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Ontario Species at Risk Evaluation Report for Eastern Foxsnake Couleuvre Fauve de L'Est (*Pantherophis vulpinus*)

Carolinian Population

Committee on the Status of Species at Risk in Ontario (COSSARO)

Assessed by COSSARO as Threatened

March 2022

Final

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Executive summary

Eastern Foxsnake (*Pantherophis vulpinus*) is a ratsnake and one of the largest snakes in Ontario. Adults Foxsnakes are yellowish in colour with dark blotches along their length with alternating smaller dark blotches along their sides. In Ontario, Eastern Foxsnakes occurs as two distinct populations: the Carolinian population in southwestern Ontario and the Great Lakes/St. Lawrence population along the eastern shoreline of Georgian Bay.

Eastern Foxsnakes spend most of the active season in open habitats, including wetlands and rocky shorelines. This species requires suitable hibernation sites and egg-laying sites, many of which are used by multiple of snakes year-after-year. The Carolinian population includes about 4,150–7,230 mature individuals.

Human-caused threats are contributing to a continuing decline in abundance of this species include large-scale habitat loss as a result of historical and ongoing conversion of wetlands and other natural areas to urban and agricultural uses. Road mortality is considered to be the predominant threat to the Eastern Foxsnakes in the Carolinian region, followed by climate change, and natural system modifications.

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1. Eligibility for Ontario status assessment

1.1. Eligibility conditions

1.1.1. Taxonomic distinctness

Eastern Foxsnake (*Pantherophis vulpinus*: Baird and Girard 1853) is classified as a North American ratsnake (Family = Colubridae, Order = Squamata, Class = Reptilia). Other English names that are sometimes used locally for this snake include: hardwood rattler, marsh whomper, and copperhead. The scientific name *vulpina* (= fox) is presumed to have been derived from the type specimen's collector, Rev. Charles Fox (Conant 1940; Rivard 1979; Cook pers. comm. 1998).

The scientific name of Eastern Foxsnake (genus and species) has changed since the previous status report (detailed account provided by Crother *et al.* 2011). COSSARO previously assessed Eastern Foxsnake as *Elaphe gloydi*. The generic name *Elaphe* is no longer applied to New World ratsnakes (Utiger *et al.* 2002; Crother 2017), which are now represented by the genus *Pantherophis* (Crother *et al.* 2011). Eastern Foxsnake was therefore recognized as *P. gloydi* until Crother *et al.* (2011) re-evaluated Foxsnake taxonomy using mitochondrial DNA (mtDNA) analysis. The current accepted scientific name for Eastern Foxsnake is *P. vulpinus* (Crother 2017), with *gloydi* now considered a junior synonym of *vulpinus* (Crother *et al.* 2011).

1.1.2. Designatable units

Two designatable units (DU) were identified in 2008 based on discreteness and evolutionary significance: Carolinian population and Great Lakes / St. Lawrence (GLSL) population. COSEWIC re-evaluated these DUs were re-evaluated with a specific focus on whether or not snakes inhabiting the Norfolk County area (part of the Carolinian DU – but geographically isolated) should be recognized as a separate DU (COSEWIC 2021). Although there is some evidence for the discreteness of snakes from the Norfolk County area from a genetic and physical fragmentation perspective, it is not considered evolutionarily significant, and for the purposes of this report, they are considered to be part of the Carolinian DU.

There is a clear natural disjunction separating Foxsnakes in the Georgian Bay region from those in the Carolinian region (~250–300 km). A disjunction also exists within the Carolinian region, between those in the Norfolk County area and other Carolinian region Foxsnakes (separation distance of 120 km). Genetic analyses (Row *et al.* 2011) and historical assessment of habitat distribution suggest these disjunctions predate European settlement. Although genetic analysis found little genetic differentiation in the Georgian Bay region, some differentiation was found between snakes in the Norfolk County area and snakes from elsewhere in the Carolinian region (Row *et al.* 2011).

1.1.3. Native status

Eastern Foxsnakes are native to Ontario.

1.1.4. Occurrence

The global range of Eastern Foxsnake is limited to the Great Lakes region of North America east of the Mississippi River (Figure 1). It is found mainly in Ontario and the states of Illinois, Indiana, Michigan, Missouri, Ohio, and Wisconsin (Crother *et al.* 2011; NatureServe 2021).

