm. to C. Campbell, 1971). A visit by C. Campbell on April 15, 1973 (6 person-hours) yielded only *T. sirtalis* and Dekay's Brownsnake (*Storeria dekayi*). Frequent visits and surveys of the Pond Mills area, including Saunders Pond, from 2002 to 2006 revealed no *T. butleri*, only *T. sirtalis*, *S. dekayi* and *L. triangulum* (S. Gillingwater pers. comm. 2010). G. Waldron (pers. comm.

2009) admitted that he was not very experienced with herpetology at the time and that it is possible that the identification was made in error.

An additional historic record by an independent observer for the London area has been rejected. Dr. William (R.C.) Bothner's collection at the Buffalo Museum of Science (personal catalogue number 1314) contains one *T. butleri* specimen labelled "20 miles west of London, R.C. Bothner and R.C. Mills, 24 August 1966" (K. Leacock pers. comm. 2009). It was examined by F.R. Cook 21 February 1967 and substantiated as *T. butleri* (courtesy of R.C. Bothner). The location was written in error and one of the collectors indicated the specimen was taken at Skunk's Misery (R.C. Mills, pers. comm. to F.R. Cook, 22 November 1966). Also, Bothner stated that "the locality data are approximate" (R.C. Bothner, pers. comm. to F.R. Cook, 21 February 1967).

d) **Lambton County, Pinery Provincial Park (1971) :** Campbell (1971a) stated that the 1971 Lands and Forests (the predecessor of the Ontario Ministry of Natural Resources) Master Plan for Pinery Provincial Park notes the capture of a *T. butleri* there in a wet meadow and the subsequent release of captive-born young. Campbell obtained notes and colour photographs (Sept 11, 1971) of both adult and young from T. Beechey of the Nature Reserves Section of Lands and Forests and determined that all were *T. sirtalis* (Campbell 1971a). The confusion arose owing to docility, rich olive-brown dorsal colour, the orange-brown lateral stripes and appropriate habitat where the adult snake was found (C. Campbell pers. comm. 2009).

   In the early 2000s, H. Casbourn (Pers. comm. 2009) suspected that a snake labelled 'Eastern Gartersnake' in the interpretive centre of the park was a *T.butleri.* This snake was later sent to the Toronto Zoo by Pinery staff and confirmed to be *T. sirtalis*.

e) **Essex County, Point Pelee (1971):** C. Campbell and P.D. Pratt investigated an alleged *T. butleri* sighting from the base of Point Pelee. No *T. butleri* were found but the habitat looked suitable (Campbell 1971a). Point Pelee is an area heavily surveyed by herpetologists, and a *T. butleri* would have likely been spotted by now. P.D. Pratt mentioned having never come across a substantiated report of *T. butleri* from Point Pelee or the central portion of Essex County, despite taking numerous reptile sightings at the Ojibway Nature Centre. Planck and Planck (1977) also failed to discover a specimen from the central part of the county during their 1976 surveys. Furthermore, extensive searches by C. Campbell did not turn up any *T. butleri* on Pelee Island, the Ohio Islands, or any other Lake Erie Islands.

f) **Grey County, Mount Forest (2002):** A local naturalist suspected *T. butleri* inhabited his property in Mount Forest, north of Luther Marsh. A photo of his specimen was erroneously labelled 'Butler's Gartersnake' in the ROM Field Guide to Reptiles and Amphibians (p. 135M, MacCulloch 2002). Cook (pers. comm. 2009) made note of this in a 2002 unpublished review of the field guide, and others with *T. butleri* experience took a similar view (R. Jones and T. Preney, pers. comm. 2009). Additional photos of the specimen viewed by J. Choquette and D. Noble in 2009 were identified as *T. sirtalis.* The confusion seemed to exist with the position of the lateral stripes near the head.

g) **Essex County, Bois Blanc Island (2009):** *Thamnophis butleri* are speculated to exist on Bois Blanc Island in the Detroit River based primarily on its close proximity to Location 3 (C. Campbell and P.D. Pratt pers. comm. 2009) and other American islands inhabited by *T. butleri*. During three intensive field surveys spanning the late 1990s to late 2000s, only Eastern Gartersnakes (*T. sirtalis*) and Northern Watersnakes (*Nerodia sipedon*) have been seen (G. Waldron and D. Martin pers. comm. 2009). An hour search by J. Choquette and D. Noble in 2009 revealed only *T. sirtalis* and *N. sipedon.*

APPENDIX 3. Estimation of the percent global range occupied by the Canadian distribution of *T. butleri* using two Canadian range estimates (EO and IAO) and two global range estimates (NatureServe 2009).

	Canadian Range (km^2)	
Global Range (km^2)	**Min (IAO)- 360**	**Max (EO)- 10, 248**
Min- 20,000	1.82%	55.99%
Max- 200,000	0.18%	5.60%
Average (2 way)	1.00%	30.80%
Average (4 way)	All pairwise combinations divided by 4 [(1.82+0.18+55.99+5.60)/4]	15.90%

APPENDIX 4. Information on Amos Butler for whom Butler's Gartersnake was named.

Butler, Amos William (1860-1937) *Thamnophis butleri* (Cope, 1889)

- 1860 Born in Brookville, IN, October 1.
- 1881 One of the founders of the Brookville Society of Natural History.
- 1891 Author of "Birds of Indiana," revised 1898.
- 1894 AB, IN U.
- 1896-1897 Ornithologist, Department of Geology and Resources of IN.
- 1897-1923 Secretary of IN Board State Charities.
- 1900 AM, IN U.
- 1905 Lecturer on economics, Purdue U.
- LLD, Hanover College.
- 1922 LLD, IN U.
- 1930 Founder International Commission on Mental Hygiene.
- A founder of American Anthropology Society and American Association of Mammalogists, IN Audubon Society, and the Academy of Sciences of IN.

APPENDIX 5. Maps of Butler's Gartersnake localities in southwestern Ontario, Windsor and Sarnia that have been lost to development, have produced no records in 2009 searches or have not been recently surveyed.

This appendix contains specific location information that may be requested by contacting the COSEWIC Secretariat.