

Recovery Strategy for the Eastern Hog-nosed Snake *Heterodon platirhinos* in Canada

Eastern Hog-nosed Snake



December 2008



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About the *Species at Risk Act* Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is “to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity.”

What is recovery?

In the context of species at risk conservation, recovery is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed and threats are removed or reduced to improve the likelihood of the species’ persistence in the wild. A species will be considered recovered when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (http://www.sararegistry.gc.ca/the_act/default_e.cfm) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What’s next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the Species at Risk Act and recovery initiatives, please consult the SARA Public Registry (<http://www.sararegistry.gc.ca/>) and the Web site of the Recovery Secretariat (<http://www.speciesatrisk.gc.ca/recovery/>).

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You can download additional copies from the SARA Public Registry
(<http://www.sararegistry.gc.ca/>)

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ISBN to come

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DECLARATION

Under the *Accord for the Protection of Species at Risk* (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada. The *Species at Risk Act* (S.C. 2002, c.29) (SARA) requires that federal competent ministers prepare recovery strategies for listed Extirpated, Endangered and Threatened species.

The Minister of the Environment presents this document as the recovery strategy for the Eastern Hog-nosed Snake as required under SARA. It has been prepared in cooperation with the jurisdictions responsible for the species, as described in the Preface. The Minister invites other jurisdictions and organizations that may be involved in recovering the species to use this recovery strategy as advice to guide their actions.

The goals, objectives and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

This recovery strategy will be the basis for one or more action plans that will provide further details regarding measures to be taken to support protection and recovery of the species. Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the actions identified in this strategy. In the spirit of the *Accord for the Protection of Species at Risk*, all Canadians are invited to join in supporting and implementing this strategy for the benefit of the species and of Canadian society as a whole. The Minister of the Environment will report on progress within five years.

AUTHOR

This recovery strategy was developed by David Seburn, ecological consultant, with the assistance of the Eastern Foxsnake/Eastern Hog-nosed Snake Recovery Team.

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with assistance from Angela McConnell, and subsequently by co-chairs Gary Allen and Angela McConnell.

STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENT

A strategic environmental assessment (SEA) is conducted on all *Species at Risk Act* recovery strategies, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals* (2004). The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. Environmental effects, including impacts to non-target species and the environment, were considered during recovery planning. The SEA is incorporated directly into the strategy and also summarized below.

This Recovery Strategy will clearly benefit the environment by promoting the recovery of the Eastern Hog-nosed Snake. Education initiatives will benefit Eastern Hog-nosed Snake, in addition to other reptiles, including other Species at Risk (e.g. Eastern Foxsnake, Milksnake). The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and other species through conservation, management, stewardship and research, and will not entail any significant adverse effects. Refer to the following sections of the document in particular: description of the species' needs – Ecological Role, Habitat and biological needs, and Limiting factors (Section 1.4.3); broad strategies to be taken to address threats (Section 2.4.1, Table 2); and Effects on Other Species (Section 2.8).

RESIDENCE

SARA defines residence as: “*a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating*” [SARA S2(1)].

Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SARA public registry: http://www.sararegistry.gc.ca/plans/residence_e.cfm

PREFACE

This Recovery Strategy addresses the recovery of Eastern Hog-nosed Snake. In Canada, the range of this species is limited to the province of Ontario.

The Ontario Ministry of Natural Resources, Parks Canada Agency and the Canadian Wildlife Service worked in cooperation to develop this Recovery Strategy. All responsible jurisdictions reviewed and acknowledged receipt of the strategy. The proposed strategy meets SARA requirements in terms of content and process (Sections 39-41).

EXECUTIVE SUMMARY

The Eastern Hog-nosed Snake (*Heterodon platirhinos*) was designated Threatened in Canada in 2001 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). It is widespread across much of eastern North America, but in Canada, it is limited to two areas of Ontario: the Carolinian Life Zone of southwestern Ontario, and central Ontario south of the French River and Lake Nipissing. Although the current distribution of the Eastern Hog-nosed Snake in Ontario is not completely known, it is clear that this species has declined in range. The Eastern Hog-nosed Snake has been extirpated from the Regional Municipalities of Halton, Peel, and York and possibly from Bruce, and Prince Edward counties. It has also been extirpated from Point Pelee National Park and Pelee Island. Threats faced by the Eastern Hog-nosed Snake include: habitat loss, degradation and fragmentation, roads, persecution, collecting and contaminants.

The goal of this recovery strategy is the long-term persistence of key Eastern Hog-nosed Snake populations throughout the range of the species in Canada. The objectives of recovery activities during the next few years will focus on the following five areas:

- 1) Inventory and Monitoring to increase our knowledge of the current range and distribution of Eastern Hog-nosed Snakes,
- 2) Research focusing on habitat use and demographics,
- 3) Conservation and Management, including habitat protection and acquisition,
- 4) Defining and protecting critical habitat, and
- 5) Communication and Stewardship through the development of a communication strategy to address persecution and collection, and stewardship guidelines to promote best management practices and land-use guidelines.

Specific steps within each of these areas are outlined.

Critical habitat has not yet been defined for the Eastern Hog-nosed Snake. However, a research project investigating ways of identifying critical habitat based on pre-existing field data has already begun. This on-going work will be refined until critical habitat is formally identified for each of the key populations. A Schedule of Studies has also been identified to aid in the identification of critical habitat.

One or more action plans or similar planning documents will be developed to elaborate on the approaches recommended in the strategy. Recommendations for Eastern Hog-nosed Snake also may be incorporated into multi-species or ecosystem-based action plans where this is expected to be the most effective and efficient approach for implementation (e.g. habitat protection and landscape restoration). An action plan or similar planning document for Eastern Hog-nosed Snake recovery will be completed by December 2013.

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1. BACKGROUND

1.1 Species Assessment Information from COSEWIC

Common Name:	Eastern Hog-nosed Snake
Scientific Name:	<i>Heterodon platirhinos</i>
Assessment Summary:	2001
Status:	Threatened
Reason for Designation:	The Eastern Hog-nosed Snake is rare and decreasing in abundance and area of occurrence. It suffers from loss of habitat and is unusually susceptible to persecution by people because it is a large snake that employs a threatening, though harmless, defensive display. Also, it is unusually vulnerable to road traffic because it moves slowly.
Occurrence:	Southern Ontario
Status History:	Designated as Special Concern in 1997, then reassessed as Threatened in 2001.