In Ontario, Eastern Foxsnakes are occur in two discrete areas of the province, Carolinian and Eastern Georgian Bay regions (Figure 2). This species therefore spans two Amphibian and Reptile faunal provinces (Carolinian and Great Lakes / St. Lawrence). In the Carolinian region, Foxsnakes are found in Essex, Chatham-Kent, and Lambton counties, and in the Norfolk County area (Port Burwell to Port Maitland, including Long Point).

1.2. Eligibility results

Eastern Foxsnake (*Pantherophis vulpinus*) is eligible for status assessment in Ontario.

2. Background information

2.1. Current designations

- GRANK: G5 (NatureServe 2022)
- IUCN: Least Concern (April 18, 2016)
- NRANK Canada: N3
- COSEWIC: Threatened (December 2021)
- SARA: Endangered (Schedule 1)
- ESA 2007: Endangered (month and year of last assessment)
- SRANK: S3

2.2. Distribution in Ontariofigu

The Ontario range of Eastern Foxsnake is limited to southwestern and central Ontario and spans two Amphibian and Reptile faunal provinces (Carolinian and Great Lakes / St. Lawrence) (Figure 2). Foxsnakes occur in two discrete areas of Ontario, Carolinian and Georgian Bay regions. In the Carolinian region, Foxsnakes are found in Essex, Chatham-Kent, and Lambton counties, and in the Norfolk County area (Port Burwell to Port Maitland, including Long Point).

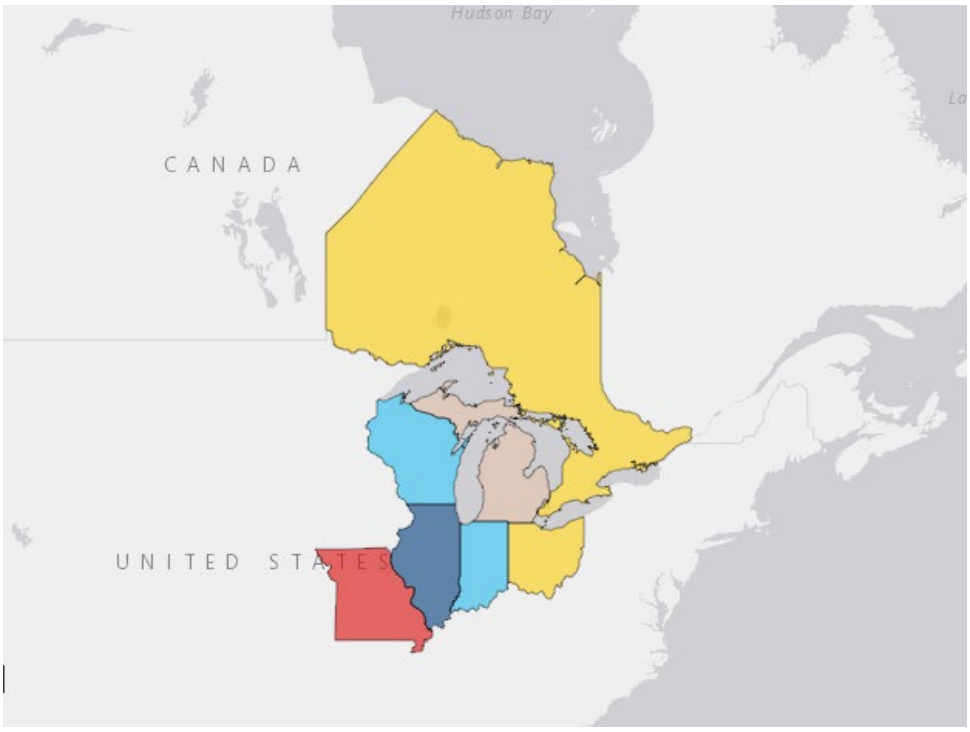

Figure 1. Eastern Foxsnake global range (NatureServe Explorer 2022).

