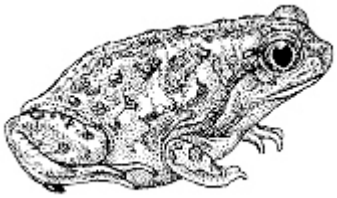
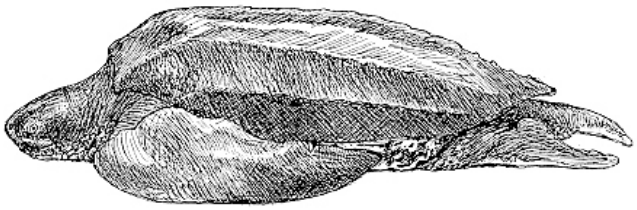
Conservation Priorities for the

Amphibians and Reptiles of Canada





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Executive Summary

Amphibians and reptiles make up an important component of the biodiversity of Canada. They occupy virtually all habitats, from marine to prairie to forest. Juveniles are important food sources for many species, while adults are significant predators on a variety of invertebrates and small vertebrates. A total of 15 amphibians and 18 reptiles have been designated as Endangered, Threatened, or Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). In addition, two species, the pygmy short-horned lizard of British Columbia and the timber rattlesnake of Ontario, have been extirpated from Canada.

Canada's amphibians and reptiles face a number of serious threats. Habitat loss, particularly the loss of wetlands, is the greatest threat to most species. The increasingly fragmented landscape has resulted in fewer populations that are more widely separated and more completely isolated. Habitat protection itself has not always been effective: Point Pelee National Park has lost a minimum of nine species of amphibians and reptiles during the 20th century. Illegal collecting for the pet trade affects many species of reptiles and even occurs within national parks. Deliberate killing, combined with traffic mortality, takes a heavy toll on many species. Elevated populations of raccoons and other nest predators reduce recruitment in many species of reptiles. Global climate change and particularly increases in ultraviolet radiation may limit breeding success in many amphibians. Newly emerging infectious diseases, such as chytridiomycosis (a fungal disease) and the ranaviruses (iridoviruses), have been linked to amphibian die-offs. Outbreaks of grossly deformed frogs continue to occur, particularly in agricultural environments. Chemical contaminants have been implicated in amphibian deformities and reproductive decline. The introduction of exotic species upsets the natural balance of many systems and increases the chance of introducing disease.

This document comprises conservation outlines for each of the 33 amphibians and reptiles at risk (outlines have not been developed for the two extirpated species). These outlines have been developed in consultation with a number of Canada's expert herpetologists and highlight the threats each species faces, as well as required management actions. While this document augments the existing COSEWIC reports, it does not replace full recovery plans. Habitat conservation and protection are key issues for virtually all species at risk.

General recommendations have been made for the conservation of amphibians and reptiles and for specific subsets of each of those groups (e.g., snakes). A number of basic actions would benefit most amphibians and reptiles, as well as a number of other species: effective provincial wetland policies, reducing the runoff of contaminants into waterways, and forestry guidelines that include fishless streams and small wetlands. Identification of areas of high diversity of amphibians or reptiles is crucial to ensuring adequate protection for these species.

Major goals for amphibian conservation include research on emerging infectious diseases, preventing the introduction of predatory fish into fishless water bodies, and ensuring effective groundwater management in headwaters. Control of expanding populations of the introduced bullfrog in British Columbia is needed immediately. The effect of cattle on prairie frog populations needs to be clarified. A commercial ban on the selling of juvenile frogs for fishing bait would help prevent the spread of disease and reduce the mixing of different genetic populations.

Reptiles tend to be long-lived, and effective conservation must focus on reducing mortality. Traffic mortality could be reduced through roadside barriers and education programs. Illegal collecting should be controlled through greater enforcement of wildlife regulations and working with responsible members of the pet trade. Reducing nest predation is important, particularly in areas with high numbers of nest predators. The identification and protection of communal hibernacula is important to many species. Public education about snakes is required to try to reduce the deliberate killing of many individuals.

In general, the conservation of amphibians and reptiles at risk in Canada is hampered by a profound lack of both biological knowledge about many of these species and adequate funding to support vital research. Detailed information concerning specific habitat needs, dispersal ability, and hibernating requirements is lacking for many species. Without this information, it is difficult to plan effective conservation actions.

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If the world goes on the way it is going it will one day be a world without reptiles. Some people will accept this calmly, but I mistrust the prospect. Reptiles are a part of the old wilderness of earth, the environment in which man got the nerves and hormones that made him human. If we let the reptile go it is a sign we are ready to let all wilderness go. When that happens we shall no longer be exactly human.

Archie Carr — *The Reptiles*

1.0 Introduction

Amphibians and reptiles represent an important component of the biodiversity of Canada. They occupy almost the full range of habitat types found in this country, from the Atlantic and Pacific Oceans to prairie wetlands, from coastal rain forests to boreal forests. Larval and juvenile amphibians are critical food sources for many species of birds, mammals, reptiles, and amphibians. Adult reptiles and amphibians are important predators of many species of invertebrates and small vertebrates. Globally, the concern over amphibian decline has highlighted the importance of many of these species as indicators of environmental disturbance and possible climate change. Many amphibians and reptiles are cryptic and hence rarely seen, but they often account for a large percentage of the biomass in many ecosystems.

While amphibians and reptiles are commonly thought of as a single group, it should be stressed that they are separate classes of vertebrates. Phylogenetically, birds and reptiles are more closely related than amphibians and reptiles. While amphibians and reptiles share traits such as ectothermy (cold-bloodedness), they differ in more important physiological and ecological traits. The simple fact that amphibians undergo metamorphosis, while reptiles do not, fundamentally separates the two groups. Additionally, amphibians in general are much more tightly linked with water. Reptiles tend to be larger, take longer to mature, and live longer.

Southern Canada represents the northern limit for most species of amphibians and reptiles. A few species, such as the blue racer of southwestern Ontario or the Pacific giant salamander of southwestern British Columbia, barely extend into Canada. Populations at the edge of their range have often been viewed to be of limited conservation concern because they are peripheral, yet these populations are often vital to the long-term survival

and evolution of a species. Peripheral populations are often genetically distinct because of divergent natural selection. Preservation of genetic diversity is critical for successful long-term conservation. Hence, conservation of Canadian populations of reptile and amphibian species at risk is vital to their conservation as a whole.

Amphibians and reptiles face a number of serious threats. Many large snakes are persecuted by humans and are killed on sight. Wetland loss in southern Canada has eliminated many populations of amphibians and also increased the distance between remaining populations. Traffic mortality takes a heavy toll on many species of snakes that bask on warm roads and on female turtles seeking nesting sites. Collecting of numerous reptiles (commercially or privately) is also a significant threat to many populations.

Despite the ecological role amphibians and reptiles play and the threats they face, these species have frequently been neglected in conservation programs. For example, amphibians and reptiles represent 16 per cent of (13 of 82) threatened and endangered vertebrate species in Canada yet received only 2 per cent of the $6.2 million available through the federal recovery program in 1998/99 (Prior and Nadeau 1999).

An analysis of the major threats facing amphibians and reptiles follows this section. Some of these threats (e.g., loss of wetlands) affect many other taxonomic groups, while others (e.g., collecting of individuals for the pet trade) are largely exclusive to amphibians or reptiles. General recommendations for the conservation of reptiles and amphibians and individual action plans for each species or subspecies at risk follow. An appendix provides contact information for individual species experts.

Tailed Frog

2.0 Significant Threats to Amphibians and Reptiles

2.1 Habitat Loss

Changes to the landscape of southern Canada over the past 200 years have been profound. The loss of mature forests, wetlands, and native prairie communities reduces the amount of available habitat. One of the most critical issues for amphibians and reptiles is the loss of wetlands, for almost all species of amphibians are dependent on these habitats for breeding. Many reptiles are also associated with open water for feeding and for hibernation.

Freshwater ecosystems are one of the world's most vulnerable habitats, and once degraded they tend to deteriorate faster than terrestrial ecosystems (Stiassny 1999). This is partly because wetlands are aquatic "islands" in a sea of land. The historic and ongoing loss of wetlands in southern Canada is a critical threat to a wide range of amphibians and reptiles and many other taxa. It is estimated that 50 per cent of the historic wetlands in southern Canada have been drained, mainly for agriculture (Biodiversity Science Assessment Team 1994). On the prairies, approximately 70 per cent of wetlands have been drained, while in southwestern Ontario roughly 90 per cent of wetlands have been lost. The loss in southern Ontario is particularly disturbing because almost half of the Canadian amphibian and reptile species at risk are found in this area.

Those wetlands that do remain are often under a number of ecological threats including invasion by exotic species such as purple loosestrife *(Lythrum salicaria)*, eutrophication, and contamination from a variety of pollutants such as pesticides from agricultural runoff. Vegetated areas adjacent to water bodies, forming buffer zones, are essential for ecological health, but often are inadequate for protecting species that make use of wetlands. For example, turtles commonly nest up to 100 metres away from water (Burke and Gibbons 1995), and many provinces regulate a buffer zone of only 10 to 20 metres.

In addition, wetlands continue to be drained. Even significant wetlands on agricultural land are routinely drained in southern Ontario. This occurs despite a provincial wetland policy because the wetlands are on agricultural land. If wetland policies do a poor job of protecting provincially significant wetlands, they generally ignore ephemeral or seasonal ponds, which are important for many spring-breeding amphibians. These temporary ponds provide safe breeding sites because they are free of fish. Unfortunately, these are also the first ponds to be drained or plowed under in agricultural areas.

2.2 Habitat Fragmentation

Even when quality habitats remain, they are often effectively isolated from each other. For example, the loss of such a high percentage of wetlands in southern Canada increases the average distance between wetlands. When this factor is combined with the development of the adjacent land or the creation of roads separating wetlands, the net

effect is to isolate populations. The isolation of populations is an important issue because many species of amphibians exist as a series of interconnected breeding subpopulations, or a metapopulation (Gill 1978). Each subpopulation has a chance of being extirpated due to stochastic events such as drought (Hecnar 1997). The persistence of the metapopulation as a whole depends on these subpopulations being recolonized. When the natural landscape processes are disrupted because of habitat fragmentation, recolonization often cannot occur. Thus, a local extirpation event may lead to the regional collapse of a species.

Amphibians and reptiles depend on a number of discrete habitats over the course of the year for different activities such as breeding or nesting, summer foraging, and hibernation. The fragmentation of these individual habitats through road construction or other forms of development can have profound implications for the long-term stability of a population. If even one of the habitats is completely isolated (e.g., by a four-lane highway with a traffic median down the centre) from the others, then the population may face extirpation.

2.3 Ineffective Land Protection

A cornerstone of conservation action has been the protection of areas from human development to ensure ecological integrity. While this process has resulted in many victories, it has not always been successful. Point Pelee National Park is a sobering example of how protection can still result in significant species loss. Early surveys of amphibian and reptile diversity at Point Pelee are not necessarily complete, but at least four species of amphibians and five reptiles have been lost during the 20th century (Anonymous 1996). Four species of frogs have been lost since 1940 — Fowler's toad, Blanchard's cricket frog, grey treefrog, and the bullfrog. The last two species have been lost since 1980. The tiger salamander may also have been extirpated from Point Pelee, but its presence there is documented by only a single record from 1915.

Species loss in reptiles has been largely from the early part of the 20th century. The black rat snake, milk snake, and massasauga rattlesnake all vanished from Point Pelee before approximately 1920. The blue racer was last observed there around 1960, and the hognose snake was lost before 1980. The timber rattlesnake may also have been present at Point Pelee, but its presence is documented by only one record from 1918. The loss of so many large snake species from Point Pelee may be the result of persecution by humans. It is curious that the large and conspicuous fox snake has persisted when these other snakes have been lost. It is also interesting that none of Point Pelee's seven native turtle species have been eliminated. However, neither the spotted turtle nor the spiny softshell turtle have been reported in a number of years (Linke pers. comm.) and may now be extirpated.

Habitats favoured by many species often are not highly valued by park managers or are subject to land-use conflicts. For example, a population of long-toed salamanders was

centred on the Lafarge borrow pit in Bow Valley Provincial Park in Alberta. This population was intensively studied by biologists from the University of Calgary in the early 1990s (Powell et al. 1997). A visit to the site in 1999 found that the pond had been drained as a result of the resumption of mining activities just outside the park. The population of salamanders has undoubtedly been eliminated (Powell pers. comm.).

Successful conservation requires good stewardship across the landscape, not just in parks. The identification of interested landowners and the development of conservation-oriented management practices on their land are critical for long-term success. These activities can range from education of landowners about species found on their land to conservation easements that protect areas in perpetuity.

2.4 Illegal Collecting

The demand for some reptiles within the burgeoning reptile pet trade is staggering. For example, spotted turtles fetch up to $US150 each (Anonymous 1999). Legal exports of spotted turtles alone from the United States during the period from 1995 to 1998 averaged 291 turtles per year. The amount of illegal trade is unknown, but likely exceeds the legal U.S. exports. A proposal to have spotted turtles listed on Appendix II of the Convention on the International Trade in Endangered Species (CITES) at the April 2000 meeting of CITES in Kenya (Anonymous 1999) was defeated. The proposal nonetheless documents many local extirpations attributed to poaching. Dr. Carl Ernst, one of the world's preeminent turtle biologists, has documented three populations extirpated due to poaching in Pennsylvania and Virginia. Another population in Michigan has vanished, likely due to poaching. Most disturbing is the account of a collector removing more than 1000 spotted turtles from North Carolina in 1993/94. In Canada, poaching is known to have occurred at Wainfleet Bog in southern Ontario and quite possibly at a population on Georgian Bay. Dealers use a variety of means to obtain animals. One dealer is known to have approached Professor Ron Brooks of the University of Guelph in the early 1990s with an offer to buy all the wood turtles he could provide.

Within Canada, the illegal collection of reptiles is a serious threat. It is unclear how many species are affected, but illegal collecting affects turtles, lizards, and snakes. Most known collecting events are in Ontario, but other provinces are also likely affected. Illegal collecting even occurs in many national parks. Five-lined skinks have been stolen from Point Pelee National Park (Seburn and Seburn 1998b). An adult massasauga rattlesnake was stolen from a display in the visitor's centre at Georgian Bay Islands National Park in 1999 (McIntyre pers. comm.).

Wood turtles are particularly valued by the pet trade, and illegal collecting of individuals is increasing. As populations continue to decline in the United States, collectors appear to be turning to Canadian populations as a source of turtles for the pet trade. For example, a population in southern Ontario along two streams consisted of approximately 270 known and marked individuals in the early 1990s (Brooks et al. 1999). Follow-up surveys

indicate that the population "declined suddenly and drastically" along one of the streams, with the overall population declining by about 50 per cent. Illegal collecting is the most likely cause. Other populations that are not being monitored may be suffering a similar fate.

North American turtles are increasingly in demand in Asian food markets. In the United States, softshell turtles, map turtles, and snapping turtles are commonly exported or sold domestically for food (Behler 1997). It remains unclear how large the market for Canadian turtles is, but the province of Quebec is in the process of banning the sale of softshell turtles.

Collecting need not be on a commercial scale to have deleterious effects on reptile populations. Wood turtles were eliminated within 10 years of opening a 1000-hectare protected area in Connecticut to hiking (Garber and Burger 1995).

2.5 Deliberate Killing

Snakes are widely feared and disliked. The killing of any snake encountered is all too common a practice for many people. Such persecution has resulted in the extirpation of the timber rattlesnake from Canada. The range of the massasauga rattlesnake is also greatly restricted, in large part due to persecution.