1.2 Description

The Eastern Hog-nosed Snake is a heavy-bodied snake with a distinctive upturned scale on its snout. It is typically 50-85 cm in total length. Colour and pattern are highly variable. Some individuals have a distinct pattern of dark blotches along the back alternating with blotches along the sides. Other individuals lack blotches and are gray, brown or olive, or rarely black (melanistic). Some Eastern Hog-nosed Snakes are intermediate in pattern with faint blotches (Figure 1).



Figure 1: Photo of Eastern Hog-nosed Snake

Photo by Jeremy Rouse

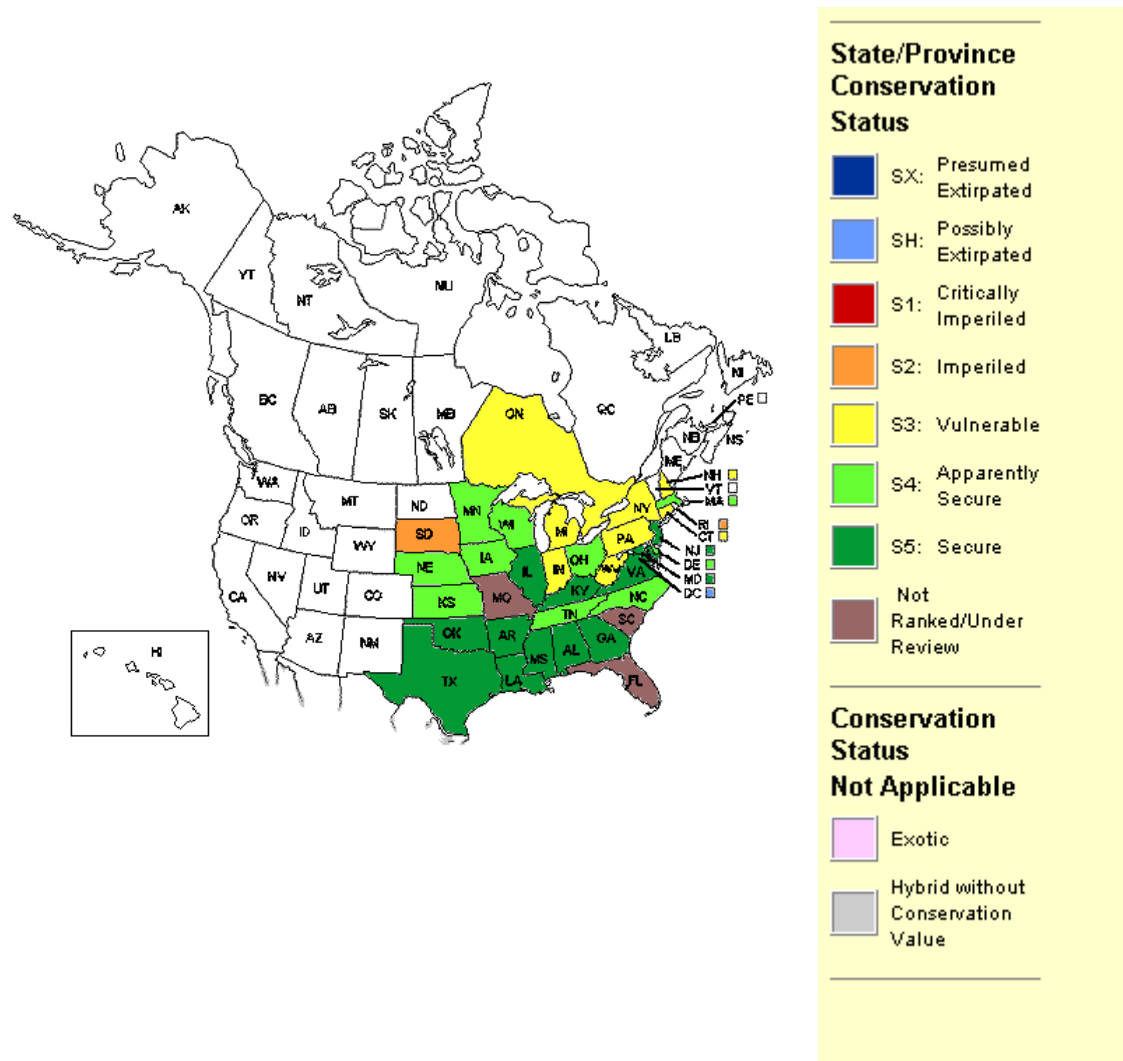
The Eastern Hog-nosed Snake has an elaborate defensive display. When threatened, it will raise its head, flatten its neck in cobra-like fashion, gape its mouth and hiss loudly. It will strike forward at the perceived attacker with its mouth closed, but it rarely bites. It is not venomous. If the defensive behaviour does not drive off the attacker, the Eastern Hog-nosed Snake will writhe about, flip over on its back and play dead.

1.3 Populations and Distribution

The Eastern Hog-nosed Snake is widespread in eastern North America, with less than 10% of its global distribution in Canada. It occurs from Florida and Texas in the south, to southern New England, Ontario and Minnesota in the north. It is found as far west as western Kansas. The Eastern Hog-nosed Snake is absent from the St. Lawrence drainage (eastern Ontario and most of New York state). It is considered very common both globally (G5) and in the United States of America (N5), but rare to uncommon in Canada

(N3). In general, the Eastern Hog-nosed Snake is more common in the south of its North American range and less common in the north (Figure 2)

Figure 2. Conservation ranks for the Eastern Hog-nosed Snake (NatureServe 2007).