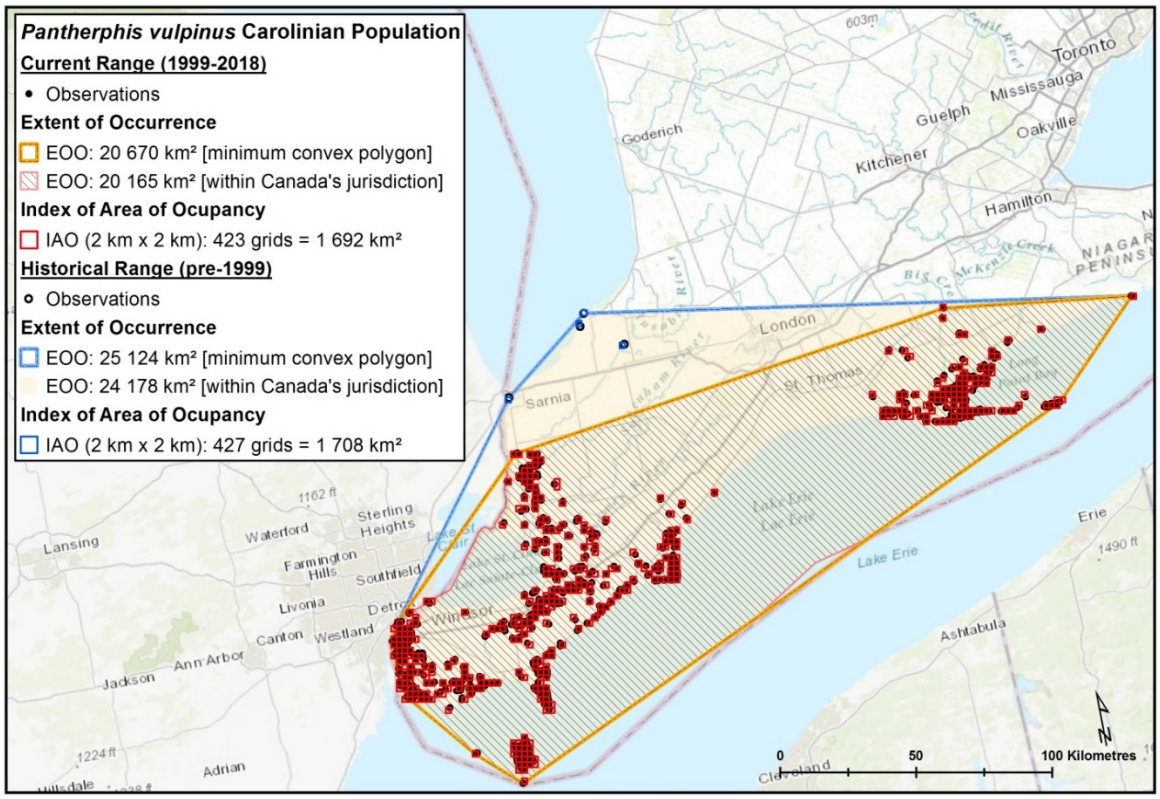

Figure 2. Eastern Foxsnake range in the Carolinian DU based on current (1999-2018) and historical (pre-1999) observation records as provided in COSEWIC (2021).

2.3. Distribution, status and the broader biologically relevant geographic range outside Ontario

Eastern Foxsnakes range from the Great Lakes region to the Mississippi River. In Canada, this species is only found in the province of Ontario. In the United States, Eastern Foxsnakes are found in Illinois, Indiana, Michigan, Missouri, Ohio, and Wisconsin. The entire range for this species is separated into two disjoint regions. The first region is loosely defined as the northern Wisconsin and the Upper Peninsula of Michigan southward to east-central Missouri, southern Illinois, and central Indiana (Vogt 1981, Powell 1990, Oldfield and Moriarty 1994, Harding 1997, Minton 2001). The second region includes the Great Lakes basin in southern Ontario (including Georgian Bay), the southeastern part of the lower peninsula of Michigan, and northern Ohio. This second region includes the northern Lake Erie shoreline to Long Point Bay (Ontario), Pelee Island and several other small Lake Erie Islands, and the southern Lake Erie shoreline in Erie County, Ohio (Powell 1990; Harding 1997).