A visitor to Georgian Bay Islands National Park in the late 1990s was observed to go out of his way to kill a massasauga rattlesnake (McIntyre pers. comm.). The individual looked for a large stick and beat the snake to death. He was charged, and the case went to trial. The judge appeared ambivalent about the "crime" of killing a snake, particularly a rattlesnake. Ultimately, because of the snake's status as a threatened species, the individual was fined $500.

Some traffic fatalities are also intentional. Many biologists have observed cars swerving to the side of the road to hit snakes or turtles. Researchers have also observed turtles being shot for "sport." Persuading people to abandon such senseless killing should be a focus of education programs.

2.6 Traffic Mortality

The effect of traffic mortality on amphibians and reptiles is significant. It is estimated that over five million amphibians and reptiles are killed each year on roads in Australia (Ehmann and Cogger 1985). Up to 10,000 red-sided garter snakes are killed each year along a 3.2-kilometre stretch of Provincial Trunk Highway 17 in Manitoba (Larche and Roberts 1998). Traffic mortality does not simply reduce population sizes. Snake populations have been found to decline and become population sinks because of traffic mortality (Rosen and Lowe 1994).

When roads are constructed adjacent to or through wetlands, the results for amphibians and reptiles may be catastrophic. For example, along a 3.6-kilometre causeway at Long Point on Lake Erie in southern Ontario, more than 7500 amphibians on average are killed each year (Ashley and Robinson 1996). Research conducted in the Ottawa area indicates that anuran (frog and toad) populations decrease in size with increasing traffic volume (Fahrig et al. 1995). Traffic mortality keeps on increasing as the number of roadless areas dwindles and the number of cars increases.

2.7 "Subsidized Predators"

Many species have adapted and thrived with human modification of the landscape. Fewer larger predators and an abundance of food waste from humans have benefited these species. The raccoon is the prototypical example, having become abundant even in urban environments. In many places their populations are higher now than ever before. It is estimated that there are 15 to 20 times as many raccoons in the United States now as in the 1930s (Sanderson 1988).

As extremely efficient nest predators, raccoons can have devastating effects on the reproductive success of turtles. Other subsidized nest predators include skunks, cats, dogs, and coyotes. In addition, several species of corvids, such as the common raven, are predators of hatchlings (Boarman 1997).

Ironically, many "protected areas," such as parks that offer camping facilities, have elevated populations of raccoons. At Rondeau Provincial Park in southern Ontario, 100 per cent of unprotected spiny softshell turtle nests were predated in 1998 (Fletcher 1998). While turtles are adapted to high levels of nest predation, they are unable to cope with complete reproductive failure in the long term. Unless action is taken, such populations are essentially extirpated already. Tropical biologist Dan Janzen described such populations as the living dead.

2.8 Climate Change and Ozone Depletion

Although global climate change is popularly referred to as "global warming," in reality we can expect far more than just warmer temperatures. A warmer, more energized atmosphere will lead to more extreme weather events. Severe storms like the ice storm of January 1998 in eastern Ontario and Quebec resulted in severe canopy damage to the forests of these areas. Mid-winter thaws may affect hibernating amphibians and reptiles. Droughts may lead to premature drying of ephemeral ponds that are critical to amphibian breeding.

Decreases in the amount of stratospheric ozone have resulted in increases in ultraviolet (UV) radiation, including UV-B (Kerr and McElroy 1993), the most biologically active

component of ultraviolet radiation. The eggs of many amphibian species may be vulnerable to these increases in UV radiation, particularly species that lay eggs near the surface of the water column. Ambient levels of UV radiation were found to cause reduced hatching success in boreal toads and Cascades frogs in field experiments in Oregon (Blaustein et al. 1994a). In contrast, ambient UV radiation did not affect hatching success of red-legged frogs in British Columbia (Ovaska et al. 1997). There also may be a synergistic effect between UV radiation and pH. Northern leopard frog eggs exposed to low pH and high UV radiation had significantly reduced hatching success compared with hatching rates under either variable by itself (Long et al. 1995). An analysis of the potential vulnerability of Canadian amphibians to UV radiation found the boreal toad, Canadian toad, and spotted frog complex to be most vulnerable (Ovaska 1997). Other species that may be vulnerable are the northwestern salamander, the tiger salamander, the Great Basin spadefoot, the Fowler's toad, the Great Plains toad, and the wood frog.

2.9 Emerging Infectious Diseases

Two diseases, chytridiomycosis and iridoviral infections, have been found repeatedly at the sites of mass deaths of amphibians in Australia and North and Central America (Daszak et al. 1999).

Chytridiomycosis is a fungal disease first identified in 1998 from sites in Australia and Panama (Berger et al. 1998). The skin of dead and dying frogs consistently contained large numbers of sporangia of a new genus of chytrid fungus (phylum Chytridiomycota, genus *Batrachochytrium*). No significant difference could be found between the Australian and Central American chytrids. Chytrids are widespread fungi found in aquatic habitats. Although the disease has yet to be confirmed in Canada, it has been reported from two species found in Canada: the northern leopard frog and the boreal toad (Daszak et al. 1999). Chytridiomycosis has been linked to declines of northern leopard frogs in Colorado in the 1970s, which suggests it may have been a factor in declines across the Canadian prairies during the 1970s (Seburn and Seburn 1998a). Mass die-offs of northern leopard frogs were observed in Manitoba: "Piles of dead and dying frogs were reported from many Lake Manitoba shorelines, whereas heaps nearly a metre high were recorded from the major frog hole areas" (Koonz 1992). Chytridiomycosis has now been reported from 38 species of amphibians, representing 12 different families (Daszak et al. 1999). The most likely cause of the epidemics is the introduction of disease into populations previously unexposed. The increase in human mobility and the ease of access to previously remote areas increases the probability of more such epidemics.

Iridoviruses are composed of five recognized genera, one of which, *Ranavirus,* is known to be pathogenic to fish, amphibians, and reptiles (Daszak et al. 1999). Larval stages of amphibians appear to be most susceptible and mortality can be 100 per cent. Metamorphs die without overt signs of infection. The virus invades the liver, kidneys, and digestive tract and quickly becomes lethal. The Regina ranavirus is responsible for die-offs of tiger salamanders from southern Saskatchewan in 1997 and 1998 (Schock et al. 1998,

Bollinger et al. 1999). Given the fact that other iridoviruses (e.g., the Bohle iridovirus) have the ability to infect amphibians, reptiles, and fish, the discovery of the Regina ranavirus in Canada is quite serious. Introductions of game fish and the common practice of transporting bait (fish or frogs) from one watershed to another all increase the likelihood of widespread transmission. Recently, sticklebacks and red-legged frog tadpoles in a national park in California were found to be carrying the same iridovirus (Mao et al. 1999), suggesting that fish introductions may be a serious threat.

Infections or other stresses may also make amphibians more susceptible to other pathogens. For example, a common water mold *(Saprolegnia ferax)* that is known to attack fish is responsible for mortality of up to 95 per cent of boreal toad embryos in Oregon (Blaustein et al. 1994b).

2.10 Amphibian Deformities

Increasing media attention has been paid to a number of occurrences of deformed frogs in the eastern United States and Canada. Images of frogs with extra legs or missing eyes are shown in newspapers and television news broadcasts. The cause of mass deformities of transforming frogs remains elusive, but various factors have been implicated, including agricultural pesticides, parasitic trematode infestations, and the synergistic effect of increasing UV radiation (Ouellet in press).

The most extensive research conducted in Canada has occurred in Quebec. Hindlimb deformities have been commonly observed in recently transformed bullfrogs, green frogs, northern leopard frogs, and American toads (Ouellet et al. 1997). Deformity rates tend to be higher at agricultural sites, suggesting that herbicides and pesticides are a likely cause. Because deformities do not always occur in these areas, a number of factors may be involved, including the timing of pesticide application and the presence or abundance of certain diseases or parasites. No single cause explains all occurrences.

Trematodes that parasitize tadpoles can result in metamorphic frogs with additional legs (Sessions and Ruth 1990). The trematode encysts in the region of limb bud development, interfering with normal metamorphosis. Parasite infestation is a natural phenomenon but may reach unnatural levels because of changes to the habitat. For example, snails are often the intermediate host for trematodes. Snail populations can increase dramatically under eutrophic conditions associated with poor water quality or increased levels of nitrates.

2.11 Chemical Contaminants

Pollution such as polychlorinated biphenyls (PCBs), dioxins, and furans are absorbed by animals in the food they eat. Animals such as reptiles that are higher up the food chain often accumulate high levels of contaminants because each prey species down the food

chain has concentrated the toxins. To date, much of the work on amphibian and reptile toxicology has been concentrated in the Great Lakes Basin.

Organochlorine pesticide use has declined in North America since the 1970s, but these contaminants can persist for long periods of time. For example, DDT was frequently sprayed to control mosquitoes at Point Pelee National Park until 1967 (Russell et al. 1995). Spring peepers collected from the park in 1993 contained DDT and its breakdown products DDE and DDD at levels that exceed the limit for fish set by the Great Lakes Water Quality Agreement. This limit was set to protect fish-eating birds, but the high levels in spring peepers would also affect frog-eating birds such as herons and egrets, as well as amphibian predators such as bullfrogs. It should be noted that bullfrogs are now absent from Point Pelee.

Ingredients other than the active ingredients in many pesticides can pose threats to amphibians in particular. Many herbicides contain a detergent additive, termed a dispersant or wetting agent (Tyler 1997), the purpose of which is to break down the surface tension on the leaf surface to improve herbicide coverage. These dispersants can interfere with cutaneous respiration in frogs and gill respiration in tadpoles.

Female reptiles secrete many contaminants into their eggs. In the Great Lakes Basin, up to 67 per cent of snapping turtle eggs in some areas either do not hatch or result in deformed young (Bishop and Gendron 1998). In general, the PCB congener pattern in snapping turtles is similar to that in fish-eating birds, with lower chlorinated PCBs appearing to be metabolized while higher congeners persist (Bonin et al. 1995). In contrast, in the mudpuppy, a totally aquatic and long-lived salamander, the pattern is more similar to that seen in fish, with lower chlorinated PCBs being predominant. Within the Great Lakes Basin, the highest levels of PCB contamination in both snapping turtles and mudpuppies are downstream of Cornwall in the St. Lawrence River (Hebert et al. 1993, Bonin et al. 1995).

Other chemicals may not cause death or obvious deformities but still have important effects. Certain chemicals are very similar to natural hormones and can affect individuals reaching maturity. For example, some chemicals will mimic the female hormone estrogen and can prevent juvenile males from maturing properly. Studies of snapping turtles from southern Ontario have found that adults from contaminated sites had reduced secondary sexual characteristics (precloacal length) compared with those from control sites (de Solla et al. 1998).

Amphibians are common in many agricultural landscapes, but they are threatened by nitrate and nitrite runoff from the widespread use of nitrate fertilizers. Even low levels of nitrates can cause reduced activity, reduced feeding, and increases in deformities in tadpoles (Hecnar 1995). A recent review evaluated the direct and indirect effects of nitrate on amphibian populations (Rouse et al. 1999). Lethal and sublethal effects in amphibians are detected in laboratory tests at nitrate concentrations between 3 and 100 milligrams per litre. Environmental concentrations of nitrate in surface waters in agricultural watersheds in southwestern Ontario and states in the Lake Erie watershed

ranged from 1 to 40 milligrams per litre. Twenty per cent of water samples had nitrate levels above 3 milligrams per litre. More than 2 per cent of the samples contained nitrate levels that would be high enough to kill a large portion of tadpoles of native amphibian species (Rouse et al. 1999). Furthermore, amphibian food sources such as insects and predators such as fish are also affected by elevated levels of nitrate in surface waters. The dramatic decline in the Oregon spotted frog may be linked to nitrate pollution, as tadpoles of this species are particularly sensitive (Marco et al. 1999). Ultimately, there is a need to reduce the amount of nitrate ending up in our waterways.

The sensitivity of mudpuppies, frog tadpoles, and adult frogs to use of 3-trifluoromethyl-4-nitrophenol (TFM) in the Great Lakes has been noted on many occasions. TFM has been used annually since 1958 for the control of sea lampreys throughout the Great Lakes. Amphibians regularly have been found dead in creeks immediately after TFM treatment (Gilderhus and Johnson 1980, Matson 1990). Laboratory tests have confirmed that species native to the Great Lakes Basin, such as the grey tree frog, northern leopard frog, and bullfrog, are sensitive to levels of TFM used for sea lamprey control (Chandler and Marking 1975). Mudpuppy population size decreased by a minimum of 29 per cent after a spray event in the Grand River of Ohio (Matson 1990).

2.12 Exotic Species

The introduction of nonnative species is a global problem. Many species introductions (e.g., that of the zebra mussel) have resulted in obvious ecological and economic problems. In terms of amphibians and reptiles, there have been two kinds of introductions within Canada: those of species not native to Canada and those of species native to other parts of Canada.

British Columbia has more introduced species of amphibians and reptiles than any other Canadian jurisdiction. The European wall lizard has been introduced to part of Vancouver Island. The clouded salamander of southwestern British Columbia may also have been introduced (Jackman 1998). It may have been transported in shipments of oak bark from California during the 19th century. The most threatening introduced species are the bullfrog and to a lesser degree the green frog. Both species are native to eastern Canada, but the origin of the introduction of the green frog is unclear.

Bullfrogs were introduced to Victoria on Vancouver Island around 1940 by a garden supply company. Only in the early 1990s did bullfrogs begin to expand their distribution along the east coast of the island past Nanaimo (Price pers. comm.). Various factors are responsible for this expansion of the bullfrog's range. Bullfrogs are adapted to breed in wetlands containing fish. With the increase in stocking of lakes with sport fish, native frog species may decline while bullfrogs thrive (Hayes and Jennings 1986). Bullfrogs are also voracious predators that consume juvenile frogs of other species and even the adults of smaller frogs. Bullfrogs pose serious threats to red-legged frogs and Oregon spotted frogs. The latter species may be unable to coexist with bullfrogs because Oregon spotted

frogs are virtually completely aquatic and therefore cannot escape from the voracious bullfrogs.

The eastern box turtle is considered by many to have been introduced in southern Ontario, but it may have existed there before European contact. Individuals are occasionally found at Point Pelee National Park, but they are believed to be released pets (Anonymous 1996).

The red-eared slider is the most widely introduced reptile in Canada. They are widespread, though not always abundant, in southern British Columbia and Ontario and likely many other provinces. Sliders are the common pet-shop turtle. Most individuals die at a young age, but those that survive grow to 10 to 20 centimetres. Frequently they become unwanted and are released into the wild. They are able to overwinter successfully in southern Ontario (Lamond 1994), and large numbers occur in many places, including Point Pelee National Park (Anonymous 1996). It is unclear if the red-eared slider competes with other freshwater turtles, but their continued release into the wild brings with it the risk of spreading disease.

3.0 General Recommendations

The habitat requirements for most species of amphibians and reptiles found in Canada are not demanding. Many species even thrive in suburban landscapes as long as there are streams, ponds, fields, and small groves of trees. Despite this adaptability, populations continue to be lost and many species are at risk. The following conservation actions are designed to help benefit amphibians and reptiles. The actions are organized by major taxonomic groupings. Actions that will benefit amphibians and reptiles overall are listed first, followed by specific actions aimed at particular families or other subgroups.