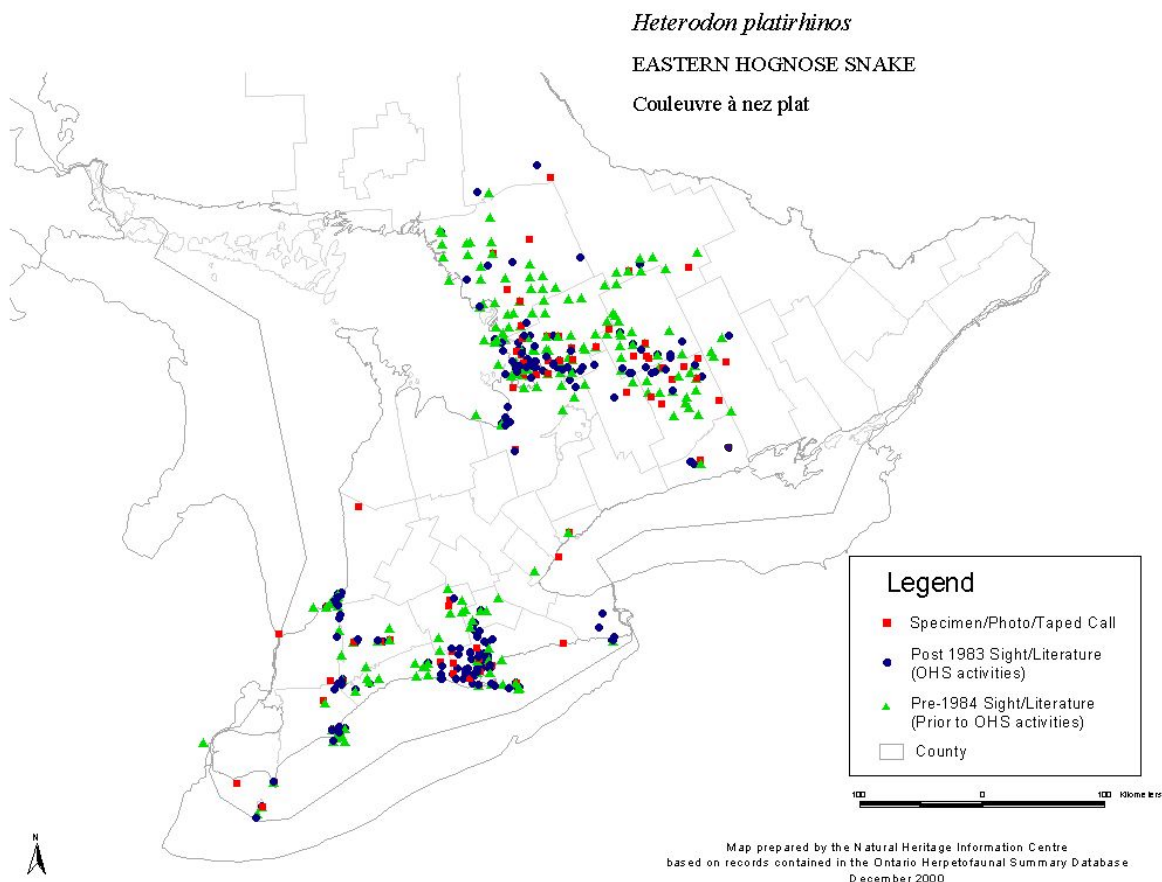


In Canada, the Eastern Hog-nosed Snake is only found in the province of Ontario. Within Ontario, it is found in two geographically separate areas: the Carolinian Life Zone of southwestern Ontario and in central Ontario south of the French River and Lake Nipissing (Figure 3). The northern limit of the range corresponds approximately to the 120 day frost-free period (Schueler 1997).

Although the current distribution of the Eastern Hog-nosed Snake in Ontario is not completely known, it is clear that this species has declined. The Natural Heritage Information Centre (NHIC) of the Ontario Ministry of Natural Resources has determined that 8% of known element occurrences (EOs) or “populations” of Eastern Hog-nosed Snakes in Ontario have been extirpated (Oldham and Austen 1998). The Eastern Hog-nosed Snake has been extirpated from the Regional Municipalities of Halton, Peel and York as well as from Pelee Island and Point Pelee National Park (Oldham and Austen 1998). Although most extirpations occurred in southwestern Ontario, there are reports of extirpations from across the range.

In addition, 35% of element occurrences are ranked historic, or unconfirmed in the last 20 years. Although historically the Eastern Hog-nosed Snake has been reported in Bruce and Prince Edward counties, it may now be extirpated from these areas (Oldham and Austen 1998). Quantitative data on population sizes are lacking, but remaining populations may have declined as a result of increased rates of mortality.

Figure 3. Eastern Hog-nosed Snake Observations in Ontario



1.4 Needs of the Eastern Hog-nosed Snake

1.4.1 Habitat and biological needs

The Eastern Hog-nosed Snake grows quickly and maturity can be reached in approximately 2 years in Kansas (Platt 1969), but possibly up to 4-5 years in Ontario (Cunnington pers. comm. 2004, Rouse pers. comm. 2004). Females in the northern part of their range lay an average of 25 eggs, with larger females laying more eggs (Platt 1969). At least some females breed two or more years in a row in Ontario (Cunnington and Cebek 2005).

There have been few in-depth studies concerning Eastern Hog-nosed Snake ecology. Additional research is required on habitat use in different areas of Ontario. Five physical features have been used to define the preferred habitat of the Eastern Hog-nosed Snake: well-drained soil; a loose or sandy soil; open vegetative cover such as open woods, brushland or forest edge; proximity to water; and climatic conditions typical of the eastern deciduous forest biome (Platt 1969). Analysis of habitat use at Wasaga Beach Provincial Park in Ontario found that Eastern Hog-nosed Snakes prefer forested areas and wetlands. Conifer plantations, meadows and developed areas were found to be less suitable (Cunnington 2004b). Snake use of habitat was clustered in areas that provided a diverse habitat mosaic. A Description of Residence will be posted on the Species at Risk Act Public Registry.