Table 1. Condition of the Species in Adjacent Jurisdictions and Broader Biologically Relevant Geographic Range

Adjacent Jurisdictions	Biologically Relevant to Ontario (n/a, yes, no)	Condition	Notes & Sources
Quebec			
Manitoba			
Michigan	Yes	SNR	NatureServe 2022
Minnesota			
Nunavut			
New York			
Ohio	Yes	S3	NatureServe 2022
Pennsylvania			
Wisconsin	No	S4S5	NatureServe 2022
Other Relevant Jurisdiction			

2.4. Ontario conservation responsibility

Approximately 70% of the range for Eastern Foxsnakes is found within Ontario (COSEWIC 2008) indicating that the conservation responsibility for this species is high.

2.5. Direct threats

As is the case with many species at risk, the ecological life history traits of Eastern Foxsnake increase the threats to the species. These traits include seasonal migrations that expose the snakes to road mortality and other threats and their propensity to concentrate in larger numbers during specific times of year.

Hibernation

Eastern Foxsnakes hibernate communally resulting in seasonal concentrations of individuals during spring and fall. When concentrated at hibernation sites, Eastern Foxsnakes are vulnerable to natural disturbance and stochastic events (i.e., flooding, collapse, temperature extremes, and predation), which can result in mortality and on occasion loss of individuals (Shine and Mason 2004). Additionally, alteration to the structure of hibernation sites can result in catastrophic loss of individuals. Collapse of access locations resulted in the trapping of hibernating Eastern Foxsnake in limestone substrates on Pelee Island (Porchuk 1996). Unpredictable mortality events due to environmental stochasticity are an important limitation threatening already small and isolated local populations with extirpation, especially during times when individuals of the species are concentrated.

Road Mortality

Road mortality is one of the most conspicuous and commonly reported sources of Foxsnake mortality in Canada. Foxsnakes will readily cross or bask near roads (Rivard 1976), placing them at risk. Outside of settled areas, road mortality and the isolating effect of roads (including genetic fragmentation) have been best documented on county roads and provincial highways (Row *et al*. 2010). Many protected areas still have high road densities and/or traffic volumes within or adjacent to their boundaries (Crowley 2006; Farmer and Brooks 2012; Choquette and Valliant 2016). While recent development of large-scale infrastructure projects have occurred in Foxsnake habitat, (e.g., The Herb Gray Parkway in Windsor), comprehensive mitigation and offsetting strategies are becoming standard for these types of projects in Ontario (e.g., wildlife crossings, barrier fencing, habitat acquisition and enhancement; see Baxter-Gilbert *et al.* 2015 and OMECP 2016). The largest future impact from roads on this species will most likely be driven by road mortality on existing and improved roads, rather than from habitat loss due to construction of new roads. This is due to the extensive existing road network that overlaps the Foxsnake Carolinian range.

Habitat Loss

The expansion and intensification of agriculture has resulted in permanent loss and degradation of Foxsnake habitat and isolation of habitat patches, including the removal of hedgerows and riparian habitat. The types of agriculture involved are generally intensive crops like corn and soybean, and development of greenhouses, which provide little to no habitat. Although hay fields may provide relatively more suitable habitat based on vegetation cover, these crops are frequently harvested (2–3 times per season), exposing snakes to increased risk of mortality.

Land use changes represent a threat to Foxsnakes. Intensive agricultural landscapes and high-traffic roads create dispersal barriers between suitable habitat patches and contribute to population fragmentation and mortality of individuals. Dileo *et al.* (2010) found that five genetic clusters of Foxsnakes in the Carolinian region corresponded generally with patches of suitable marshland and prairie habitat isolated by intensive agriculture. Row *et al.* (2010) used a combination of habitat suitability modelling and population genetic analysis to determine that boundary regions between most of the

genetic clusters of Foxsnakes in the Carolinian region were dominated by low suitability habitat. These studies suggest that habitat degradation results in limitations on dispersal of Eastern Foxsnakes, which in turn has resulted in a genetically fragmented population in the Carolinian region. Results by Dileo *et al.* (2010) and Row *et al.* (2010) are further substantiated by movement behaviour observed by Row *et al.* (2012) who found that radio-tracked Foxsnakes at two sites in the Carolinian region spent most of their active season in marshes and natural meadows and avoided agricultural fields.