AMPHIBIANS AND REPTILES

Effective wetlands policies. Comprehensive guidelines are required in all provinces. Wetland planning should occur on the landscape scale. Protecting a wetland while surrounding it with roads on all sides or allowing cattle to wade into and defecate in the water is not protection. Policies must also apply to temporary ponds, which are critical to many species of amphibians.

Public education about wetland loss. The issue of tropical deforestation has caught the attention of many people in developed countries. Yet most of these same people do not realize that freshwater habitats are facing threats of equal magnitude. Unlike the loss of tropical forests, the loss of wetlands is occurring in everyone's backyard.

Support for atlas and monitoring programs. The complete distribution in Canada of many amphibians and reptiles remains unknown. The northern limits in particular are

poorly documented, and populations in these areas may be the most immediately affected by global climate change. The publication of atlas results will help to better document distributions, as well as increase public education about these groups.

Effective forestry guidelines. Forestry guidelines must include small, fishless headwater streams. Guidelines should take into consideration the habitat needs of amphibians and reptiles. It is important to leave slash piles and coarse woody debris on the forest floor for salamanders and snakes. Selective logging has less of an effect on species than clear-cutting.

Reduction of the use of pesticides. These pollutants often end up in ponds where they affect breeding amphibians. Contaminants frequently accumulate in the tissues of nontarget organisms and become concentrated in the amphibians and reptiles that eat them.

Identification of important national and regional areas of diversity. Identifying areas of herpetological diversity is the first step in adequately protecting key habitats. The Canadian Amphibian and Reptile Conservation Network (CARCNET) has launched the Important Amphibian and Reptile Areas program to identify these critical areas.

Ensuring ecological integrity of areas with high diversity of species at risk. Regular monitoring of these species should occur to ensure that populations remain viable. For example, Rondeau Provincial Park in southern Ontario supports six species of amphibians and reptiles that are designated by COSEWIC (Fowler's toad, spotted turtle, spiny softshell turtle, five-lined skink, fox snake, and hognose snake), yet there has been little or no research conducted on most of these species.

Inclusion of amphibian and reptile conservation in park management plans. For many species, habitat requirements — such as those for hibernation sites, breeding ponds or nesting areas, and summer forage habitat — change over the course of the year. Planning that eliminates one type of habitat or fragments habitats can result in declines or extirpations. Planning that takes into account the full spectrum of habitat requirements is most essential in small protected areas with a high degree of development (e.g., campgrounds and roads).

Identification of cryptic subspecies. Genetic analysis has recently been used to distinguish species complexes in the spotted frog and the tailed frog. In the case of the spotted frog, this analysis resulted in the discovery that one species was virtually extirpated. Effective conservation cannot occur when all species and subspecies are not known. Research efforts should be applied to determining other cryptic species or subspecies.

AMPHIBIANS

Reduction of nitrate runoff into waterways. There are a number of ways to reduce nitrate runoff into waterways: reduce fertilizer use in both agricultural and residential areas; place tile drainage systems at a greater depth; fence watercourses to keep out cattle; and encourage the development of vegetative buffer zones next to streams and other wetlands. Buffer zones also improve shelter and spawning or nesting habitat for amphibians and other species.

Research on emerging infectious diseases. So far, only one outbreak of an iridovirus in amphibians has been confirmed in Canada (in Saskatchewan) but very little research has been done on this topic. Chytridiomycosis has been linked to the decline of northern leopard frogs in the western United States and may therefore be responsible for their decline in western Canada in the late 1970s. Efforts should be made to examine preserved specimens collected during the decline for evidence of chytrid fungi. Additional research on the effects of chytrid fungi should be instigated in association with researchers in the United States.

Monitoring of disease-prone species. Infectious diseases have been linked with tiger salamanders, boreal toads, and northern leopard frogs in western North America. Routine monitoring of populations of these species should be done to identify and prevent future outbreaks.

Prevention of introduction of game fish into fishless water bodies. Introduced fish can eliminate some amphibians from a water body through competition and predation. In addition, fish may transmit diseases.

Effective groundwater management. A number of amphibian species depend on permanent water or temporary water bodies of certain duration. With the drawdown of aquifers, permanent water bodies can become seasonal and temporary wetlands may be too ephemeral to support breeding populations. This is particularly important on the prairies, in the Okanagan Valley, the mountainous streams of Quebec, and in headwater areas across Canada.

Salamanders (stream-dwelling salamanders)

Effective protection of fishless stream habitat from logging. Currently, the forestry code of most areas does not always recognize small, fishless streams, and hence logging frequently occurs right up to the stream margin. This activity usually renders the stream uninhabitable by salamanders because of increases in siltation and water temperature. The forestry codes of British Columbia and Quebec are of prime concern, given the number of COSEWIC-listed species in those provinces.

Frogs and Toads

Research on the effect of cattle on frogs. Grazing leases on the prairies have protected thousands of hectares of land that otherwise may have been developed. However, cattle routinely trample vegetation at the edge of ponds, stir up mud, and defecate in the water, possibly affecting embryo and tadpole development and survival. Research should be done to determine how cattle and amphibians can best coexist.

Bullfrog control in British Columbia. Bullfrogs are expanding their range in British Columbia, possibly because of changes in habitat. The effect on other native species is poorly known. In addition, students at elementary schools commonly collect tadpoles to study metamorphosis. Teachers must be informed that bullfrogs should not be released and that no frogs should be released in water bodies other than the one from which they were collected.

Banning of the selling of young frogs as fishing bait. The release of frogs into the wild may lead to the transmission of diseases and the spreading of genes from widely different populations.

REPTILES

Protection of communal hibernacula. Many species hibernate communally, returning to the same site each year. With so little understanding of the constraints on overwintering success, lack of optimal hibernation sites may limit many species.

Reduction of traffic mortality. Reduction of traffic mortality should be encouraged, particularly as many of the individuals killed by vehicles are females seeking nesting sites. Roadside barriers near particular hot spots may reduce traffic mortality.

Determination of the effect of the pet trade on reptiles. Even the total number of species at risk is unknown. Five-lined skinks, wood turtles, and spotted turtles are the most commonly reported species, but a number of snakes are also highly prized. Are species being exported from Canada through official channels? Conservationists should work closely with responsible members of the pet-trade community to document and control illegal collecting and trade.

Greater enforcement of wildlife regulations. Collection of individuals for the pet trade takes a serious toll on adults of many species. Given the difficulty of determining the origin of individual turtles within the pet trade, serious consideration should be given to banning the sale of all species native to Canada, regardless of their origin.

PIT tagging of all commercially desirable species. Species popular with the pet trade (e.g., spotted and wood turtles) should be marked with microchip transponders (PIT tags) in all research projects. Poaching of research animals sometimes occurs, and PIT tagging them would allow them to be identified if they should turn up after a poaching event.

Turtles (freshwater turtles)

Reduction of nest predation. In protected areas with high numbers of nest predators, nesting success may be reduced to near zero. Control of nest predators may not be feasible in many areas but may be practical where other concerns, such as rabies, also exist. Sweeping the soil at nesting areas after turtles have laid their eggs has proven to be moderately successful in some cases. In serious cases, nests should be protected with physical barriers.

Increased public awareness of traffic mortality. Public education may also help to reduce the threat presented by traffic. Newspaper articles in rural weekly newspapers could increase public education. Such articles should be timed to run just before the peak in turtle nesting and should emphasize that, because many of the turtles on the roads are females seeking to lay eggs, this issue is a "motherhood" issue. An accompanying cartoon-style graphic depicting a turtle with a Baby-on-Board sign on its carapace could be used to reinforce the message.

Lizards

Canadian lizards do not lend themselves well to group protection. Only five species are extant, and only British Columbia has more than one species.

Snakes

Public education about the role of snakes. There cannot be too much public education about the harmless nature of most snakes and their valuable role in nature. It has been argued that humans have an innate tendency to be wary of snakes, and even a few negative encounters can lead to lifelong fear (Wilson 1996). This tendency is suggested by the fact that many higher primates demonstrate an aversion to snakes, even when reared in a lab and having no previous exposure to snakes. Education, especially at the elementary school level, may help to rid people of their fear of snakes.

4.0 Conservation Action Plans

In this section, we focus on both the threats to and the conservation actions required to protect the species, subspecies, and populations identified by COSEWIC as Vulnerable, Threatened, Endangered, as of April 1999. As this document was being finalized, COSEWIC, at its annual meeting in May 2000, added two populations of the tailed frog to its list, bringing the total number of amphibians and reptiles at risk to 33 It was not possible to deal with these additions in the same manner as the other species dealt with in this report, but we provide some basic information on threats to the tailed frog. COSEWIC also changed the category Vulnerable to Special Concern, and this term has been used throughout this document.

The four categories of risk are defined as follows by COSEWIC:

- **Special Concern** — Species with characteristics that make them particularly sensitive to human activities or natural events
- **Threatened** — Species likely to become endangered if limiting factors are not reversed
- **Endangered** — Species facing imminent extinction or extirpation
- **Extirpated** — Species no longer existing in the wild in Canada, but occurring elsewhere

Limiting ourselves to the 33 species, subspecies, or populations listed as special concern, threatened and endangered reflects only administrative reality, as COSEWIC will continue to assess other amphibians and reptiles, many of which are likely to be added to the growing list of species at risk.

Patterns of risk vary across the different groups of species (Table 1). No salamander is designated at a category higher than Special Concern, even though many have very restricted distributions in Canada and appear to be declining. Frogs are designated as Endangered more than any other taxonomic group. Snakes appear on the list of species at risk more than any other group, but snakes are also the largest group of organisms among reptiles and amphibians. On a percentage basis, lizards are more at risk than any other group, making them the most threatened group of amphibians and reptiles. This is ironic because the public in Canada generally is less aware of lizards than of other groups.

Table 1. Distribution of species, subspecies, and populations at risk in Canada. An individual species may be listed more than once if more than one population has been designated. For example, the northern leopard frog is designated as Endangered in British Columbia and as Special Concern on the prairies.

	Number of Species Occurring in Canada	Endangered	Threatened	Special Concern	Total at Risk
Amphibians					
Salamanders	21	0	0	5	5
Frogs	24	4	1	5	10
Reptiles					
Turtles	12	1	2	2	5
Lizards	6	0	0	3	4
Snakes	25	3	4	3	11
Total	**88**				**33**

In the following conservation action plans, within each class of organism species are arranged taxonomically by order and family and then alphabetically by genus and species. Thus, closely related species, which often face similar threats, are placed close to each other.

It must be stressed that the existing level of knowledge pertaining to the basic life history of many species of amphibians and reptiles found in Canada is woefully lacking. Adequate management of increasingly fragmented habitats and landscapes cannot occur in the absence of knowledge about how far animals disperse, how large a home range they occupy, and what their precise requirements for hibernation habitat are. A better understanding of hibernation would benefit all species, for most Canadian amphibians and reptiles spend five or more months of the year hibernating.

4.1 Amphibians

The class Amphibia contains over 4700 described living species (Glaw and Kohler 1998). This number is more than the number of described living mammal species. In addition, description rates for amphibians continue to increase. It is estimated that the total number of amphibian species is in excess of 5000. While many "new" species are tropical, the latest addition to Canada's amphibian community occurred in the 1990s, when the spotted frog was determined to be two distinct species (the Columbia spotted frog and the rare Oregon spotted frog) on the basis of genetic analysis (Green et al. 1996, 1997).

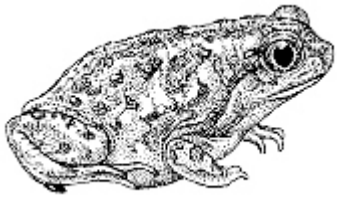
Amphibians lack a single distinct feature — such as the feathers of birds or the scales of reptiles — that identifies them as a group. Nonetheless, amphibians all share a number of characteristics:

- They are ectotherms: their body temperature depends upon the environment.
- They have soft, generally moist skin.
- Most amphibians lay unshelled eggs, either in water or in damp locations.
- Most have two distinct life phases — one aquatic and one terrestrial.

Amphibians are subdivided into three orders, only two of which are found in Canada:

1. **Salamanders (Caudata).** Salamanders make up less than 10 per cent of all amphibian species. The greatest diversity of salamander species occurs in the Appalachians of the eastern United States. Globally, salamanders are widely distributed in the Northern Hemisphere but are scarce south of the equator, except in South America.
2. **Frogs and Toads (Anura).** This is the largest order, with over 4000 species worldwide. Frogs are distributed on every continent, with the exception of Antarctica.
3. **Caecilians (Gymnophiona).** Caecilians are limbless amphibians that resemble worms. Fewer than 200 species are known, and all are limited to the tropics.

Concern over perceived global declines of amphibians began around 1990 (e.g., Blaustein and Wake 1990, Wake 1991). A meta-analysis conducted on 936 populations of 157 species from 37 countries around the world found significant declines from approximately 1960 to the present (Houlahan et al. 2000). Less than 10 per cent of the populations reflect extirpations, hence even extant populations are undergoing significant declines.



Great Basin Spadefoot Toad

4.1.1 Salamanders

Salamanders are commonly confused with lizards. They resemble lizards in shape, but unlike their reptilian counterparts, salamanders do not have scales, claws, or external ear openings. Salamanders are secretive, voiceless, and often nocturnal, and so are rarely encountered by people.

All salamanders lay eggs, either in water or in damp locations. While some species bypass the larval form, most hatch as larvae and spend months or years before transforming. Mortality is high at this stage. Some species attain maturity without transforming from the larval form. Others, such as the Pacific giant salamander, may or may not transform, depending on environmental conditions. Longevity in many species can exceed 20 years.

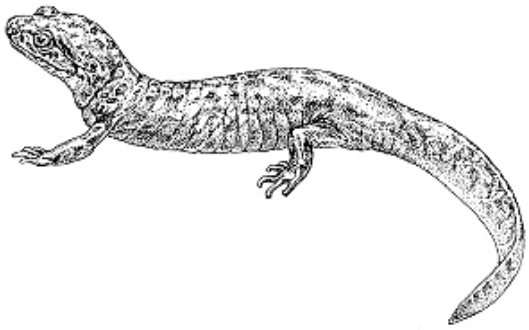
Five families of salamanders are found in Canada:

1. **Newts (Salamandridae).** A large family of Old World and New World salamanders. Only two species are found in Canada, and neither is designated by COSEWIC.
2. **Mudpuppies (Proteidae).** A small family consisting of only two genera. Only one species, the mudpuppy, is found in Canada. This is the only Canadian species that is completely aquatic.
3. **Giant Salamanders (Dicomptodontidae).** A small family consisting of only one genus with two species. Only one species, the Pacific giant salamander, is found in Canada, and it is considered a species of Special Concern by COSEWIC.
4. **Mole Salamanders (Ambystomatidae).** Large salamanders that tend to spend much of the year underground. Seven species are found in Canada. The smallmouth salamander, limited to Pelee Island in southern Ontario, is designated as Special Concern by COSEWIC.
5. **Lungless Salamanders (Plethodontidae).** The largest family of salamanders. As their name suggests, these salamanders lack lungs but breathe through their skin, which must remain moist. Ten species of lungless salamanders are found in Canada. Three species (spring salamander, mountain dusky salamander, and Coeur d'Alène salamander) are designated as Special Concern by COSEWIC.

From a conservation perspective, salamanders are an important component of many forest ecosystems. In some areas, salamander biomass can exceed that of breeding birds or small mammals (Burton and Likens 1975). Salamanders are also top predators of the detritus food chain, consuming a wide variety of invertebrates.