In southwestern Ontario, in areas such as Rondeau Provincial Park and Long Point, Eastern Hog-nosed Snakes use beach and dune habitat, often relying on driftwood and other artificial and natural ground cover (Gillingwater and Piraino 2004). Individual snakes have been found moving between driftwood and Cottonwood trees along the beach dune habitat actively foraging for Fowler's Toads (Gillingwater and Piraino 2004). Eastern Hog-nosed Snakes made use of a network of naturally formed tunnels at Long Point (Gillingwater and Piraino 2004). Tunnel entrance points often originated near exposed logs and continued on to wood and debris, which had been covered by a thick layer of sand in previous years. Eastern Foxsnakes (*Elaphe gloydi*) and Fowler's Toads also used these areas (Gillingwater and Piraino 2004).

1.4.2 Ecological role

The diet of the Eastern Hog-nosed Snake consists mainly of American Toads (*Bufo americanus*) and Fowler's Toads (*Bufo fowleri*) although it will also take frogs, salamanders, turtle eggs, small mammals and birds (Platt 1969). Juveniles feed upon small prey such as Redback Salamanders (*Plethodon cinereus*), Spring Peepers (*Pseudacris crucifer*) or invertebrates (Michener and Lazell 1989). Because Eastern Hog-nosed Snakes feed mainly on toads, their populations may respond to changes in toad populations. This reliance may be significant in the Carolinian Region where Fowler's Toad has declined, although the American Toad remains one of the most widespread and abundant amphibians in southern Ontario (Hecnar 1997).

1.4.3 Limiting factors

The Eastern Hog-nosed Snake reaches its northern limit in Ontario, hence climate is a limiting factor for this species. As such it is possible that the Eastern Hog-nose Snake has limited recruitment, particularly in the northern part of its range in Ontario.

Habitat is also a limiting factor for this species, because of its reliance on areas with sandy soil. As this habitat is developed, the amount of habitat available for the Eastern Hog-nosed Snake in Ontario is reduced.

Populations of the Eastern Hog-nosed Snake typically exist at low densities (Platt 1969, Michener and Lazell 1989, Cunningham 2006, Rouse pers. comm. 2004). It is unclear what effect increased rates of mortality have on the viability of populations.

Eastern Hog-nosed Snake adults are very mobile, with home ranges greater than 100 ha and daily movements of approximately 100 m (Cunnington 2004a). Range lengths (the maximum distance between any two radio locations) for 10 individuals radio-tracked in Georgian Bay averaged 2.7 km and the maximum range length recorded was over 6 km (Rouse and Willson, unpublished data). This mobility makes Eastern Hog-nosed Snakes more vulnerable to such threats as traffic mortality and habitat fragmentation than more sedentary species. It is further compounded by the fact that they are relatively slow-moving and, as such, are more susceptible to road mortality (Andrews and Gibbons 2005).

1.5 Threats

Threats to the Eastern Hog-nosed Snake, listed in order of perceived importance, are: habitat loss, degradation and fragmentation, roads, persecution, collecting and contaminants. All threats are range wide.

1.5.1 Threat classification

Table 1. Threat Classification Table

1Habitat loss, degradation and fragmentation		Threat Information		
Threat Category	Habitat Loss or Degradation	Extent	Widespread	
			Local	Range-wide
General Threat	Housing development	Occurrence	Current	
		Frequency	Continuous	
Specific Threat	Habitat conversion; habitat fragmentation; isolation	Causal Certainty	High	Medium
		Severity	High	Medium
Stress	Reduced population size	Level of Concern	High	

2Road kill		Threat Information		
Threat Category	Habitat loss or degradation	Extent	Widespread	
			Local	Range-wide
General Threat	Road construction	Occurrence	Current	
		Frequency	Seasonal	
Specific Threat	Road kill; habitat fragmentation	Causal Certainty	High	
		Severity	High	
Stress	Increased mortality	Level of Concern	High	

3Persecution		Threat Information		
Threat Category	Disturbance or harm	Extent	Widespread	
			Local	Range-wide
General Threat	Discriminate killing	Occurrence	Current	
		Frequency	Seasonal	
Specific Threat		Causal Certainty	High	Medium
		Severity	Medium	
Stress	Increased mortality	Level of Concern	Medium	

4Collecting		Threat Information		
Threat Category	Biological Resource Use	Extent	Widespread	
			Local	Range-wide
General Threat	Pet trade	Occurrence	Current	
		Frequency	Seasonal	
Specific Threat	Collection of animals	Causal Certainty	Medium	
		Severity	Unknown	

Stress	Reduced population size	Level of Concern	Medium	
5	Contaminants	Threat Information		
Threat Category	Pollution	Extent	Widespread	
			Local	Range-wide
General Threat	Crop production (e.g., pesticide, herbicide, or fertilizer application)	Occurrence	Unknown	
		Frequency	Seasonal	
Specific Threat	Consuming contaminated prey	Causal Certainty	Low	
		Severity	Unknown	
Stress	Reduced fitness or poor reproductive success	Level of Concern	Low	

1.5.2 Description of threats

1.5.2.1 Habitat loss, degradation and fragmentation

Development continues to eliminate habitat for the Eastern Hog-nosed Snake. For example, Wasaga Beach is one of the fastest growing communities in Ontario (Watters 2003). Privately owned natural areas adjacent to Wasaga Beach Provincial Park used by Eastern Hog-nosed Snakes are being turned into housing developments. Even when habitat is not destroyed completely, housing developments can lead to increased interactions between snakes and people and this has led to at least three Eastern Hog-nosed Snakes being killed around Wasaga Beach Provincial Park (Cunnington pers. comm. 2004). Other forms of development (e.g. road construction, or sand or gravel pits) can also degrade or destroy habitat for Eastern Hog-nosed Snakes.

The landscape of southwestern Ontario in particular has been greatly modified by humans during the last century. One of the impacts of this is the fragmentation of natural areas. Although the effects of habitat fragmentation on the Eastern Hog-nosed Snake have not been studied, research on a wide variety of vertebrates suggests that increasing fragmentation leads to reduced population levels, increased risk of extirpation due to stochastic events, reduced gene flow among populations, increased inbreeding, and loss of genetic diversity (Young and Clark 2000).