The expansion of human settlements results in permanent loss and fragmentation of Foxsnake habitat, and the death of individuals during construction and operation. Human settlements may also act as population sinks due to the combined effects of many associated threats (Lawson 2004). In the Carolinian region, the Windsor Census Metropolitan Area (CMA) is the fourth fastest growing community in Canada (Statistics Canada 2019b), resulting in the destruction of natural areas for housing development (Town of LaSalle 2003). However, within the range of the Carolinian DU, most development has already taken place, and little additional habitat loss is expected over the next 10 years. From 2008 to 2015, 91% of the 23 ‘agreements’ and ‘overall benefit permits’ issued under the Ontario *ESA Act* to mitigate and offset development activities impacting Eastern Foxsnake or their habitats were in the Carolinian region (OMECP 2016).

Additionally, Foxsnakes are threatened by wild and prescribed fires, maintenance of drains/swales and berms, and control of invasive European Common Reed. Wild and prescribed fires can result in direct mortality, sometimes of multiple individuals in a short time period. In 2000, at Rondeau Provincial Park, 18 adult Eastern Foxsnakes were found killed by an unplanned spring fire in the south end of the park (Gillingwater 2001). Even when fires are prescribed and well planned, snakes can be killed (Russell *et al.*1999; Cross *et al.* 2015). In southern Ontario, the threat of wildfire is thought to be limited to protected areas and areas that are managed for grasslands or savannah using prescribed burns.

The maintenance of drains/swales and berms may cause Foxsnake mortality and destruction of hibernation sites. Drain maintenance includes roadside swales and municipal drains and occurs during active and hibernation seasons. Impacts are presumed greatest during the hibernation season, but vegetation removal could cause mortality/injury in the active season. This threat is concentrated within and across the Carolinian DU where there is a predominance of managed wetlands and municipal drains and roadside swales.

Foxsnakes and their habitat may be impacted by the invasive European Common Reed, in addition to the intensive methods used to control large stands of the plant. This plant is incredibly widespread across the Carolinian region, particularly across the north shore of Lake Erie, and is present at many, if not most, wetland sites occupied by Foxsnakes (COSEWIC 2021). Large monocultures of the plant do not appear to degrade Foxsnake habitat. Results from a radio-telemetry study at Rondeau Provincial Park from 2013-2018 suggest that Foxsnakes do not avoid European Common Reed stands and are able to move through and use even dense stands (COSEWIC 2021). Rather, negative

impacts are presumed to be from control efforts during the active season (rolling, cutting, burning), potentially resulting in injury or death of snakes, followed by a short-term reduction in natural cover resulting in greater exposure to predators (COSWEIC 2021). Protected areas are heavily impacted by European Common Reed, and many parks are planning future removals including Point Pelee National Park (Government of Canada 2022).

Persecution
Foxsnakes are deliberately killed out of dislike or fear of snakes, their large size, and as they are sometimes mistaken for venomous species (e.g., Eastern Massasauga, Eastern Copperhead [*Agkistrodon contortix*]) due to their size, the markings and coloration of their head, the bold markings on their body, and habit of vibrating their tail in dry vegetation when alarmed (Rivard 1976). Human encounters with foxsnakes are common because much of the species' Canadian range occurs within a heavily populated area, and because the snakes inhabit sites that experience high levels of human use. Foxsnakes are adept at using human-made features and often are found in boat houses, sheds, basements, campsites, and on roads, placing them at an elevated risk of intentional killing (Rivard 1976; COSEWIC 2021).

Eastern Foxsnakes are also sometimes collected as pets. Although Foxsnakes do well in captivity, few captive-bred individuals are available (Staszko and Walls 1994), creating a demand for wild snakes. The collection of wild Foxsnakes as pets was identified by Rivard (1976) and has been more recently documented at the Ojibway Prairie Complex and at Long Point (COSEWIC 2021).

2.6. Specialized life history or habitat use characteristics

In general, Foxsnakes enter hibernation in September and October, emerge in mid-April to mid-May, and breed from late May to mid-June. Foxsnakes become reproductively active, and are therefore considered mature, at snout-vent lengths of 93–100 cm (Lawson 2005), and after four to five years of age (Willson 2000; ECCC 2020). Mature snakes typically account for ~46% of individuals in a subpopulation (range of 29–67%), based on average capture rates from studies completed in Ontario. Longevity is estimated at 12–15 years in the wild (ECCC 2020). Most of the adult females in an area are gravid annually (Mackinnon 2005).