Although concern about the decline of amphibians has focused mainly on frogs, there is growing awareness that salamanders are also declining. In the eastern United States, researchers revisited 205 populations of 38 species of plethodon salamanders at 127 sites in 22 states originally surveyed in previous decades (Highton 2000). The number of salamanders had declined significantly in more than half of the populations. Habitat destruction accounted for the decline of only 22 populations. The cause(s) of the remaining declines is unknown.

Salamanders often depend on two distinct environments: the aquatic breeding site and the terrestrial nonbreeding environment. Protection of both is essential for population survival. Forestry practicesthat do not take into account the importance of fishless, headwater streams are a common threat to salamanders. Buffer strips along all water bodies would protect a wide range of species and ecosystem functions.



Pacific Giant Salamander

Pacific Giant Salamander *(Dicamptodon tenebrosus)*

COSEWIC Status: SPECIAL CONCERN (1989)

Recovery plan exists? No

Distribution: Limited to extreme southwestern British Columbia. Known only from 60 small streams in the Chilliwack River drainage. Populations are contiguous with U.S. populations.

Habitat: Closed-canopy mountain streams in Douglas-fir and bigleaf maple forests.

Threats: Habitat destruction and degradation. Logging practices alter or destroy stream habitat through erosion and siltation. Terrestrial adults may be threatened by clear-cutting.

Reproductive capacity to rebound: Moderate. Females can lay up to 200 eggs, but they do not breed annually. Age at maturity is at least 5 to 6 years.

Management actions completed or under way:

- The Pacific giant salamander is on British Columbia's Red List of species at risk.
- Chilliwack Lake Park protects a few creeks, and other parks partially protect some creeks.
- An inventory of populations was completed during the period from 1994 to 1996. The complete distribution of this species may not be known.

Management actions required:

- Protect additional small watersheds.
- Buffer strips should be required along streams inhabited by Pacific giant salamanders. The Forest Practices Code of British Columbia does not automatically call for buffer strips adjacent to small, fishless streams.
- The recovery potential of streams in areas that have already been logged should be determined. Pacific giant salamanders currently occur in streams running through second-growth forests that were logged in the past, which indicates that the species can either persist in spite of logging or can recolonize. Continued research on the effects of logging on habitat and life cycle are required for proper management.
- Fill basic gaps in life history information (e.g., age at maturity, factors influencing recruitment and whether larvae transform or remain aquatic, terrestrial habitat use).

Scientific contacts: Bill Neill, John Richardson

References: Farr 1989, Orchard 1992, Ethier 1993, Richardson and Neill 1997, Cannings et al. 1999

Smallmouth Salamander *(Ambystoma texanum)*

COSEWIC Status: SPECIAL CONCERN (1991)

Recovery plan exists? No

Distribution: Limited to Pelee Island in southwestern Ontario.

Habitat: Deciduous woodlands that are flooded by spring and/or fall rains.

Threats: Northern limit of species. There is little evidence that smallmouth salamanders occupied mainland Ontario in the past. Increased development on Pelee Island may reduce wooded areas. Smallmouth salamanders are part of a complex of all-female polyploid forms involving the blue-spotted salamander. Genetically pure smallmouth salamanders are more abundant in the southern portion of Pelee Island, while polyploids with blue-spotted salamanders are more abundant on the rest of the island. Genetic swamping of the smallmouth salamanders by the polyploids is a potential threat, but it remains unclear how habitat changes will affect the composition of the salamander community.

Reproductive capacity to rebound: Moderate. Females lay over 300 eggs and may breed annually. Maturity is reached after the third winter.

Management actions completed or under way:

- The smallmouth salamander has been designated as threatened by the Ontario government.
- Fish Point, where this species occurs, is a nature reserve.
- Surveys of extant populations on Pelee Island were carried out in the spring of 2000.

Management actions required:

- Maintain wooded areas and breeding ponds.
- Very little is known about the ecology of smallmouth salamanders on Pelee Island. Better understanding of the size of the home range of this species, its migration paths to breeding ponds, and its hibernation requirements would aid planning. Examination of the interaction and potential competition with the polyploid forms would clarify potential threats.

Scientific contacts: Jim Bogart, Larry Licht

References: Bogart and Licht 1991

Mountain Dusky Salamander *(Desmognathus ochrophaeus)*
COSEWIC Status: SPECIAL CONCERN (1998)

Recovery plan exists? No

Distribution: Known only from a small area in the Adirondacks of southwestern Quebec. The entire known distribution is confined to five temporary streams and two seepages in an area of only 12 square kilometres less than 5 kilometres from the New York state border. The total distribution is unknown, but is probably less than 100 per square kilometre. The mountain dusky salamander was discovered only in 1988 and is known to hybridize with the closely related dusky salamander (*D. fuscus*).

Habitat: High-elevation, cool, rocky woodland, temporary streams, and the adjacent riparian habitat. These sites are maintained by groundwater through seeps and springs.

Threats: No evidence of decline; however, populations may have been more widespread historically. The area was logged in the 1800s, primarily to clear land for agriculture, and cattle have grazed much of the area. Many of the farms in the area were abandoned in the 1950s and the forest is returning. Development pressures in the area include an increase in cottages. Significant increases in groundwater consumption could threaten the persistence of some of these temporary streams. This is a serious threat, as groundwater pumping for the bottled water industry is being considered in the area. Currently, all land occupied by the mountain dusky salamander is privately owned.

Reproductive capacity to rebound: Low. Females lay 11 to 14 eggs, but probably not annually. Maturity requires 2 to 5 years.

Management actions completed or under way:
- A peatland upstream of the area, which is important for maintaining stream flow, has been acquired by the Nature Conservancy of Canada.

Management actions required:
- Land acquisition is not sufficient to protect the mountain dusky salamander. Regional groundwater planning must be done to ensure that groundwater supplies are adequate to protect this species.
- Before groundwater pumping goes ahead, it is critical to undertake a thorough analysis of the regional groundwater flow.
- Development of a landowner stewardship program could facilitate awareness of the mountain dusky salamander and encourage good land-management practices.
- Thorough surveys for other potential populations should be undertaken in surrounding streams and seepages.
- Little is known about the movement patterns of the mountain dusky salamander in Quebec. Better understanding of the terrestrial use of habitat would aid land management.

Scientific contacts: Joel Bonin

References: Sharbel and Bonin 1992, Sharbel et al. 1995, Alvo and Bonin 1998

Spring Salamander *(Gyrinophilus porphyriticus)*

COSEWIC Status: SPECIAL CONCERN (1999)

Recovery plan exists? No

Distribution: South of the St. Lawrence River in southwestern Quebec. Populations occur in two disjunct locations, both contiguous with the United States. One population occurs in a small area (~200 km^2) in the foothills of the Adirondacks, while the other is dispersed over a large area (~30,000 km^2) in the foothills and mountains of the Appalachians. Historically the spring salamander may have occurred in the Niagara area of Ontario adjacent to Buffalo, New York.

Habitat: High-elevation, permanent, cool, rocky woodland streams and the adjacent forested area. Peak densities occur in headwater streams lacking predatory fish.

Threats: Limited by specialized habitat requirements. Habitat adjacent to streams is being modified due to agriculture. Logging practices also threaten streams. Housing developments and sports activities (e.g., skiing) threaten or have eliminated populations. A proposal for groundwater pumping for the bottled water industry would be a major threat for the Adirondack population. The drawdown of aquifers is a concern, as spring salamanders cannot survive waterless periods because of their long larval period (up to 6 years). Water pollution may also be a threat because of the long larval period and the high trophic level of adults.

Reproductive capacity to rebound: Moderate. Females can lay over 100 eggs, although they may not breed every year. Maturity is reached in 4 or more years.

Management actions completed or under way:

- The Adirondack spring salamander population is all on private land. The Nature Conservancy of Canada has acquired a peatland upstream of the area, which is important in maintaining stream flow.
- The most important protected area in the Appalachian population is Mount Orford Provincial Park. Spring salamanders occur in Yamaska Provincial Park, but there are few suitable habitats. A population also occurs in the protected area of the water reservoir for Granby on Mount Shefford.

Management actions required:

- It is necessary to protect headwater stream populations in both the Adirondacks and Appalachians. In the Adirondacks, Gulf Stream near Covey Hill is a key habitat. In the Appalachians, there is a need to identify and protect sites on various mountains, particularly on Mounts Brome, Elephant, Shefford, Stokes, and Sutton.
- The provincial forestry code requires a 20-metre buffer along streams, but small headwater streams are often overlooked. The forestry code should include buffers along these streams as well.

- Headwater populations with the highest density of salamanders should be identified, their habitat characteristics determined, and forestry practices modified to preserve these habitats.
- Regional groundwater planning is required, particularly in the Adirondacks, to ensure that streams do not dry up during the summer.
- Additional surveys at the edge of the known range should be conducted to identify unknown populations.

Scientific contacts: Joel Bonin

References: Bonin 1991, 1994, 1999

Coeur d'Alène Salamander *(Plethodon idahoensis)*

COSEWIC Status: SPECIAL CONCERN (1998)

Recovery plan exists? No

Distribution: Limited to southeastern British Columbia on the east side of Kootenay Lake and the lower Moyie River drainage. Currently known from 20 sites in British Columbia on 18 different watercourses, although the complete distribution remains unknown.

Habitat: Splash zones, rock (not earth) seepages, and riparian habitat associated with exposed bedrock and waterfalls. Coeur d'Alène salamanders occur in these wet microhabitats in a landscape that is otherwise quite dry.

Threats: Destruction, degradation, and fragmentation of habitat. Forestry practices alter or destroy stream habitat. Road construction and widening also threaten populations, as the salamanders make use of wet rock walls along the highway.

Reproductive capacity to rebound: Low. Females lay an average of 6 eggs every 2 to 3 years. Age at maturity is unknown but is at least several years.

Management actions completed or under way:

- The Coeur d'Alène salamander is on British Columbia's Red List of species at risk.
- This species occurs in one provincial park (the location is being kept secret); otherwise, no sites are protected. Two other sites are proposed protected areas — new reserves similar to nature reserves with no logging or mining.
- A steel gate has been installed over a mineshaft to prevent public access to a site with Coeur d'Alène salamanders.

Management actions required:

- Additional surveys are required to confirm the complete distribution of this species, particularly the northern limit.
- Basic biological knowledge about this species, particularly related to habitat use, dispersal ability, and the effects of isolation on populations, is lacking.
- Research is also required on how forestry activities can be adequately managed to protect Coeur d'Alène salamanders and their habitat.

Scientific contacts: Penny Ohanjanian

References: Ohanjanian 1997a, Dupuis and Ohanjanian 1998, Cannings et al. 1999

4.1.2 Anurans

Most people easily recognize frogs and toads. They occupy a wide range of habitats, from meadow to prairie to forest. All Canadian species breed in water (in water bodies ranging from temporary ponds to lakes). The eggs of frogs and toads, which they usually lay in a mass, hatch in a few days or weeks. In many species, larvae (or tadpoles) transform in a few weeks; in some species, however, larvae overwinter before transforming. While females may lay thousands of eggs, mortality in the egg and tadpole stage is naturally very high (~90%). Newly transformed frogs are also extremely vulnerable to predators, and many do not survive their first winter. In many species, adults live only long enough to breed once or twice.

Five families of anurans are found in Canada:

1. **Tailed Frogs (Ascaphidae).** A small family with only two genera and one species in North America, the tailed frog. It is found only in British Columbia and may consist of two subspecies. Both populations are listed by COSEWIC. One is designated as Endangered and the other as Special Concern.
2. **Spadefoots (Pelobatidae).** A large family well adapted to dry conditions on the prairies. Two species occur in Canada, one of which, the Great Basin spadefoot, is designated as Special Concern by COSEWIC.
3. **Toads (Bufonidae).** A large family, but all species in North America belong to the genus *Bufo*. Five species occur in Canada, two of which are at risk: the Fowler's toad of southern Ontario (Threatened), and the Great Plains toad of the prairies (Special Concern).
4. **Treefrogs (Hylidae).** A large family of relatively small frogs adapted for climbing. Seven species occur in Canada. Only Blanchard's cricket frog has COSEWIC status (Endangered), and this species is believed to be extirpated from Canada.
5. **True Frogs (Ranidae).** A large family of large "typical" frogs. All species in North America belong to the genus *Rana*. Nine species occur in Canada, three of which are listed by COSEWIC: the Oregon spotted frog of British Columbia (Endangered); the Northern leopard frog, which is widespread (Endangered in British Columbia; Special Concern on the prairies); and the red-legged frog of British Columbia (Special Concern).

Frogs face a number of threats. Globally, the concern over the decline of amphibians has been driven by the loss of a number of frog species in many tropical areas. Significant range contractions have been experienced by many North American species, typified by the northern leopard frog. Potential causes of decline include increases in UV radiation, disease, and pesticides. In Canada, the greatest threat is habitat loss. Draining of wetlands for agriculture and development has decreased the number of breeding sites, decreased the connectivity between habitats, and increased the distance between sites. Agricultural pesticides may also threaten many species. High levels of contaminants can interfere with the process of metamorphosis and have been linked to deformities.

Tailed Frog *(Ascaphus truei)*

COSEWIC Status: **Southern Mountain: Endangered (2000)**
Pacific Coast: Special Concern (2000)

Recovery plan exists? No

Distribution: Limited to British Columbia. The southern mountain population is limited to extreme southeastern British Columbia. Only four occurrences are known in two drainage systems. The Pacific coast population occurs along the Pacific coast as far north as Prince Rupert. The two populations are disjunct in both Canada and the United States.

Habitat: Restricted to cool, permanent mountain streams with stable substrates.

Reproductive capacity to rebound: Moderate. The larval stage lasts approximately 4 years, and the species can take up to 3 additional years to reach maturity.

Threats: Habitat loss and degradation from logging, which causes siltation and higher water temperatures, are the main threats.. All life stages have a narrow temperature tolerance.

Management actions completed or under way:

- Few populations of the tailed frog occur in protected areas, and none of the southern mountain populations are on protected land.
- Genetic analyses are under way to clarify the relationship of the two populations. Preliminary analyses indicate that the two populations are distinct and may warrant subspecific or specific status.

Management actions required:

- Further surveys, particularly in the southern mountain area, are required to locate additional populations.
- Habitat of existing southern mountain tailed frogs must be protected.
- Research is required on habitat requirements, dispersal ability, the effect of forestry practices on habitat quality, and the effect of forest fragmentation on population stability.

Scientific contacts: Linda Dupuis

References: Dupuis and Bunnell 1997, Cannings et al. 1999

Great Basin Spadefoot Toad *(Spea intermontanus)*

COSEWIC Status: SPECIAL CONCERN (1998)

Recovery plan exists? No

Distribution: Limited to southern British Columbia. The centre of the distribution appears to be in the southern Okanagan Valley.

Habitat: Dry grasslands, shrublands, and open woodlands with sandy soil. Shallow, ephemeral ponds are typical breeding habitat.

Threats: Loss, degradation, and fragmentation of habitat. The southern Okanagan Valley is under great development pressure from intensive agriculture and housing. A variety of other factors may be affecting populations: cattle and off-road vehicles disturb temporary breeding ponds; increased use of groundwater may be lowering the water table in the Okanagan, which reduces the duration of ephemeral ponds; the increase in the number of roads in the area may also increase traffic fatalities and increase the isolation of this population. Introduction of predatory fish into lakes and ponds may also pose a threat.