1.5.2.2 Roads

Roads are a widespread and significant ecological threat (Trombulak and Frissell 2000). In southern Ontario, the primary road network expanded from approximately 7000 to over 35 000 km of roads from 1935 to 1995 (Fenech *et al.* 2001). It is unclear how significant a threat traffic mortality is for the Eastern Hog-nosed Snake. Traffic mortality had been reported from Point Pelee National Park before the snake became extirpated (Point Pelee National Park, unpublished data), as well as in Petroglyphs, Pinery, Port Burwell and Rondeau Provincial Parks (NHIC, unpublished data). This indicates that even populations within protected areas are not immune from this threat. Eastern Hog-nosed Snakes are relatively slow moving and are therefore at greater risk of being hit while crossing roads, however they have also been found to exhibit road avoidance,

which could contribute to population fragmentation (Andrews and Gibbons 2005). In addition, road construction can destroy, degrade and fragment Eastern Hog-nosed Snake habitat and allow development to occur in previously roadless areas, which increases the likelihood of negative human-snake interactions. Off-road vehicle use also poses a threat to snakes and their nests. ATV tracks have been found within 1 m of a known nest (Cunnington pers. comm. 2004) and off-road mountain bike traffic may also pose risk in this same regard.

1.5.2.3 Persecution

The fear of snakes that some people have is exacerbated by the defensive behaviour of the Eastern Hog-nosed Snake. This results in many snakes being needlessly killed around homes, cottages, farms, and even in protected areas. The Eastern Hog-nosed Snake is listed as a specially protected reptile in the Fish and Wildlife Conservation Act (FWCA) which prohibits its killing, capture, hunting or trapping, however persecution continues. For example, a pair of Eastern Hog-nosed Snakes was killed by a landowner adjacent to Wasaga Beach Provincial Park in 2002 (Cunnington 2004a). The landowner was successfully prosecuted under the FWCA. At Rondeau Provincial Park, local cottagers have stated that they have or know of others who have routinely killed Eastern Hog-nosed Snakes in the park (Gillingwater pers. comm. 2004) and the species is now rare within the park. Local landowners surrounding the park have also stated that they have killed this species in the past (Gillingwater pers. comm. 2004). Although it is difficult to quantify the level of this threat, it primarily targets adult snakes and hence removes valuable breeding members from populations.

1.5.2.4 Collecting

There is a large community of reptile keepers. While most are law-abiding, illegal collecting of reptiles for the pet trade does occur. Although the Eastern Hog-nosed Snake cannot be legally sold in Ontario, individuals have been seen for sale in pet stores (Gillingwater pers. comm. 2004). Despite the fact that the Eastern Hog-nosed Snake has a reputation of being difficult to maintain in captivity, there is a growing demand for this species. A pair of Eastern Hog-nosed Snakes was selling for \$160 US on the Internet in October of 2004. There was also an online advertisement from a dealer offering to buy wild caught Eastern Hog-nosed Snakes. There is even a multi-page website dedicated to the care, feeding and breeding of hog-nose snakes in captivity.

1.5.2.5 Contaminants

The Eastern Hog-nosed Snake may be sensitive to some contaminants, particularly through the effects of contaminants on their food source. For example, at Point Pelee National Park, where the Eastern Hog-nosed Snake is now extirpated, total DDT concentrations in Spring Peepers have been found to approach levels where toxic effects are expected to be observable (Russell and Haffner 1997). Small amphibians such as Spring Peepers may be a major food source for juvenile Eastern Hog-nosed Snakes (Michener and Lazell 1989). DDT was sprayed within the park from approximately 1950-1965 (Linke 1994). It is also noteworthy that Fowler's Toad, a major food source for the Eastern Hog-nosed Snake, was extirpated from Point Pelee about the time DDT spraying began in the park (Russell and Haffner 1997).

1.6 Actions Already Completed or Underway

1.6.1 Research and Monitoring

- Natural Heritage Information Centre maintains a database that has compiled all known records of the Eastern Hog-nosed Snake in Ontario. The database is updated as new information is obtained.
- Research on Eastern Hog-nosed Snake demographics, movements and habitat use has been conducted at Wasaga Beach Provincial Park since 2001 (Cunnington 2002, 2004a,b, 2006, Doucette and Gurr 2001).
- Surveys for Eastern Hog-nosed Snakes were undertaken at Rondeau Provincial Park during 2000 and 2001 (Gillingwater 2002).
- Eastern Hog-nosed Snake surveys were conducted at Long Point National Wildlife Area from 1996-1999 and again in 2003-2004 (Gillingwater and Piraino 2004).
- Sporadic surveys for Eastern Hog-nosed Snakes have been undertaken at the St. Williams Crown Forest from 1997 to 2004 (Gillingwater pers. comm. 2004).
- Radio telemetry studies on movement patterns of Eastern Hog-nosed Snakes were conducted as part of the study of the effect of the Highway 69 expansion near Parry Sound on threatened snake species (Rouse 2006).
- Inventory and monitoring of individuals at Pinery Provincial Park.
- Surveys along the Trent-Severn waterway were conducted in 2005, with a focus on locations of historic sightings. While no Eastern Hog-nosed Snakes were located over the course of the field surveys, data from two confirmed sightings of the species were obtained (Cunnington *et al.* 2005).
- Observations of Eastern Hog-nosed Snakes have been recorded for decades at Georgian Bay Islands National Park (GBINP). Since 1993, all Hog-nosed Snakes captured in the high use areas of the park have been implanted with a PIT tag, measured, weighed and released. Since that time, staff at GBINP have implanted 15 unique tags and had 13 of these recaptured. Between 2003 and 2005, road mortalities on neighbouring Muskoka Road 5 have also been recorded.
- Element occurrence data cleanup for all NHIC records of Eastern Hog-nosed Snake completed in 2006.

1.6.2 Education

- The Wasaga Beach Eastern Hog-nosed Snake Research Program has undertaken a school education program since 2000. In conjunction with the Georgian Bay Reptile Awareness Program, a snake awareness program was delivered to students at the four elementary schools in Wasaga Beach from 2001-2003 (Doucette and Gurr 2001, Cunnington 2004a). Approximately 1700 students attended these presentations each year.
- The Wasaga Beach Eastern Hog-nosed Snake Research Program prepared a 5-minute educational video in 2002 on the Eastern Hog-nosed Snake and the research being conducted at Wasaga Beach Provincial Park. The video is

used during programs at the park and is also available on the Internet (www.wasagabeachpark.com).