In Ontario, females lay eggs from early to mid-July (Willson 2000; Brooks *et al*. 2003), after 30–50 days of gestation (Willson and Brooks 2006). Females lay 6–29 eggs per clutch (Willson 2000) and will only spend 1–4 days at their oviposition site before leaving the eggs to incubate on their own (COSEWIC 2008; MacKinnon pers. comm. 2008). Eggs require 50 to 65 days to incubate (Harding 1997). In the Carolinian region, hatchlings emerge from late August to mid-September (Willson 2000). Hatchlings may remain at the oviposition site for up to a week before dispersing. Females are highly selective of oviposition sites and will make long-distance movements to and from these sites each year (Watson 1994; Row *et al*. 2012).

The use of anthropogenic structures suggests that Eastern Foxsnakes are able to tolerate some level of human disturbance. They have also been observed using hibernation and egg-laying sites artificially created for research or conservation purposes (e.g., Willson 2000; Smith 2019) and have used hibernacula created out of the basements of demolished homes in Windsor (OMECP 2016).

Each year individual Eastern Foxsnakes make long-distance movements to and from hibernation sites (Row *et al.* 2012), which are typically located outside of the active season portion of their home range (Watson 1994). During the active season, females in the Carolinian region have been detected a mean maximum distance of 930 m (± 81 SE, n = 5: R. Willson unpubl. data cited in COSEWIC 2008) to ~ 2,000 m (Row *et al.* 2012) from hibernacula.

Eastern Foxsnakes are proficient swimmers and will take to the water and swim long distances across bays and between islands. Swimming can create links across large expanses of open water. Analysis by Row *et al.* (2010) suggests that open water separating the Lake Erie Islands (~4–9 km) presents less of a dispersal barrier for Eastern Foxsnakes in the Carolinian region than does unsuitable terrestrial habitat.

2.7. Existing Conservation and Recovery Actions

A recovery strategy for Eastern Foxsnake in Ontario was published in 2010, followed by a government response statement in 2011, and a specific habitat regulation for each DU in 2012 (EFRT 2010; OMECP 2016).

A recovery strategy for Eastern Foxsnake in Canada was published in 2020, wherein designated critical habitat is described (ECCC 2020). Within the Carolinian DU, protected areas represent less than 1% of this species occupied range.

Through the Species at Risk Stewardship Fund, province of Ontario has supported stewardship partners to conduct 66 projects ($2,799,291) focused on the Carolinian population of Eastern Foxsnake. As part of these projects, 4,596 hectares of habitat were enhanced for Eastern Foxsnake. Additionally, two projects focused on evaluating road mitigation for reptiles, including Eastern Foxsnakes, have been completed.

Extensive research on Eastern Foxsnakes has been completed in Ontario, including surveys in Rondeau Provincial Park from 2013–2019, the Ojibway Prairie Complex and associated Herb-Gray Parkway from 2011–2018. Historically, research on Pelee Island (Porchuck and Brooks 1995, Willson 2000, Willson and Brooks 2006), at Point Pelee National Park, and Rondeau Provincial Park (COSEWIC 2021). Research efforts include considerable work pertaining to genetic population structure (Row et al. 2008, Row et al. 2010), and fragmentation (Row et al. 2007)

3. Ontario status assessment

3.1. Application of endangered/threatened status in Ontario

3.1.1. Criterion A – Decline in total number of mature individuals

Meets Threatened, A2cd +3cd+4cd. Suspected >30% decline in number of mature individuals over the past three and next three generations (22.5 years) and including a period spanning both past and future, based on c) a decline in extent of occurrence and quality of habitat, and d) actual and potential levels of exploitation (roadkill and intentional killing).

3.1.2. Criterion B – Small distribution range and decline or fluctuation

Not applicable. IAO of 1,692 km^2 is below the threshold for Threatened, but population is not severely fragmented, occurs at >10 locations, and does not experience extreme fluctuations.