Reproductive capacity to rebound: Moderate. Females lay up to 800 eggs. Maturity is reached in 2 or more years. Reproduction is very uncertain and may occur only every few years when spring rains are intense. Even when breeding does occur, many ponds dry up before metamorphosis is complete.

Management actions completed or under way:

- The Great Basin spadefoot is on British Columbia's Blue List of species at risk (Special Concern).
- A few populations of this species are protected. The three largest known populations all have some degree of protection: the 100-hectare Haynes Lease Ecological Reserve protects part of the habitat of the Osoyoos Lake population; Crown land temporarily protects the Osoyoos sewage lagoons population; Lac du Bois Provincial Park protects the Lac du Bois population.
- The Nature Trust of British Columbia has acquired land on which spadefoot toads live. The most significant area is the White Lake Ranch west of Okanagan Falls.

Management actions required:

- Osoyoos Municipal Council is seriously considering the area around the sewage lagoons as an ideal area for a housing development project. This area is home to one of the largest known populations of spadefoot toads, and development should be prevented.
- Breeding sites should be fenced to keep out cattle.
- Priority should be given to protecting water bodies of all sizes adjacent to grassland habitat.

- Fish introductions should not be undertaken where spadefoot toads breed in permanent water bodies.
- Development on private land adjacent to major breeding sites should be discouraged.
- Basic information about the biology of this species is lacking and must be obtained to develop proper management techniques. Particular gaps in knowledge relate to such aspects as the precise aquatic habitat requirements of this species, its movement and dispersal patterns, its summer habitat requirements, and its hibernation preferences. Without this information, it is difficult to assess the amount and type of habitat required around breeding ponds.
- The potential to modify suboptimal sites to increase the amount of high-quality habitat should be assessed.

Scientific contacts: Richard Cannings

References: Orchard 1992, St. John 1993, Leupin et al. 1994, Cannings 1998, Cannings et al. 1999

Great Plains Toad *(Bufo cognatus)*

COSEWIC Status: SPECIAL CONCERN (1999)

Recovery plan exists? No

Distribution: Limited to southeastern Alberta, southern Saskatchewan, and extreme southwestern Manitoba. Populations in Alberta and Saskatchewan are contiguous, but the Manitoba range is disjunct.

Habitat: Mixed-grass prairie. Breeding sites typically are temporary, shallow ponds formed by winter melt or spring rains. Permanent water bodies fed by springs may be critical during prolonged droughts. Great Plains toads will not breed in muddy water.

Threats: Northern limit of species. Conversion of grasslands to cropland has reduced the quantity and quality of habitat. Destruction of prairie wetlands has probably reduced the number of populations and increased the distance between populations. Oil and gas development is also a potential threat. Cattle reduce the quality of breeding pond habitat by stirring up mud, an activity that poses a threat if cattle make use of a pond before the eggs in it hatch.

Reproductive capacity to rebound: High. Females lay an average of 9000 eggs annually. Maturity is reached in 3 to 5 years.

Management actions completed or under way:

- The Great Plains toad is on the provincial Red List of species at risk in Alberta.
- Many breeding sites occur within the Suffield National Wildlife Area. This site is not completely protected, as oil and gas development occurs within it.
- Great Plains toads are not known to exist in any parks in Alberta, Saskatchewan, or Manitoba. They do occur in a number of community pastures used for grazing. This land is protected from development but is not always managed for wetlands.

Management actions required:

- Determine the complete extent of the range of the Great Plains toad, particularly in Saskatchewan, using reconnaissance auditory surveys in years of high water. Surveys in the 1980s done during a drought period may have underestimated the number of populations on the prairies.
- More knowledge about dispersal, habitat use, and hibernating requirements is needed.
- In grazed areas, which make up much of the Canadian habitat, the placement near wetlands of salt blocks for cattle should be discouraged.
- Determine the significance of the effect of cattle on Great Plains toads. This research could be conducted in association with research on other sensitive prairie species — both plant and animal.
- Education programs for the oil and gas industry should be developed concerning the effects its activities have on this species. Discussion with this industry has begun.
- Encourage programs that discourage the conversion of grasslands to cropland.

Scientific contacts: Andrew Didiuk

References: James 1998, Didiuk 1999

Fowler's Toad *(Bufo fowleri)*

COSEWIC Status: THREATENED (1999)

Recovery plan exists? No

Distribution: Limited to the north shore of Lake Erie in southern Ontario. Only three major populations occur, at Rondeau, Long Point, and Point Abino. Fowler's toad has been extirpated from Point Pelee and Pelee Island since the 1940s.

Habitat: Early successional habitats around ponds along sandy shorelines.

Threats: Habitat loss along the Lake Erie shoreline. The loss of small wetlands near shoreline beaches is of particular concern because these small ponds are often important breeding sites.

Reproductive capacity to rebound: High. Females breed during their first or second spring and lay an average of 2500 eggs. Populations fluctuate dramatically. Severe winter storms reduce adult populations but create the required breeding habitat.

Management actions completed or under way:

- Fowler's toad has been designated as threatened by the Ontario government.
- Populations at Rondeau and Long Point are protected. The habitat at Long Point is more secure from landscape alteration. The population at Point Abino is on private land to which there is limited public access.
- A long-term ecological study at Long Point has been under way since 1988.

Management actions required:

- The habitat should not be modified. Fowler's toads are adapted to unstable environments, and any attempt to stabilize dunes to improve the overwinter survival of this species will result in the loss of breeding habitat to ecological succession.
- Determine the status of populations at Rondeau and Point Abino, and develop land-management policies that benefit Fowler's toads (e.g., allow natural succession to occur, preserve adequate habitat).
- Encourage beach management that favours natural conditions.

Scientific contacts: David Green

References: Green 1992, 1997, 1999

Blanchard's Cricket Frog *(Acrins crepitans blanchardi)*
COSEWIC Status: ENDANGERED (1986)

Recovery plan exists? Yes

Distribution: Historically confirmed only from Point Pelee and Pelee Island in southern Ontario; now likely extirpated from Canada.

Habitat: Permanent wetlands.

Threats: Unknown. Last observed at Point Pelee in 1920. A dramatic decline occurred on Pelee Island in the 1970s, and Blanchard's cricket frog is now likely extirpated. Substantial wetland loss has occurred on Pelee Island, but suitable habitat appears to remain still. Fluctuating water levels of Lake Erie and breaching of beach ponds by storms may also be a factor in the extirpation of this species. Exposure to agricultural pesticides may also have played a role.

Reproductive capacity to rebound: Moderate. Females breed during their first spring and can lay up to 400 eggs. The population turnover each year is approximately 100 per cent. This turnover rate makes populations particularly vulnerable to stochastic events. Blanchard's cricket frog fits a classic metapopulation model, and successful repatriation would depend on more than one connected breeding population.

Recovery plan objectives: The goal of the recovery plan is to establish four populations on Pelee Island and, after accomplishing this, establish a population in Point Pelee National Park.

Management actions completed or under way:
- None. The recovery team disbanded after completing the recovery plan. Restoration has not been deemed to be a high priority, given the modest distribution of the species within Canada and the lack of knowledge about the cause(s) of its decline.

Management actions required:
- Confirm the extirpation of Blanchard's cricket frog from Pelee Island through intensive auditory monitoring over two calling seasons.
- Evaluation of the possible causes of the decline of this species is essential before considering reintroductions. If pesticides played a role in the decline, then toxicological studies should be conducted on Blanchard's cricket frog in conjunction with jurisdictions in the United States where the species is still present.
- Determine if reintroductions are feasible or desirable on Pelee Island.

Scientific contacts: Mike Oldham
References: Oldham and Campbell 1986, Oldham 1992, Kellar et al. 1997

Red-legged Frog *(Rana aurora)*

COSEWIC Status: SPECIAL CONCERN (1999)

Recovery plan exists? No

Distribution: Widely distributed on Vancouver Island, the Gulf Islands, and the southwestern mainland of British Columbia.

Habitat: Permanent or occasionally temporary water bodies and the surrounding forested habitat.

Threats: Habitat loss through loss of wetlands has been the major threat historically. Currently, the presence of the introduced bullfrog, a predatory species, may be a significant threat. Even bullfrog tadpoles are a significant predator of newly hatched red-legged frog tadpoles. The introduction of game fish is also a significant threat to red-legged frog embryos and tadpoles. Logging may present a threat to terrestrial life stages.

Reproductive capacity to rebound: High. Females lay an average of 680 eggs and breed annually. Maturity is reached in the third year.

Management actions completed or under way:

- The red-legged frog occurs in Pacific Rim National Park, Strathcona National Park, Brooks Peninsula Provincial Park, and Elk Falls Provincial Park. The species may also occur in the following provincial parks: Garibaldi, Golden Ears, Indian Arm, Pinecone Burke, Mount Seymour, and Cypress.
- The effects on this species of forest fragmentation on Vancouver Island are currently being researched.
- A study is under way on the interactions between bullfrogs and red-legged frogs.

Management actions required:

- Research on the interactions between bullfrogs and red-legged frogs is critical in determining whether these species can coexist. Anecdotal evidence suggests that red-legged frogs decline when bullfrogs invade their habitat.
- Park staff should be made aware of the terrestrial and aquatic habitat needs of red-legged frogs.
- Confirm the presence and determine the status of populations within provincial parks where the presence of the red-legged frog is uncertain.
- Investigate the effects of the introduction of game fish.
- Prevent further loss of wetlands within the range of the red-legged frog.
- Insure habitat connectivity between occupied sites.

Scientific contacts: Heather Waye, Purnima Price

References: Waye 1999

Northern Leopard Frog *(Rana pipiens)*

COSEWIC Status: B.C. Populations: ENDANGERED (1998)
Prairie Populations: SPECIAL CONCERN (1998)
Eastern Populations: NOT AT RISK (1999)

Recovery plan exists? No

Distribution: Widespread in Canada. Historically common in southeastern British Columbia, the species is now reduced to one known native population in that province and has also been introduced to Vancouver Island. The range of the northern leopard frog has contracted significantly in Alberta, and declines have also occurred in Saskatchewan and Manitoba. Populations in British Columbia are disjunct from prairie populations.

Habitat: Highly variable. Northern leopard frog can breed in wetlands ranging from small ponds to lakes. Generally it favours relatively open areas.

Threats: Unknown. Populations of this species collapsed across the prairies during the mid-1970s to late 1970s. Potential causes include drainage of wetlands, drought, modification of habitat, introduction of game fish, use of pesticides, disease, eutrophication of wetlands, and increases in UV radiation.

Reproductive capacity to rebound: High. Females mature in under 2 years and can lay up to 7000 eggs. Mortality is very high (~90%) before metamorphosis. Recolonization of now unoccupied watersheds may be difficult without human intervention.

Management actions completed or under way:

- The northern leopard frog has been declared provincially endangered in Alberta and is on British Columbia's Red List.
- This species occurs in a number of protected areas. In British Columbia, it is limited to the Creston Valley Wildlife Management Area. It occurs in the Suffield National Wildlife Area and a number of public lands leased for grazing in Alberta, and it is present in Grasslands National Park in Saskatchewan. There is little current information on the distribution of the northern leopard frog in Manitoba.
- Some areas in Alberta have been fenced to keep cattle out of wetlands.
- Trial reintroductions in central Alberta resulted in northern leopard frogs breeding and surviving for several years.
- In the Caroline, Alberta, area in 1999, 1500 young of that year were released from egg masses hatched in captivity.
- During 1998/99, additional surveys were conducted in the Columbia Basin of British Columbia for other populations that may still exist. No new populations were detected.
- Creston Valley Wildlife Management Area has agreed to postpone drawdowns at the northern leopard frog location and will help manage the area for this species. Historically, this site has been managed for waterfowl.

- Fencing has been constructed along the western edge of the Creston site to exclude cattle.
- Habitat use in spring, summer, and winter is being examined at the Creston site, and surveys for predatory fish are being undertaken.

Management actions required:
- Halt the loss of prairie wetlands.
- Maintain natural aquatic connections between wetlands. Northern leopard frogs disperse along these aquatic corridors, and the increasing trend toward channelization may hinder the dispersal of the species.
- Northern leopard frogs should be reintroduced to now unoccupied watersheds. Reintroduction is being considered at another site in the Creston Valley Wildlife Management Area in British Columbia and in areas in Alberta.
- Hibernation, breeding, and summering habitat should be mapped to assess landscape-level habitat requirements.
- Protection of continuous riparian habitat along major rivers on the prairies is essential for maintaining connections between wetlands and ensuring that travel corridors exist.
- Develop guidelines for creating and maintaining suitable habitat for northern leopard frogs in wetlands managed for waterfowl.
- Recent evidence suggests that this species may have declined in Colorado because of chytridiomycosis. There is an urgent need to locate northern leopard frogs collected during the decline on the prairies and test them for the presence of the chytrid fungus.

Scientific contacts: Heather Waye (BC), Wayne Roberts (AB)

References: Ohanjanian 1997b, Seburn et al. 1997, Wagner 1997, Seburn and Seburn 1998a, Waye and Cooper 1999

Oregon Spotted Frog *(Rana pretiosa)*

COSEWIC Status: ENDANGERED (1999)

Recovery plan exists? In progress

Distribution: Limited to the extreme southwestern corner of British Columbia in the Fraser River Lowlands. This species is currently known only from three sites. The Oregon spotted frog was identified as a unique species separate from the more widely distributed Columbia spotted frog in 1997. The Oregon spotted frog was previously believed to be extirpated.

Habitat: Breeds in shallow areas of permanent wetlands. Mainly aquatic.

Threats: Loss and fragmentation of habitat have been the major threats historically. Other threats include the introduced predatory bullfrog, game fish, livestock, and alteration of the water table. Agricultural pollutants may also threaten this species, as it appears to be highly sensitive to nitrates. Reed canarygrass *(Phalaris arundinacea),* an invasive perennial with creeping rhizomes, is present at all sites and reduces the amount of open breeding habitat. The three remaining populations are isolated from each other. Two are only about 10 kilometres apart, and the third is about 50 kilometres away from the other sites. Globally, the Oregon spotted frog is no longer present in over 90 per cent of its historic range.

Reproductive capacity to rebound: High. Females lay approximately 1000 eggs annually. Maturity is reached in 3 or more years.

Management actions completed or under way:

- The Oregon spotted frog is on British Columbia's Red List of species at risk.
- Intensive searches in 1996/97 confirmed that this species was present in British Columbia at three localities.
- One site (Naval Radio Station) is owned by the Department of National Defense, and this site offers some protection, as natural succession is held back by staff and civilians are not allowed on the site. The second site (Mountain Slough) is on private land, but there is little chance of development there because of the hydrology of the site. The third site (Maria Slough) is owned by the Seabird Indian Band.
- A management plan for the Naval Radio Station site is under way.

Management actions required:

- Increase protection of the three extant populations of the Oregon spotted frog.
- It is important that surveys for unknown populations be done, as other localities may exist.
- Ensure that no further loss of wetland habitat occurs in the Lower Fraser Valley.
- Halt introductions of exotic species to wetlands, and instigate removal programs for introduced predatory species.

- Any wetlands containing this species should be protected and monitored, given the low number of populations in Canada and globally.

Scientific contacts: David Green, Russ Haycock

References: Green et al. 1996, 1997; Haycock 1999a, b; Marco et al. 1999

4.2 Reptiles

More than 6600 species of reptiles occur worldwide (Russell and Bauer 1993). In the early decades of the 20th century, many new species were described. That "boom" of discovery appears to be over (Stork 1999).