- A full colour educational display card on the Eastern Hog-nosed Snake was distributed to homes and businesses in Wasaga Beach in 1999 and 2003. A new card was produced in 2005.
- The Georgian Bay Reptile Awareness Program, based out of Parry Sound, provided extensive outreach on all reptile species at risk to the entire Georgian Bay area. They reached about 2000 students and 2300 members of the general public with programs in 2003 (in addition to those in conjunction with Wasaga Beach Eastern Hog-nosed Snake Research Program, mentioned above). Programs were taken to schools (targeting grades 4 and 10) and cottage associations, and snake sensitivity training was provided to construction workers (G. Clayton pers. comm. 2004). They also produced a poster and brochure on the reptiles of the Georgian Bay area that have been widely distributed.
- Outreach programs by Upper Thames River Conservation Authority promote species at risk including the Eastern Hog-nosed Snake. This includes developing and distributing a full colour, double-sided handout on the Eastern Hog-nosed Snake. An updated card was produced in 2005.
- Natural history interpretation programs, which include information on the Eastern Hog-nosed Snake, are in effect at some parks in Ontario with this species.
- The Toronto Zoo created and distributes a “Snakes of Ontario” poster to promote snake conservation. Prior to that, the Norfolk Field Naturalists produced and distributed a “Snakes of Ontario” poster to every public school in Norfolk County.
- A landowner survey and educational program on large snakes (Eastern Foxsnake, Eastern Hog-nosed Snake and Eastern Ratsnake) was undertaken by the Norfolk Field Naturalists in the Long Point area in 1992 and 1993.
- Education on the Eastern Hog-nosed Snake, along with other species at risk, has been a consistent effort in the interpretation programming at GBINP for many years. The education effort reaches thousands of visitors and youth attending the two YMCA camps at GBINP. Programs and information are oriented to generate awareness and reduce human persecution.
- Public outreach (including presentations and distribution of educational rack cards) was conducted along the Trent-Severn Waterway during summer 2005. Approximately 600 individuals were reached (Cunnington *et al.* 2005).

1.7 Knowledge Gaps

A number of issues must be resolved to better implement recovery activities:

- **Distribution.** A better understanding of the current distribution is essential to identify the status of populations of this species. Additionally, more complete distribution information will allow for better ranking of key conservation areas. Given the difficulty of determining reliable population estimates, range occupancy is the best surrogate for population size.
- **Population density.** Reliable estimates of population densities in different kinds of landscapes will provide key information for identifying the amount of various habitats and habitat mosaics required for successful conservation of populations.
- **Habitat use.** Detailed understanding of habitat use across all seasons and for juveniles as well as adults in different landscapes is essential for identifying key habitat features and protecting adequate amounts of land and configurations. An understanding of habitat use will allow for investigation of the quality of remaining habitat across the province.
- **Genetic uniqueness.** Measures of genetic variability of Eastern Hog-nosed Snake populations across the range will provide valuable information on the genetic uniqueness of various populations and help set conservation priorities. It will help determine if the northern and southern Ontario populations are genetically distinct, possibly representing different source populations.

2. RECOVERY

2.1 Recovery Feasibility

Recovery of the Eastern Hog-nosed Snake is considered feasible for the following reasons:

- 1) Individuals capable of reproduction remain present throughout the range in Canada.
- 2) It is likely that sufficient habitat remains available for recovery, particularly in central Ontario.
- 3) There are no unavoidable threats to the species or its habitat that preclude recovery and cannot be mitigated through recovery actions.
- 4) Recovery techniques required are not highly experimental or known to be ineffective.

2.2 Recovery Goal

The goal of this recovery strategy is the long-term persistence of key Eastern Hog-nosed Snake populations throughout the existing range in Canada.

It is unclear how much the Eastern Hog-nosed Snake has declined across its range in Canada and this lack of knowledge hampers recovery planning. However, given the loss of Eastern Hog-nosed Snake habitat, particularly in southwestern Ontario, it is not likely that the distribution of the species can be significantly increased. The Eastern Hog-nosed Snake is also considered globally secure (G5), being widespread and relatively common in much of the eastern United States of America. Key populations will be identified following the general principles of ecological representation, redundancy, and resiliency (Stein *et al.* 2000). Conservation of peripheral populations is important to maintain evolutionary potential (Lesica and Allendorf 1995).

2.3 Recovery Objectives

Recovery actions should be integrated with complementary activities for other species at risk wherever possible. Actions undertaken should address the following objectives towards achieving the recovery goal:

- I. **Inventory and Monitoring**
 - Determine current distribution of the species and the number of protected areas with extant populations.
 - Implement a standardized monitoring protocol.
- II. **Research**
 - Fill knowledge gaps regarding habitat use, population biology and threats.
- III. **Conservation & Management**
 - Ensure conservation through land protection, land use planning, development of regulations, enforcement of existing regulations, and development of measures to mitigate identified threats.
- IV. **Critical Habitat**
 - Define and map critical habitat and residence required to meet recovery goals for each of the Ontario population regions.
- V. **Communication & Stewardship**
 - Develop and deliver communication and education programs to increase awareness, land stewardship, and application of best management practices.

2.4 Approaches Recommended to Meet Recovery Objectives

2.4.1 Recovery planning

Strategies to effect recovery are outlined in Table 2.