3.1.3. Criterion C – Small and declining number of mature individuals

Not applicable. Number of mature individuals (4,147–7,232) is below the threshold for Threatened and there is a continuing decline in the number of mature individuals, but at least one subpopulation has more than 1000 mature individuals, no subpopulation has more than 95% of mature individuals, and there are no extreme fluctuations in number of mature individuals.

3.1.4. Criterion D – Very small or restricted total population

Not applicable. The population is not very small or restricted.

3.1.5. Criterion E – Quantitative analysis

Not applicable. No analysis completed.

3.2. Application of Special Concern in Ontario

Not applicable as species meets criteria for Threatened under criterion A.

3.3. Status category modifiers

3.3.1. Ontario's conservation responsibility

Approximately 70% of the range for Eastern Foxsnakes is found within Ontario (COSEWIC 2008).

3.3.2. Status modification based on level of risk in broader biologically relevant geographic range

As outlined above in Section 2.3, Eastern Foxsnakes are found in two disjoint regions. Portions of the species' global range that extends into northern Wisconsin and the Upper Peninsula of Michigan southward to east-central Missouri, southern Illinois, and

central Indiana are located far enough from the Ontario populations that they should not be considered part of the broader biologically relevant range. The portion of the Foxsnake range that includes the Great Lakes Basin, the Lake Erie Shoreline and the lower peninsula of Michigan best represent the broader biologically relevant range for this species.

In Michigan Eastern Foxsnakes have not been assessed (i.e., SNR) while in Ohio they are listed as Vulnerable (S3). While Michigan has not assessed Foxsnakes, individuals located immediately adjacent in Michigan are likely to be facing similar threats to those in Ontario. Given that approximately 70% of the global range of Eastern Foxsnakes is found in Ontario, indicating a high conservation responsibility for this species, no modification based on the level of risk in the broader biologically relevant range has been applied to this assessment.

3.3.3. Rescue Effect

Eastern Foxsnakes on the Canadian Lake Erie islands are within dispersal distance of Foxsnakes on U.S. islands. Foxsnakes may also be able to cross from the U.S. to Ontario at the Detroit River and the north end of Lake St. Clair (to Walpole Island). Eastern Foxsnakes show the capacity to disperse long distances over water (see; however, potential rescue from the U.S. would be limited to the isolated genetic clusters directly adjacent to the U.S. border, given the fragmented nature of the Carolinian population.

3.4. Other status categories

3.4.1. Data deficient

Not applicable.

3.4.2. Extinct or extirpated

Not applicable.

3.4.3. Not at risk

Not applicable as species meets criteria for Threatened under Criterion A.

4. Summary of Ontario status

Eastern Foxsnake (*Pantherophis vulpinus*, Carolinean DU) is classified as Threatened in Ontario based on meeting criterion A2cd +3cd+4cd.

This status of this species is consistent with the definition of Threatened under the Endangered Species Act, 2007.

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Appendix 1: Technical summary for Ontario

Species: Eastern Foxsnake (*Pantherophis vulpinus*) - Carolinian Population

Demographic information

Demographic attribute	Value
Generation time. Based on average age of breeding adult: age at first breeding = X year; average life span = Y years.	7.5 years
Is there an observed, inferred, or projected continuing decline in number of mature individuals?	Yes, inferred and projected decline.
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.	Suspected >30% reduction primarily from road mortality based on population viability modelling on similar species and high road density across the range.
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years or 3 generations.	Suspected >30% reduction primarily from road mortality based on population viability modelling on similar species and high road density across the range.
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over any 10 years, or 3 generations, over a time period including both the past and the future.	Suspected >30% reduction based on continuing range-wide road mortality.
Are the causes of the decline (a) clearly reversible, and (b) understood, and (c) ceased?	a. No b. Yes c. No
Are there extreme fluctuations in number of mature individuals?	No

Extent and occupancy information in Ontario

Extent and occupancy attributes	Value
Estimated extent of occurrence (EOO). *If value in COSEWIC status report is not applicable, then use geocat.kew.org. State source of estimate.*	20,165 km^2