Reptiles, which evolved from the ancient amphibians, are characterized by shelled eggs and dry, scaly skin. The scaly skin is taken to an extreme with the hard shell of most turtles. Unlike amphibians, reptiles do not undergo metamorphosis. They possess claws and external ear openings.

There are four orders of reptiles, two of which occur in Canada:

1. **Turtles (Chelonia).** There are more than 250 species of turtles in the world. Turtles are adapted to a variety of terrestrial habitats, including deserts, in which tortoises live. Many species are also adapted to aquatic life, in both freshwater and marine ecosystems.
2. **Lizards and Snakes (Squamata).** Snakes and lizards are each a suborder of Squamata, although some authorities consider each group to be a separate order. Snakes evolved from the lizards and together the two suborders contain over 6300 species.
3. **Alligators and Crocodiles (Crocodylia).** This order is a small group of approximately 20 species worldwide that are adapted to freshwater, brackish, and marine ecosystems.
4. **Tuatara (Rhynchocephalia).** This order is represented by two lizard-like species, the Tuatara, from New Zealand.

4.2.1 Turtles

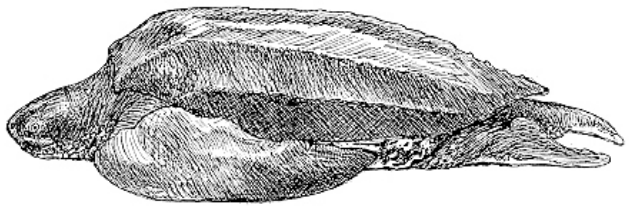
With their characteristic shell, turtles are easily identified. While only freshwater turtles breed in Canada, sea turtles make use of marine waters off both the east and west coasts. Unlike many species of reptiles, turtles tend not to be feared by most people. This may be because of the perceived slowness and the lack of aggression in many turtle species. In many cultures, turtles are a symbol of longevity and wisdom.

In general, turtles are characterized by a number of biological traits. They are long-lived and slow to mature. Many species in Canada require 10 or more years to mature. Females typically do not breed every year. All species lay eggs. Nests are simple holes dug in a loose substrate in a sunny area. In most species of turtles, sex determination is temperature dependent — the incubation temperature of the eggs determines the sex of the offspring.

Six families of turtles occur in Canada:

1. **Snapping Turtles (Chelydridae).** A small family of only two species. Only the snapping turtle occurs in Canada. It is widespread and relatively common.
2. **Musk and Mud Turtles (Kinosternidae).** A family of 20 or more species, most occuring in Central America. One species, the common musk turtle, occurs in Canada. It is limited to southern Ontario and extreme western Quebec.
3. **Pond and Marsh Turtles (Emydidae).** The largest family of turtles, with approximately 100 species. Five species are native to Canada, three of which have COSEWIC Status: the spotted turtle (Special Concern), the wood turtle (Special Concern), and the Blanding's turtle (Threatened in Nova Scotia).
4. **Marine Turtles (Cheloniidae).** A family of six species. Three of them are reported occasionally in Canadian waters: the Atlantic Ridley turtle, the green turtle, and the loggerhead turtle.
5. **Leatherback Sea Turtles (Dermochelyidae).** A family of only one species, the leatherback sea turtle. It is the largest living turtle and may weigh over 900 kilograms and reach lengths in excess of 2 metres. The carapace of this species, unlike that of other sea turtles, lacks horny scutes but is covered with a leathery skin. The leatherback is considered Endangered by COSEWIC.
6. **Softshell Turtles (Trionychidae).** A large family, with many Asian species. These turtles lack the hard shell of most turtles. Only the spiny softshell occurs in Canada. It is designated as Threatened by COSEWIC.

Turtles face a number of threats. Loss and degradation of habitat affect virtually all species. Traffic is a serious threat, particularly to adult females seeking nesting sites. Nest predation, especially in many "protected areas," approaches 100 per cent because of elevated populations of raccoons and skunks. Because adult turtles may live 30 or more years, the lack of recruitment into the breeding population can go unnoticed for years. An increasingly important threat is collection for the pet trade. Unscrupulous dealers can wipe out entire populations when turtles aggregate during certain times of the year. Even the occasional removal of adults can eliminate populations. Chemical pollutants have been identified as a cause of decreased egg viability and increased rates of hatchling deformities in some polluted areas of the Great Lakes.



Leatherback Turtle

Spotted Turtle *(Clemmys guttata)*

COSEWIC Status: SPECIAL CONCERN (1991)

Recovery plan exists? No, but in Ontario a joint recovery team for the spotted turtle and wood turtle was formed in early 2000.

Distribution: Southern Ontario and possibly south of the St. Lawrence River in Quebec. There are only three records from Quebec, so either spotted turtles are very restricted in their distribution or they no longer occur in that province.

Habitat: Varies across the range. In southern Canada, the spotted turtle occupies marshes and ponds, while farther north it lives mainly in bogs.

Threats: Loss of wetlands in southern Ontario has probably eliminated populations. Populations tend to be small and isolated. Spotted turtles often make use of wetland complexes, and the fragmentation of these habitats may eliminate populations. Illegal collecting for the pet trade may be a significant threat to this species. Spotted turtles will hibernate communally, and their hibernation sites may be critical habitat for the survival of this species.

Reproductive capacity to rebound: Low. Females require 10 or more years to mature, tend to breed every other year, and lay an average of only 5 eggs. Nest predation is high.

Management actions completed or under way:

- The spotted turtle is designated as vulnerable by the Ontario government.
- Harvest or collection of spotted turtles is illegal in Ontario.
- The spotted turtle occurs in a number of protected areas in Ontario, including Georgian Bay Islands and Point Pelee National Parks (where there have been no observations in the last 10 years), Big Creek National Wildlife Area, Long Point Provincial Park, MacGregor Point Provincial Park, Rondeau Provincial Park, and Mer Bleue Bog.

Management actions required:

- Reduce illegal collecting.
- Maintain habitat quality of occupied wetlands.
- Identify and protect group hibernacula and nesting areas.
- Decrease nest predation in areas of subsidized predators such as raccoons.
- Determine the status of poorly documented populations in cooperation with the Natural Heritage Information Centre (Ontario Ministry of Natural Resources). Many sites have reports of only one or two individuals. Whether these are extant populations should be determined.
- Designate the spotted turtle as specially protected in national parks. Doing so will result in higher fines for people caught collecting this species illegally.

Scientific contacts: Ron Brooks (Ontario), Roger Bider (Quebec)

References: Oldham 1991; Litzgus and Brooks 1998a, b; Haxton and Berrill 1999; Seburn 1999

Wood Turtle *(Clemmys insculpta)*

COSEWIC Status: SPECIAL CONCERN (1996)

Recovery plan exists? No, but in Ontario a joint recovery team for the spotted turtle and wood turtle was formed in early 2000.

Distribution: Southern Ontario, southern Quebec, New Brunswick, and Nova Scotia.

Habitat: The most terrestrial Canadian turtle. It is associated with sand- and gravel-bottomed streams in areas of open-canopy forest.

Threats: Illegal collecting — either commercially for the pet trade or on an occasional basis — is a serious threat. As wood turtles become more rare, their value in the pet trade has increased. Loss, degradation, and fragmentation of habitat have also been a serious threat. Damming and channelization of streams have destroyed essential habitat. Mortality from agricultural activities is also significant in some areas. Wood turtles may hibernate communally, and their hibernation sites may be particularly sensitive to disturbance.

Reproductive capacity to rebound: Low. Females do not mature until at least 15 years of age, and many do not breed every year. Clutch size is approximately 10. Nest predation is typically greater than 80 per cent.

Management actions completed or under way:

- The wood turtle is listed on Appendix II of CITES, which means that trade must be permitted to be legal.
- Harvest or collection of this species is illegal in all provinces.
- The wood turtle occurs in the following protected areas: Algonquin Provincial Park in Ontario and La Mauricie National Park in Quebec. No population in New Brunswick or Nova Scotia is located in a protected area.
- A communal nesting site near La Mauricie National Park is in the process of being acquired by La Fondation de la Faune du Québec. Once acquired, the site will be managed by the St. Lawrence Valley Natural History Society.

Management actions required:

- Deter illegal collecting for the pet trade or by individuals.
- More vigorously enforce prohibitions on collecting.
- Maintain water quality, control sedimentation, restrict pesticide use, and establish streamside buffer zones in known habitat.
- Road building near known habitat should be minimized, and roads should not parallel inhabited streams.
- Identify and protect important communal hibernation sites.
- Reduce nest predation.
- Deter females from nesting along the shoulders of roads by modifying the substrate, establishing a thick vegetative cover, or paving the shoulder. Ensure safe nesting habitat exists nearby.

- Where necessary, create or augment nesting habitat. Nesting areas should have a sandy substrate, a slope of less than 40 degrees, a southern aspect, and less than 20 per cent ground cover and should be more than 1 metre above the water level and preferably less than 10 metres from water.
- Encourage landowners to learn about wood turtle habitat and ways to protect this species (e.g., preserving nesting habitat).

Scientific contacts: Ron Brooks (Ontario), Roger Bider (Quebec), Don McAlpine (New Brunswick), Tom Herman (Nova Scotia)

References: Litzgus and Brooks 1996, Buech et al. 1997, Herman 1997, Saumure and Bider 1998, Seburn 1998, Brooks et al. 1999, Galois and Bonin 1999

Blanding's Turtle *(Emydoidea blandingi)*

COSEWIC Status: Nova Scotia Populations: THREATENED (1993)
Other Populations: NOT AT RISK

Recovery plan exists? Yes, for Nova Scotia populations.

Distribution: Southern Ontario, extreme southwestern Quebec, and southern Nova Scotia, where there are at least two disjunct populations.

Habitat: Limited in Nova Scotia to peaty, slow-flowing streams near lakes.

Threats: These populations are remnants from a warmer climatic period. Establishing Kejimkujik National Park (the centre of the Nova Scotia range) may have increased raccoon populations and hence predation of Blanding's turtle nests. Habitat modifications, such as the construction of roads, beaches, and campgrounds, may have reduced habitat. A population outside the park on an adjacent watershed occurs mainly on private land. Manipulation of the water level for hydroelectric power is a significant potential threat. Populations may also be declining in Ontario.

Reproductive capacity to rebound: Low. Females require up to 20 years to mature and do not breed annually in Nova Scotia. Clutch size averages approximately 10 eggs, but successful hatching is constrained by low seasonal temperatures and high nest predation.

Recovery plan objectives: The goal of the recovery plan is to establish a self-sustaining population both in protected areas (Kejimkujik National Park [KNP]) and outside the park within the species' historical range in Nova Scotia. The recovery team has identified four main objectives:

1. Determine the habitat requirements and habitat availability for the population
2. Implement protection and management of habitat necessary for recovery
3. Clarify our understanding of life history and distribution, particularly of juveniles
4. Stabilize the population's age structure through increased recruitment

Management actions completed or under way:
- KNP is restricting public access to known nesting areas of Blanding's turtle within the park.
- KNP is restricting the use of machinery (e.g., lawn mowers and road maintenance equipment) alongside roadways during the nesting season.
- KNP is considering the needs of Blanding's turtles during any development planning.
- Nests have been screened to foil nest predators.
- A public poster program resulted in the identification of a population outside of KNP.

Management actions required:
- Reduce nest predation to ensure long-term survival.
- Ensure protection of habitat outside of KNP.

- Determine the status of populations in Ontario and Quebec.

Scientific contacts: Tom Herman

References: Herman et al. 1995, 1998; Standing et al. 1997, 1999; Mockford et al. 1999

Leatherback Sea Turtle *(Dermochelys coriacea)*

COSEWIC Status: ENDANGERED (1981)

Recovery plan exists? In progress

Distribution: Adults not uncommon off the Atlantic coast from May to November; very rare off the coast of British Columbia. Globally, the leatherback sea turtle is the most widely distributed reptile in the world.

Habitat: Shallow water inshore of the edge of the continental shelf. Leatherbacks are also observed in deep ocean waters.

Threats: The major threat in Canadian waters is entanglement in fishing gear. Industrial waste and ingestion of plastic items mistaken for jellyfish may cause mortality. Outside of Canada, nesting habitat is diminishing and the leatherback is threatened by excessive collecting of its eggs. Fisheries operating adjacent to nesting beaches may also result in significant mortality of adults. High-seas drift nets are also a source of mortality.

Reproductive capacity to rebound: Moderate. Females apparently breed every 2 to 3 years, laying 6 or more clutches of up to 150 eggs. It is unclear how many years this species takes to reach maturity, but probably 10 or more.

Management actions completed or under way:

- The leatherback is listed on Appendix I of CITES, which prohibits virtually all trade.
- This species is specifically protected in New Brunswick under the New Brunswick Endangered Species Act.
- Specific legal protection is under way in Nova Scotia. (Both Prince Edward Island and Newfoundland consider the species to fall under federal mandate.)
- The Nova Scotia Leatherback Turtle Working Group has been formed.
- A video designed to inform fishers about entrapped leatherbacks and their release has been produced.
- The working group (Nova Scotia), federal fisheries officers (New Brunswick), and the Canadian Coast Guard (Newfoundland) assist leatherbacks entangled in fishing gear.

Management actions required:

- Coordinate approaches for assisting entangled leatherbacks.
- Continued to educate fishers and fisheries officers.
- The characteristics of leatherback habitat in Canadian waters must be determined more precisely. This knowledge will help identify when and where leatherbacks may be at risk.
- Deter Canadians vacationing in tropical locations from buying sea turtle merchandise. These products cannot be brought into Canada, as all sea turtles are listed on Appendix I of CITES.

Scientific contacts: Don McAlpine (New Brunswick), Mike James (Nova Scotia), John Lien (Newfoundland)

References: Cook 1981, Goff and Lien 1988, Goff et al. 1994, Ernst et al. 1994

Eastern Spiny Softshell Turtle (A*palone spiniferus spiniferus*)
COSEWIC Status: THREATENED (1985)

Recovery plan exists? Yes

Distribution: Limited to four apparently isolated areas in southern Ontario and Quebec: the Ottawa and St. Lawrence Rivers, Lake Champlain and surrounding tributaries, the western end of Lake Ontario, and southwestern Ontario.

Habitat: Mainly riverine. The eastern spiny softshell turtle prefers areas with a soft substrate, sandbars, and mud flats. Nests are laid in sandy areas close to water in full sunlight. Hibernation sites require well-oxygenated water and a soft substrate.

Threats: Loss, alteration, and fragmentation of habitat. A number of stream-management techniques affect softshell turtles. Bank stabilization projects eliminate or prevent access to nesting sites. Sandy areas preferred for nesting are often used for human recreation. Dams alter stream flow, reducing spring flows that historically scoured away vegetation and maintained open areas. Dams also may increase water levels after nesting, which causes flooding of nests. Pollution, nest predation, incidental catches by fishers, removal by collectors, and removal for food are also threats to this species. Lack of good hibernation sites may be a limiting factor. Softshell turtles tend to hibernate in large numbers, and therefore populations are vulnerable at these times.

Reproductive capacity to rebound: Low. Females require 12 or more years to mature. Typically, softshell turtles lay a single clutch of 12 to 18 eggs. Nest predation is high.

Recovery plan objectives: The goal of the recovery plan is to downlist the softshell turtle from Threatened to Special Concern. The recovery team has identified four objectives:

1. Maintain current population numbers.
2. Manage habitat to allow for the population to increase.
3. Prevent any net loss of habitat for the southwestern Ontario subpopulation.
4. Prevent any net loss of and increase the amount of habitat available for the other subpopulations.