Table 2. Recovery Planning Table

Priority	Threats addressed	Broad strategy to address threat	Recommended approaches to meet recovery objectives
Objective I : Inventory and Monitoring			
High	n/a	Public reporting program	<ul style="list-style-type: none"> • Develop, promote and implement a public reporting program to solicit observations
High	n/a	Protected areas query	<ul style="list-style-type: none"> • Solicit reports from staff
High	n/a	Habitat monitoring protocol	<ul style="list-style-type: none"> • Develop and implement a standardized method for classifying habitat used by Hog-nosed Snake (HOSN) (e.g. Ecological Land Classification system)
High	n/a	Population surveys	<ul style="list-style-type: none"> • Prioritized list of areas to survey • Develop and implement a standard population monitoring protocol • Surveys in conjunction with other appropriate SAR to determine continuing presence of HOSN
Medium	n/a	Long-term monitoring	<ul style="list-style-type: none"> • Develop standardized data sheet/spreadsheet for recording data • Continue and expand reporting of observations within protected areas
Low	Collecting	Illegal trade	<ul style="list-style-type: none"> • Survey of dealers and stores to determine supply of and demand for HOSN

Objective II: Research				
High	n/a	Population studies	<ul style="list-style-type: none">Intensive demographic studies at a few selected sites across the range to determine habitat use, home range and population density	
High	n/a	Population modeling	<ul style="list-style-type: none">Determine habitat use of juvenilesUse basic life history data to estimate the effect of differing population sizes on probability of population survival	
Medium	n/a	Genetic profiling	<ul style="list-style-type: none">Determine which protected areas are large enough to adequately protect populationsDNA samples should be collected from all snakes handled in any research programProfiling of populations once sufficient sample sizes are availableIdentification of population markers to aid in identifying origin of poached snakes	
Low	Contaminants	Effects of contaminants	<ul style="list-style-type: none">Toxicological study of selected HOSN populations carried out in association with other research	
Low	n/a	Predator-prey relationship	<ul style="list-style-type: none">Research project to determine dependence upon toad populations and food preference of juveniles	
Objective III: Conservation & Management				
High	Habitat loss	Habitat protection	<ul style="list-style-type: none">Prioritize private sites for urgency and conservation importanceIdentify and contact ownersDetermine ideal protection strategy for each site	
High	Habitat loss	Habitat acquisition	<ul style="list-style-type: none">Identify key areas where land purchase is essential for survival of HOSN	
High	Habitat loss	Identify key populations	<ul style="list-style-type: none">Develop guidelines and a spatially explicit model to identify habitat essential to long-term survival of HOSN	
High	Habitat loss	Habitat threat assessment	<ul style="list-style-type: none">Assess specific threats facing major populations across range	
High	Habitat loss	Planning documents	<ul style="list-style-type: none">Develop and apply provincial habitat mapping guidelines for the purposes of the Provincial Policy Statement. Encourage adoption of policies by municipalities to protect significant habitat in Official Plans and other planning documents (e.g. protected areas, municipalities)	
High	Habitat degradation	Management plans	<ul style="list-style-type: none">Encourage protection and recovery of HOSN in management plans for all protected areas	
High	All	Legislation	<ul style="list-style-type: none">Encourage regulation under the Ontario Endangered Species Act	
High	Habitat loss and degradation	Recovery Implementation Groups	<ul style="list-style-type: none">Establish regional Recovery Implementation Groups (RIGs) for carrying out identified protection measures	

Objective IV: Critical Habitat			
High	Habitat loss	Define critical habitat	<ul style="list-style-type: none"> • Create subcommittee to define critical habitat • Through implementation of the schedule of studies, produce guidelines for resource users to identify critical habitat for purposes of SARA
High	Habitat degradation	Identify activities that may destroy or harm critical habitat	<ul style="list-style-type: none"> • Analysis of habitat use data to determine which land uses are compatible with HOSN • Identification of land uses that need testing to determine their compatibility with HOSN • Additional telemetry studies to determine land use compatibility (possibly combine with population studies)
Objective V: Communication & Stewardship			
High	Persecution	Communication Strategy	<ul style="list-style-type: none"> • Develop and implement a communication strategy integrated with other snake SAR to ensure an efficient and coordinated approach to inform and engage the target audiences • Survey target audience to determine level of persecution
High	Persecution and Collecting	Inform wildlife enforcement staff	<ul style="list-style-type: none"> • Develop & deliver workshops & materials for wildlife enforcement officers in conjunction with other Recovery Teams
High	Habitat loss and degradation and Persecution	Stewardship guidelines	<ul style="list-style-type: none"> • Develop and promote best management practices & land-use guidelines for landowners and municipal planners
High	ALL	Partnerships with First Nations	<ul style="list-style-type: none"> • Identify key First Nations lands with major populations • Consult First Nations with respect to protection of populations on their lands
Medium	Traffic mortality	Road signs	<ul style="list-style-type: none"> • Identify known sites within protected areas where traffic mortality occurs • Erect “Brake-for-snakes” signs where appropriate
Medium	Collecting	Educate pet industry	<ul style="list-style-type: none"> • Develop and distribute information regarding the buying and selling of species at risk to the retail pet industry in Ontario

2.4.2 Narrative to Support Recovery Planning Table

Successful recovery should be implemented at the landscape scale, with emphasis placed on ensuring the protection of large enough areas to protect viable populations. Many recovery actions (particularly communication and education actions) should be integrated with other species at risk, particularly the Fowler’s Toad, Eastern Foxsnake, Eastern Ratsnake, Milksnake and the Massasauga Rattlesnake, where appropriate.

2.5 Performance Measures

Significant data gaps exist in the information required for successful recovery of the Eastern Hog-nosed Snake. Activities in the next few years must focus on filling these data gaps. Performance measures to assess the team's success include:

I Inventory and Monitoring

- Number of records submitted to the Natural Heritage Information Centre (NHIC)
- Number of historical EOs re-surveyed to determine current status of the Hog-nosed Snake
- Implementation of a standardized monitoring protocol

II Research

- Additional intensive studies on Eastern Hog-nosed Snakes are undertaken to fill the knowledge gaps regarding habitat use, population biology and threats as outlined in Table 2

III Conservation & Management

- Report outlining methodology for identifying key populations and key populations identified
- Development of a prioritized list of candidate sites for protection
- Prioritized list of areas for conservation based on threats
- Habitat guidelines finalized and distributed to relevant agencies
- Appropriate zoning and activities identified in all new or updated park management plans

IV Critical Habitat

- Critical habitat will be fully identified within 5 years of posting this recovery strategy