Extent and occupancy attributes	Value
Based on minimum convex polygon (MCP) within Ontario using records from 1999-2018.	
Index of area of occupancy (IAO). *If value in COSEWIC status report is not applicable, then use geocat.kew.org. State source of estimate.* *AOI is based on records from 1999-2018 (current)*	1,692 km^2
Is the total population severely fragmented? i.e., is >50% of its total area of occupancy is in habitat patches that are: (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	a. No b. No
Number of locations. *See Definitions and Abbreviations on COSEWIC and IUCN websites for more information on the term "location". Use plausible range to reflect uncertainty if appropriate.*	Unknown but considered to be considerably more than 10 based on road mortality data.
Number of NHIC Element Occurrences *Request data from MNRF.*	37
Is there an observed, inferred, or projected continuing decline in extent of occurrence?	Yes, inferred and projected decline based on climate change vulnerability analysis
Is there an observed, inferred, or projected continuing decline in index of area of occupancy?	Possibly, projected decline based on climate change vulnerability analysis
Is there an observed, inferred, or projected continuing decline in number of sub-populations or EOs?	Yes, inferred decline of at least two subpopulations
Is there an observed, inferred, or projected continuing decline in number of locations?	Unknown
Is there an observed, inferred, or projected continuing decline in [area, extent and/or quality] of habitat?	Yes, observed, inferred, and projected decline in area, extent, and quality of habitat due to ongoing threats.
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 sub-population or total

population (if known)

Sub-population (or total population)	Number of mature individuals
Insert additional rows as necessary. If total population, do not use table format.	Estimated to be 5,696 (4,147–7,232, 95% confidence interval)

Quantitative analysis (population viability analysis conducted)

Probability of extinction in the wild is unknown.

Threats

Based on the results of the threats calculator completed by COSEWIC on May 26, 2020 the overall threat impact for this species is “High”. The following were identified as the primary threats.

- Transportation & Service Corridors (medium)
- Climate Change & Severe Storms (medium – low)
- Natural System Modifications (medium – low)
- Biological Resource Use (low)
- Pollution (low)
- Agriculture and Aquaculture (low)

Additional limiting factors identified by the threats calculator include:

- Large congregations at hibernation sites that place snakes at risk of natural catastrophes and anthropogenic disturbance
- Long seasonal migrations that place snakes at risk of road mortality

Rescue effect

Rescue effect attribute	Value
Does the broader biologically relevant geographic range for this species extend beyond Ontario?	Yes
Status of outside population(s) most likely to provide immigrants to Ontario	Unranked (Michigan) Vulnerable (Ohio)
Is immigration of individuals and/or propagules between Ontario and outside populations known or possible?	Yes, but it is limited to isolated genetic clusters directly adjacent to the Canadian/USA boarder
Would immigrants be adapted to survive in Ontario?	Yes

Rescue effect attribute	Value
Does the broader biologically relevant geographic range for this species extend beyond Ontario?	Yes
Is there sufficient suitable habitat for immigrants in Ontario?	Unlikely, especially in Essex and Lambton counties due to the extent of development.
Are conditions deteriorating in Ontario?	Yes
Is the species of conservation concern in bordering jurisdictions?	Yes
Is the Ontario population considered to be a sink?	No
Is rescue from outside populations likely?	No; however, this may be possible for subpopulations present along the Canada/USA border.

Sensitive species

Yes, species is considered a “restricted species” by the Ontario Natural Heritage Information Centre (NHIC).

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Acronyms

COSEWIC: Committee on the Status of Endangered Wildlife in Canada
COSSARO: Committee on the Status of Species at Risk in Ontario
ESA: Endangered Species Act
EO: Element occurrence (as defined by NHIC)
EOO: extent of occurrence
GRANK: global conservation status assessments
IAO: index of area of occupancy
IUCN: International Union for Conservation of Nature and Natural Resources
MNRF: Ministry of Natural Resources and Forestry
NHIC: Natural Heritage Information Centre
NNR: Unranked
NRANK: National conservation status assessment
SARA: Species at Risk Act
SNR: unranked
SRANK: subnational conservation status assessment
S1: Critically Imperiled
S2: Imperiled
S3: Vulnerable
S4: Apparently Secure
S5: Secure
IUCN: International Union for Conservation of Nature and Natural Resources
CDSEPO: Le Comité de détermination du statut des espèces en péril en Ontario