Management actions completed or under way:

- The creation, enhancement, and protection of nest sites are being undertaken in southwestern Ontario.
- Agreements are being developed with landowners in southwestern Ontario on whose land there are nest sites..
- The softshell turtle occurs in the following protected areas: Point Pelee National Park and Rondeau Provincial Park.
- Nesting and hibernation sites in the Lake Champlain population were identified through radio telemetry during the period from 1996 to 1999.

- Studies in Quebec are being conducted in collaboration with U.S. organizations because softshell turtles move between Quebec to Vermont over the course of the year. The agencies involved are U.S. Fish and Wildlife, Vermont Fish and Wildlife, and The Nature Conservancy.
- Negotiation for protection of critical sites in Quebec is under way.
- In Quebec, awareness campaigns focusing on landowners, local municipalities, and commercial fishers are being conducted. These campaigns include pamphlets, posters, and presentations by the St. Lawrence Valley Natural History Society.
- A ban on the selling of all species of softshell turtles is in effect in Quebec.

Management actions required:

- Determine if populations remain in all four identified areas. There are few recent reports of softshell turtles from the Ottawa River or the western end of Lake Ontario, and these populations may be close to being extirpated. Softshell turtles were last observed at Point Pelee National Park in 1996; their status there is unknown and probably precarious at best.
- Decrease nest predation. At Rondeau Provincial Park, nest predation of unprotected nests in 1998 was 100 per cent. Sweeping away all signs of the female from the nest area has proven effective for deterring predators.
- Identify and protect key hibernation and nesting sites.
- Determine the genetic relatedness of isolated subpopulations.
- Work toward restricting human access (by land and water) to critical sites (e.g., nesting areas) in which turtles concentrate and are at risk of disturbance or injury (e.g., from boat propellers or fishhooks). A key area is the nesting site within the city of London, which is in one of the most vandalized areas of the city.
- Ban selling of all softshell turtles in Ontario. International trade in softshell turtles for human consumption is growing in Asian markets. This trade increases the risk that eastern spiny softshell turtles will be collected and sold, both for domestic uses and for export. Given the difficulty of distinguishing softshell species, the only reliable solution is to ban the sale of all softshell turtles.

Scientific contacts: Michelle Fletcher (Ontario), Patrick Galois (Quebec)

References: Campbell and Donaldson 1985; Ernst et al. 1994; Fletcher 1996, 1997, 1998; Oldham and Obbard 1996; Bonin 1997; Ministère de l'Environnement et de la Faune 1997

4.2.2 Lizards

Lizards are the most diverse group of reptiles, and over 3800 species occur worldwide (Russell and Bauer 1993). Most species are not adapted to cool climates, so Canada has only five species. One additional species, the pygmy short-horned lizard, has been extirpated from Canada.

Most lizards, and all Canadian species, are insectivorous. While most species lay eggs, a number of species in a variety of families bear live young. In Canada, the three skink species all lay eggs, while the short-horned and northern alligator lizards both bear live young.

The five Canadian lizard species represent three families:

1. **Skinks (Scincidae).** A large family of more than 1000 species. Skinks are smooth, cylindrically shaped lizards. Three species occur in Canada, making the skinks the most diverse family of lizards in Canada. Two of the three species have been designated by COSEWIC: the five-lined skink and the northern prairie skink are both designated as Special Concern.
2. **Horned Lizards (Phrynosomatidae).** A family of over 100 species. Some authorities consider this group to be a subfamily of the Iguana family. Horned lizards are distinctive, with squat bodies and "spines." Two species are known historically from Canada: the pygmy short-horned lizard of British Columbia has been extirpated and the short-horned lizard of the prairies has been designated as Special Concern by COSEWIC.
3. **Alligator Lizards (Anguidae).** A family of approximately 75 species. Alligator lizards have stiff bodies because of bony armour (osteoderms) in their skin. Only one species is found in Canada, the northern alligator lizard. It is limited to southern British Columbia.

The greatest threat to most lizard species in Canada is habitat loss. Most species are limited to extreme southern Canada and therefore reside in the most populated areas of the country. Habitat degradation may be an issue in areas where hibernation sites are limited, but very little information is available on this subject. Collecting for the pet trade is a threat to some species as well.

Five-lined Skink *(Eumeces fasciatus)*

COSEWIC Status: SPECIAL CONCERN (1998)

Recovery plan exists? No

Distribution: Two disjunct areas of southern Ontario: on the Canadian Shield and along lakeshores in extreme southwestern Ontario.

Habitat: Varies across range. In southwestern Ontario, the five-lined skink is found in sandy areas along the shoreline of Lake Erie, as well as in open sandy woods. On the Canadian Shield, the species is found in rock outcroppings. Five-lined skinks make their nests under woody debris or in logs (in southwestern Ontario) or under thin rock slabs (on the Canadian Shield).

Threats: At Point Pelee National Park, the population has declined because of removal or destruction of woody debris and logs by park staff (this activity was stopped in about 1994) and park visitors. Illegal collecting of eggs and nesting females is also a serious threat at the park. Collecting has also caused the removal and destruction of woody debris. Little information is available about the status of populations on the Canadian Shield.

Reproductive capacity to rebound: Low. Females require more than 1 year to reach maturity and rarely live more than 5 years. Clutch size is small (<10).

Management actions completed or under way:

- The five-lined skink has been designated as vulnerable by the Ontario government
- This species occurs in a variety of protected areas, including Georgian Bay Islands and Point Pelee National Parks and Awenda, Petroglyphs, Pinery, Rondeau, and Six Mile Lake Provincial Parks. Skinks may be quite rare in some of these areas.
- Point Pelee National Park now is removing drift material only from the shorelines of beach areas. Experimental movement of this material to the stabilized dunes has resulted in increased abundance of five-lined skinks, but the material (including logs) continues to disappear.
- Removal or disturbance of woody debris is prohibited at Point Pelee, yet these activities remain a major threat to the critical habitat.
- Interpretive programs at Point Pelee emphasize that visitors are not allowed to remove anything from the park, including plants, animals, and inanimate objects.
- The five-lined skink has been identified as a species of high conservation concern in the current draft of the management plan for Point Pelee and has been designated as a protected species in the National Parks Act.

Management actions required:

- Enforcement of the ban on collecting wildlife must occur in all parks.
- Removal or disturbance of woody debris must be deterred in all parks through a variety of means, including interpretive programs, signage, and enforcement by staff.

- Protection of stabilized dune areas is important for maintaining required habitat.
- Parks in which five-lined skinks live should incorporate this species into their management plans.
- Determine if populations on the Canadian Shield are stable or declining.
- Encourage landowners to protect or enhance microhabitat. Five-lined skinks can easily coexist with people if given due consideration, which may be as simple as providing cover objects in sunny locations and confining pets.

Scientific contacts: Stephen Hecnar, Carolyn Seburn

References: Seburn 1993, Seburn and Seburn 1998b, Hecnar 1994, Hecnar and M'Closkey 1998

Northern Prairie Skink *(Eumeces septentrionalis septentrionalis)*
COSEWIC Status: SPECIAL CONCERN (1989)

Recovery plan exists? No

Distribution: Restricted to two areas in southwestern Manitoba: the area of Shilo and Spruce Woods east of Brandon, and the Lauder Sandhills southwest of Brandon; populations are disjunct from distributions in the United States.

Habitat: Open areas of prairie vegetation with sandy soil.

Threats: Unclear if declines have occurred. Populations in Canada are probably a relict from the Hypsithermal, 4000 to 6000 years ago, when conditions were warmer on the prairies. The northern prairie skink occupies the majority of the available areas of sandy soil in southwestern Manitoba. One of the major threats is the loss of prairie habitat through fire suppression, which allows the expansion of Aspen Parkland. The European invasive exotic leafy spurge *(Euphorbia esula)* is taking over many prairie areas in southwestern Manitoba. It forms large, dense patches, which the skinks avoid.

Reproductive capacity to rebound: Low. Females mature after their second or third winter and appear to breed annually. Clutch size is generally less than 10. Reproductive success is probably low in cool, wet summers.

Management actions completed or under way:
- Some populations of the northern prairie skink occur within Spruce Woods Provincial Park, Spruce Woods Forest Reserve, and Canadian Forces Base Shilo, but land-use practices do not necessarily protect the northern prairie skink.

Management actions required:
- It is essential to preserve and reclaim as much of the native prairie ecosystem as possible. Controlled burns should be implemented in Spruce Woods Provincial Park and Crown lands in Carberry Sandhills to prevent conversion to Aspen Parkland.
- Controlled burns would also help control the spread of leafy spurge. This is essential for the long-term survival of the northern prairie skink, as leafy spurge has taken over complete ridges, forcing skinks to move to other areas. In three locations, skinks appear to have disappeared with the invasion of leafy spurge.
- Halt loss of prairie habitats on sandy soils.

Scientific contacts: Errol Bredin

References: Bredin 1989, 1993

Short-horned Lizard *(Phrynosoma hernandezi)*

COSEWIC Status: SPECIAL CONCERN (1992)

Recovery plan exists? No

Distribution: Southeastern Alberta and southwestern Saskatchewan (ranges are not contiguous).

Habitat: Occupies ecotones, particularly along coulee and canyon rims. South-facing slopes are preferred in general.

Threats: Populations in Canada are probably a relict from the Hypsithermal, 4000 to 6000 years ago, when conditions were warmer on the prairies. Development of coulee edges or cropping too close to edges can eliminate habitat. Ongoing oil and gas development is occurring throughout the range of the short-horned lizard in southern Alberta. This species makes use of vehicle tracks as travel routes, a behaviour that may result in significant traffic mortality during the construction of oil wells. Habitat disturbance from oil and gas development often leads to erosion, which reduces the habitat available for the short-horned lizard. Populations near urban centres appear to become eliminated because of incidental catches by children and predation by cats.

Reproductive capacity to rebound: Low. Females may require more than 1 year to reach maturity and rarely live more than 5 years. Clutch size is small (<10).

Management actions completed or under way:

- Based on the perception that the species was not severely at risk, the short-horned lizard has been downlisted from the Red List to the Blue List of species at risk in Alberta.
- In theory, oil and gas developments must conduct site impact assessments for short-horned lizards in Alberta. Such assessment does not appear to be occurring.
- The short-horned lizard is not known from any parks in Alberta. The species occurs on many public lands leased for grazing. Grazing appears to be a compatible land use and has undoubtedly preserved much short-horned lizard habitat.
- All known populations in Saskatchewan are within the boundaries of Grasslands National Park.

Management actions required:

- Prevent cropping or other development within 100 metres of coulee edges.
- Carry out intensive monitoring to determine if populations are declining.

Scientific contacts: Larry Powell

References: Powell and Russell 1998, Powell et al. 1998

4.2.3 Snakes

More than any other group of organisms, snakes are feared and persecuted by humans. These fears are unwarranted, as even rattlesnakes are more apt to avoid humans than to attack them.

Snakes are a highly diverse group, consisting of more than 2000 species. They occupy habitats ranging from marshes to deserts. All species are either insectivorous or carnivorous. Many species lay eggs, but some bear live young. This adaptation has allowed the common garter snake to exist farther north in Canada than any other reptile.

Only three families of snakes occur in Canada:

1. **Typical Snakes (Colubridae).** This is the largest family of snakes in the world, containing roughly 75 per cent of all species. Twenty-one species are found in Canada. Ten species or subspecies have been designated by COSEWIC. Three are designated as Endangered, four as Threatened, and three as Special Concern.
2. **Vipers (Viperidae).** Three species of rattlesnakes are known from Canada. The timber rattlesnake was extirpated from southern Ontario during the first half of the 20th century. The massasauga is designated as Threatened by COSEWIC.
3. **Boas and Pythons (Boidae).** Only one species of boa is found in Canada, the rubber boa of southern British Columbia. It is a secretive snake and may be declining.

The greatest threat to snakes is humans, who kill snakes intentionally or run over them accidentally (or intentionally). Because of the warmth of tarmac roads, snakes are often attracted to them, particularly in the evening as air temperatures drop. Loss and degradation of habitat also take their toll on snake populations. Collection for the pet trade is a threat to some species.

Blue Racer

Blue Racer *(Coluber constrictor foxii)*

COSEWIC Status: ENDANGERED (1991)

Recovery plan exists? Yes

Distribution: Now limited to Pelee Island in southern Ontario. There are post-1950s records from Point Pelee and Pinery Provincial Park, but these populations are now extirpated.

Habitat: Mainly open areas, such as prairies and old fields. Blue racers use limestone fissures for hibernacula. This species hibernates in small groups, often with fox snakes and Lake Erie watersnakes.

Threats: Traffic is a significant and growing threat on Pelee Island because of the increase in visitors. A minimum of 75 blue racers were killed during the period from 1993 to 1995. Other threats include habitat loss, natural succession toward forest, and persecution by humans.

Reproductive capacity to rebound: Moderate. Females mature before age 3 and generally breed annually. They lay approximately 15 eggs.

Recovery plan objectives: The goal of the recovery plan is to make the blue racer self-sustaining in Ontario through actions to make the existing Pelee Island population secure, and by creating at least one additional self-perpetuating population within the former occupied range on the Ontario mainland.

Management actions completed or under way:

- The blue racer has been designated as endangered by the Ontario government.
- Two hedgerows have been created to provide movement corridors.
- Four artificial hibernacula were created, but two were dismantled due to community opposition.
- A video was created for the ferry to Pelee Island to highlight the ecology of the island, including the blue racer.
- Several conservation initiatives for the restoration and protection of habitat are under way on Pelee Island.

Management actions required:

- It is critical to increase community awareness of and support for the blue racer. Without community support, successful recovery cannot occur.
- The largest subpopulation on the island, at Browns Road Savanna, is completely on private land, and more than 80 per cent of the land is zoned for limestone extraction. This site should be protected.
- Increase the amount of prime habitat through planned burns or other means to halt natural succession to forest.

- Nesting sites in rotting logs along shorelines are frequently disturbed. Either the land must be protected or alternate nesting sites must be found or created. Experiments with artificial nesting structures should be continued.
- The establishment of bicycle paths to reduce vehicular traffic by tourists could reduce traffic mortality.
- Reduced speed limits on roads in blue racer habitat may help to reduce traffic mortality.
- Establishment of a mainland population is considered most logistically feasible at Pinery Provincial Park. Habitat restoration must be continued before this can occur.

Scientific contacts: Ben Porchuk, Ron Brooks

References: Campbell and Perrin 1991, Porchuk 1996, Porchuk and Prevett 1999

Eastern Yellow-bellied Racer *(Coluber constrictor flaviventris)*
COSEWIC Status: SPECIAL CONCERN (1991)

Recovery plan exists? No

Distribution: Extreme southern Saskatchewan. The eastern yellow-bellied racer appears to be limited to the Frenchman River Valley and the Big Muddy Valley. Populations seem to be contiguous with those in the United States.

Habitat: Grassland areas. This species frequently makes use of the same den sites as prairie rattlesnakes.

Threats: No study of the eastern yellow-bellied racer has been conducted in Canada, so no information is available on population size or change. The species is at its northern limit. Humans may mistake eastern yellow-bellied racers for rattlesnakes. Grazing by cattle may reduce the quality of its habitat, as eastern yellow-bellied racers are less abundant in heavily grazed areas in Kansas. Known rattlesnake dens have been the target of vandalism, which may also threaten the eastern yellow-bellied racer.