V Communication & Stewardship

- Communication strategy is completed
- Stewardship guidelines are produced and presented to target audience
- Development of a prioritized list of First Nations lands with known populations
- Development of a prioritized list of known sites with traffic mortality
- Information package on species at risk developed and distributed to retail pet industry

2.6 Critical Habitat

2.6.1 Identification of the species' critical habitat

Critical habitat is the habitat necessary for the survival or recovery of a species. Identification of critical habitat is not possible at this stage due to insufficient information. The species has a large distribution in southern Ontario and is widely distributed throughout the eastern and mid-United States. Very little research has been conducted on the species, partly because it is fairly common in many areas of its extensive U.S. range. In addition, research is complicated by a low population density and the species' exceedingly cryptic and secretive behaviour. Observation data thus far indicates that the Eastern Hog-nosed Snake is a habitat generalist, as it is found in a variety of habitat types. A research project investigating ways of determining which habitat parcels should qualify as critical habitat in Ontario has begun, but requires much more work and is not expected to be completed until 2013, as outlined in the Schedule of Studies below. This would not preclude the option of protecting some habitat in the interim.

2.6.2 Examples of activities likely to result in destruction of critical habitat

Although critical habitat has not yet been defined for the Eastern Hog-nosed Snake, activities that can destroy habitat include, but are not limited to, the following:

- Road construction
- Development (e.g. residential, industrial, recreational)
- Conversion of land to agriculture
- Removal of natural vegetation
- Off-road vehicle use, particularly in nesting areas

2.6.3 Schedule of studies to identify critical habitat

Table 3. Schedule of Studies for the Identification of Critical Habitat

Description of Activity	Outcome/Rationale	Timeline
Quality check all NHIC records	<ul style="list-style-type: none"> • Improved confidence in existing locality information • Identification of potential areas to survey for the Eastern Hog-nosed Snake based on landscape factors 	2006 (completed)

Work with government and non-government interest groups to better determine the past and current distribution	<ul style="list-style-type: none"> • New records for the Eastern Hog-nosed snake submitted to NHIC 	2006-2010
Field surveys to determine extent of current range (in collaboration with surveys for other species at risk)	<ul style="list-style-type: none"> • Better understanding of the complete distribution of the species in Ontario 	2006-2010
Norfolk county snake survey in conjunction with other snake species at risk	<ul style="list-style-type: none"> • Better understanding of the complete distribution of the species in Ontario • Detailed understanding of habitat use in the Norfolk sand plain 	2009-2010
Radio telemetry study of at least one population in southwestern Ontario to determine movement patterns and habitat use	<ul style="list-style-type: none"> • Determination of movement patterns, home range size and types of habitat used 	2009-2011
Focused work including the mapping of suitable habitat in and around key population areas and then parsing those habitat blocks down into what is necessary for population persistence (viability)	<ul style="list-style-type: none"> • Critical habitat fully defined 	2009-2013

2.7 Existing and Recommended Approaches to Habitat Protection

Habitat for the Eastern Hog-nosed Snake on federal lands is subject to applicable federal legislation depending on where the federal lands are located. Examples of such federal legislation can include the Canada National Parks Act, the Canada Wildlife Act, the Historic Sites and Monuments Act, the Species at Risk Act, the Canadian Environmental Assessment Act, the Federal Real Property and Immovables Act, applicable regulations under those acts, and the Historic Canal Regulations of the Department of Transport Act. Habitat for the species in provincial parks is subject to regulations under the Ontario's Provincial Parks and Conservation Reserves Act. With respect to properties outside of the federally- and provincially-owned protected areas, Ontario's Endangered Species Act (2007) provides for species-specific regulations for the Eastern Hog-nosed Snake. Such lands are also subject to legislative protection of habitat through the Provincial Policy Statement of the Ontario Planning Act, and to protection of species under Ontario's Fish and Wildlife Conservation Act. Habitat can also be protected under the provincial Aggregates Resources Act and the Crown Forest Sustainability Act.

2.8 Effects on Other Species

Public outreach programs should have positive implications for other snakes and species at risk. For example, the Georgian Bay Reptile Awareness Program promoted appreciation and protection of reptiles at risk in the Georgian Bay area. Other snake species at risk which likely benefited include the Eastern Foxsnake, Massasauga (*Sistrurus catenatus*), and Milksnake (*Lampropeltis triangulum*). Actions to protect habitat will also likely benefit these species. In the Carolinian Region conservation and education initiatives will also likely benefit the Threatened Eastern Foxsnake and Eastern Ratsnake (*Elaphe obsoleta*). Given the fact that Eastern Hog-nosed Snakes are known predators of Fowler's Toads, a Threatened species, any action which leads to an increase

in snake populations may lead to increased toad predation. Increased predation is not expected to significantly affect Fowler's Toad populations (Green pers. comm. 2004).

2.9 Recommended Approach for Recovery Implementation

The Eastern Hog-nosed Snake makes use of a variety of habitats and can occupy a large home range over the course of a single year. Hence the survival of this species relies upon maintaining a mosaic of habitats with the ability for movement to occur among these habitats. Therefore it is recommended that a landscape approach be used in implementing recovery for this species.

2.10 Statement on Action Plans

One or more action plans or similar planning documents will be developed to elaborate on the approaches recommended in the strategy. Recommendations for Eastern Hog-nosed Snake also may be incorporated into multi-species or ecosystem-based action plans where this is expected to be the most effective and efficient approach for implementation (e.g. habitat protection and landscape restoration). An action plan or similar planning document for Eastern Hog-nosed Snake recovery will be completed by December 2013.

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4. RECOVERY TEAM MEMBERS

Co-Chairs:

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- Angela McConnell – Canadian Wildlife Service

Past co-chairs:

- Gary Allen / Angela McConnell (co-chair 2002-2005) – formerly of Ontario Ministry of Natural Resources
- Brian Hutchinson (co-chair 2002-2005) – Parks Canada
- Deb Jacobs (co-chair 2005) – Ontario Ministry of Natural Resources.
- Alistair MacKenzie (co-chair 2005) – formerly of Ontario Parks

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