Reproductive capacity to rebound: Moderate. Females probably breed every other year. In Kansas, eastern yellow-bellied racers lay an average of 12 eggs and reach maturity in their third year.

Management actions completed or under way:
- Eastern yellow-bellied racers appear to be most abundant in three main areas, two of which occur in Grasslands National Park. The third area is the Big Muddy Valley, where the grazing land has limited public access.
- Most known dens are within Grasslands National Park.

Management actions required:
- Determine the effect of cattle grazing on the Big Muddy Valley population.
- Determine the status of population(s) within Grasslands National Park. Fewer than 10 snakes have been reported from most dens.
- Identify and protect other den sites.
- Basic life history information is lacking for northern populations. No Canadian studies have been done on the eastern yellow-bellied racer. Information is needed about how far this species ranges from its den and whether there is gene flow between subpopulations.

Scientific contacts: none

References: Macartney and Weichel 1993, Campbell and Perrin 1991, Fitch 1999

Sharp-tailed Snake *(Contia tenuis)*

COSEWIC Status: ENDANGERED (1999)

Recovery plan exists? No

Distribution: Localized on southern Gulf Islands and southeastern Vancouver Island in British Columbia. An isolated record from interior British Columbia near Chase is probably in error. The complete distribution in British Columbia remains unknown.

Habitat: Relatively open Douglas-fir–arbutus stands and forest edges. South-facing rocky slopes in these areas may be critical habitat.

Threats: The sharp-tailed snake is probably a relict from the Hypsithermal, 4000 to 6000 years ago, when conditions were warmer. Loss and degradation of habitat on the rapidly developing Gulf Islands and southern Vancouver Island are the greatest threats. All known and most potential sites are on private land.

Reproductive capacity to rebound: Low. Females lay only 3 to 5 eggs. It is not known how frequently females breed or at what age they reach maturity.

Management actions completed or under way:

- The sharp-tailed snake is on British Columbia's Red List of species at risk.
- Surveys of this species were undertaken in 1998.

Management actions required:

- Currently, no sites on which sharp-tailed snakes live are protected. It is imperative to identify and survey potential habitat. South-facing, rocky slopes in Douglas-fir–Arbutus forests that are used by the snakes should be protected from disturbance and development.
- Determine the complete range of this species through additional surveys. Because of the secretive and partly fossorial habits of sharp-tailed snakes, they are difficult to locate; additional populations may well exist.
- Confirm whether the record of a mainland population near Chase is valid.
- Identify key attributes of life history and habitat use (e.g., reproductive parameters, oviposition and hibernation habitat, seasonal movements) for management purposes.

Scientific contacts: Kristiina Ovaska, Christian Englestoft

References: Spalding 1993, Cannings et al. 1999, Englestoft and Ovaska 1999, Ovaska and Englestoft 1999

Eastern Fox Snake *(Elaphe gloydi)*

COSEWIC Status: THREATENED (1999)

Recovery plan exists? No

Distribution: Southern Ontario. Populations are located along the shoreline of the Great Lakes but tend to be widely scattered.

Habitat: Unforested shoreline ecosystems adjacent to marshes. Egg laying occurs in rotting logs or under debris. Fox snakes hibernate communally, often in the foundations of old buildings.

Threats: Loss and fragmentation of habitat have been the major threats to this species historically because of the its reliance on shoreline habitat — areas prized for human development. Traffic and human persecution are also significant threats. Illegal collecting may also affect populations.

Reproductive capacity to rebound: Moderate. Females typically lay 15 to 20 eggs, but probably not every year. Maturity is reached in only a few years.

Management actions completed or under way:

- The eastern fox snake has been designated as threatened by the Ontario government.
- A communal hibernaculum outside of Georgian Bay Islands National Park has been protected by agreement with private landowners.
- This species occurs in the following protected areas: Georgian Bay Islands and Point Pelee National Parks and Rondeau Provincial Park.
- Norfolk Field Naturalists undertook population surveys and public education in 1992/93. Many people previously afraid of or hostile to large snakes became willing to live with these species.

Management actions required:

- Protect communal hibernacula and nesting sites outside of protected areas (e.g., the ANSI [Area of Natural and Scientific Interest] south of Honey Harbour).
- Within parks, motorists should be made aware of the threat to snakes posed by traffic, and efforts — such as the use of wildlife crossing signs and the reduction of speed limits — should be made to mitigate this threat.
- Anthropogenic habitat (e.g., buried foundations) within parks should be left in place, as these are often used as hibernation sites.
- Parks in which fox snakes live should instigate education programs to increase awareness and help reduce persecution and traffic mortality.
- Education programs should also be aimed at landowners whose property contains fox snake habitat to help reduce persecution of this species.

Scientific contacts: Robert M'Closkey (Point Pelee), Rob Willson

References: Sahantien 1984, Watson 1994, Willson and Prior 1999

Black Rat Snake *(Elaphe obsoleta obsoleta)*

COSEWIC Status: THREATENED (1998)

Recovery plan exists? In progress

Distribution: Southern Ontario in two disjunct areas: the north shore of Lake Erie and the eastern end of Lake Ontario.

Habitat: Open forest and forest edge, generally associated with open water. Hibernates communally.

Threats: Historically, habitat loss has been the major threat. It has been estimated that 75 per cent of the historical range of the black rat snake in southwestern Ontario has been destroyed as a result of development. Ongoing threats include more habitat loss, traffic, persecution by humans, and illegal collecting.

Reproductive capacity to rebound: Low. Females breed every other year on average and lay 10 to 20 eggs. Females require an average of 10 years to reach maturity.

Management actions completed or under way:

- The black rat snake has been designated as threatened by the Ontario government.
- Some populations exist within protected areas: St. Lawrence Islands National Park, Charleston Lake, Frontenac and Murphys Point Provincial Parks, and Queen's University Biological Station.
- The hibernaculum outside of Murphys Point is protected by agreement with the township.
- Norfolk Field Naturalists undertook population surveys and public education in 1992/93. Many people previously afraid of or hostile to large snakes became willing to live with these species.
- Both Charleston Lake and Murphys Point Provincial Parks have an "Adopt-A-Black-Rat-Snake" program.

Management actions required:

- Further development should be prevented within 200 metres of known black rat snake hibernacula. Human activities that will cause short-term disturbances should be avoided during spring and fall when snakes congregate at these areas.
- Identify and protect major hibernacula outside of protected areas.
- Maintain habitat connections between hibernacula in an area to ensure gene flow.
- Deter the removal of standing snag trees, as these are used for nesting.
- Consider the possibility of creating artificial hibernacula on protected lands in southwestern Ontario.
- Efforts should be made to educate landowners whose property is within the range of the black rat snake. Senseless killing of snakes is probably the easiest issue to deal with.

Scientific contacts: Kent Prior, Pat Weatherhead, Shaun Thompson

References: Prior and Weatherhead 1996a, b; Prior et al. 1997; Lougheed et al. 1999

Eastern Hognose Snake *(Heterodon platyrhinos)*

COSEWIC Status: SPECIAL CONCERN (1997)

Recovery plan exists? No

Distribution: Southern Ontario. Scattered populations occur along the north shore of Lake Erie. Disjunct populations occur east of Georgian Bay. Populations have been eliminated from Point Pelee, Pelee Island, and the Toronto area.

Habitat: Sandy, open wooded areas near water.

Threats: Loss and fragmentation of habitat have been and continue to be a major threat. Traffic and persecution by humans are also significant threats.

Reproductive capacity to rebound: Moderate. Females lay 20 to 40 eggs, possibly only every other year. Maturity is reached after the second winter.

Management actions completed or under way:

- The eastern hog-nosed snake has been designated as vulnerable by the Ontario government.
- Populations occur in a number of protected areas, including Georgian Bay Islands National Park and Long Point, Pinery, Rondeau, and Wasaga Beach Provincial Parks.
- Public education through parks programs in the mid-1980s at Georgian Bay Islands National Park and Pinery Provincial Park resulted in fewer snakes being killed by park visitors and more reports of snakes being left alive after encounters with humans.
- Norfolk Field Naturalists undertook population surveys and public education in 1992/93. Many people previously afraid of or hostile to large snakes became willing to live with these species.

Management actions required:

- Many hognose snakes are killed by humans who mistakenly believe that this species is venomous because it raises its head and hisses when threatened. Hognosed snakes will not bite unless provoked. Continued education about the harmless nature of this snake is needed in parks.
- Within parks (e.g., Pinery, Rondeau, Long Point) motorists should be made aware of the threat to snakes posed by traffic, and efforts — such as the use of wildlife crossing signs and the reduction of speed limits — should be made to decrease traffic mortality.
- No in-depth studies of the ecology of this species have been undertaken in Ontario. For effective management, more detailed information is needed about habitat requirements, dispersal ability, and reproductive success.

Scientific contacts: none

References: Sahantien 1984, Schueler 1997,

Lake Erie Watersnake *(Nerodia sipedon insularum)*

COSEWIC Status: ENDANGERED (1991)

Recovery plan exists? No

Distribution: Limited to the archipelago of western Lake Erie. Found on Pelee, East Sister, Hen, and Middle Islands. Extirpated from Middle Sister Island.

Habitat: Rocky shorelines. This species sometimes hibernates with blue racers on Pelee Island.

Threats: Significant declines have occurred over the past half-century, at least partially because of habitat destruction and human persecution. Higher numbers of banded morphs on the islands have been documented, leading to the threat of genetic swamping of the Lake Erie watersnake by northern watersnakes. Bioaccumulation of toxins may also be a threat because of the mainly aquatic diet, which is high in organochlorines and trace metals. Traffic mortality on Pelee Island is significant and likely to increase with increased tourism.

Reproductive capacity to rebound: Moderate. Females give birth to approximately 20 young, possibly on an annual basis. Maturity is reached at 3 to 4 years of age.

Management actions completed or under way:

- The Lake Erie watersnake has been designated as endangered by Ontario government.

Management actions required:

- It is critical to increase community awareness of and support for the Lake Erie watersnake on Pelee Island. Without community support, successful recovery cannot occur.
- Protect shoreline habitat on Pelee Island.
- Protect known hibernacula (watersnakes tend to hibernate communally).
- Public education about the Lake Erie watersnake's precarious situation should be aimed at residents of and visitors to Pelee Island (and other Lake Erie islands).
- Reduce contaminant levels within the Lake Erie Basin.
- The establishment of bicycle paths to reduce vehicular traffic by tourists could reduce traffic mortality.
- Reduced speed limits along roads around the shoreline of the island may help to reduce traffic mortality.
- Consider the possibility of reintroducing the Lake Erie watersnake to Middle Sister Island.

Scientific contacts: Richard King

References: Campbell 1991; King 1990, 1993 a, b ,c; Willson 1995;

Queen Snake *(Regina septemvittata)*

COSEWIC Status: THREATENED (1999)

Recovery plan exists? No

Distribution: Limited to southwestern Ontario west of the Niagara Escarpment. Populations are widely scattered. Populations have been lost from the Toronto area and the Bruce Peninsula. There are no recent records from a number of other historic populations.

Habitat: Generally, streams and rivers with rocky substrates. Queen snakes are rarely seen more than a few metres from water. The presence of crayfish is essential, as they make up virtually the entire diet of queen snakes.

Threats: Loss, fragmentation, and degradation of habitat. The entire Canadian distribution is limited to highly modified southwestern Ontario. The pollution of streams and rivers may affect queen snakes directly, or indirectly through their primary food source, crayfish. Crayfish are declining or have been eliminated from many areas because of runoff and siltation. Crayfish are also known to accumulate mercury, which may affect queen snakes. Dams may also affect habitat quality by altering the hydrology of streams or rivers.

Reproductive capacity to rebound: Moderate. Females give birth to approximately 10 young but may not breed annually. Maturity is reached in 3 or more years.

Management actions completed or under way:

- The queen snake has been designated as threatened by the Ontario government.
- This species has been reported from a number of protected areas, including Big Creek/Long Point National Wildlife Area, Komoka Provincial Park, Fanshawe Conservation Area, and Rock Glen Conservation Area.

Management actions required:

- Conservation authorities should take the queen snake into account when contemplating stream development projects. Dam construction along the Grand River in 1988 likely killed most of the queen snakes present at one site.
- Ensure that travel corridors exist along streams where numerous sightings of queen snakes have been reported (e.g., the Grand, Maitland, and Thames Rivers).
- Additional surveys using standardized protocols are required to confirm current distribution.
- Quantitative habitat analysis, including analysis of water chemistry and sediment characteristics, may help reveal the precise habitat requirements of the queen snake. Such analysis would help narrow the search for other potential populations.
- Research on crayfish populations in queen snake habitats may help to clarify factors limiting the distribution of queen snakes.

Scientific contacts: Craig Campbell, Kim Smith

References: Lamond 1994, Smith 1999

Butler's Garter Snake *(Thamnophis butleri)*

COSEWIC Status: SPECIAL CONCERN (1999)

Recovery plan exists? No

Distribution: Limited to southwestern Ontario. Populations occur from Windsor to Sarnia. Disjunct populations occur in Middlesex and Dufferin/Wellington Counties. Where it does occur, this species may be the most common snake. The Ontario portion of the range represents a significant percentage of the global distribution, as Butler's garter snake is not found south of Ohio.

Habitat: Prairie-like areas near wetland edges.

Threats: A relict species from the prairie corridor that existed 5000 to 7000 years ago during warm, dry conditions. Much of the historic habitat of the Butler's garter snake has vanished because of development, particularly the drainage of wetlands. Because most of the remaining populations are near urban areas, traffic mortality may be significant.

Reproductive capacity to rebound: Moderate. Females give birth to approximately 10 young every other year. Age at maturity is unknown but probably is less than 5 years.

Management actions completed or under way:

- The Butler's garter snake has been designated as vulnerable by the Ontario government.
- Populations occur in a variety of protected areas, including Luther Marsh Conservation Area, Skunk's Misery (county forest), and Ojibway Prairie (provincial nature reserve). Populations also occur at the Windsor and Sarnia airports.

Management actions required:

- Confirm the ongoing presence of populations of the Butler's garter snake and determine if they are viable. Adjacent areas should also be surveyed to examine whether the distribution is changing given changing land uses. Virtually no research has been conducted on this species since the late 1970s.
- Maintain openings in habitat through controlled burns, where appropriate.
- Identify the incidence of traffic mortality, especially in urban/suburban populations. Fencing would probably reduce traffic mortality if traffic is identified as being a significant threat.
- Basic life history information is scant, and additional information — particularly about the age at maturity, dispersal range, and hibernation site requirements of the Butler's garter snake — is needed.
- Train local naturalists, wildlife officers, and other relevant individuals to distinguish Butler's and common garter snakes.

Scientific contacts: Craig Campbell, A. P. Sandilands

References: Freedman and Catling 1978, 1979; Catling and Freedman 1980 a, b; Sandilands 1999

Eastern Massasauga Rattlesnake*(Sistrurus catenatus)*
COSEWIC Status: THREATENED (1991)

Recovery plan exists? Yes

Distribution: Ontario. Widespread along the Bruce Peninsula and Georgian Bay shoreline. Two small and disjunct populations occur in southwestern Ontario, on the Windsor prairies and at Wainfleet Bog near Port Colborne.

Habitat: Habitat varies across the range in Ontario from Canadian Shield in the north to prairies in the south, but massasaugas generally are associated with open areas. The species depends on wetlands or wet areas for hibernation.

Threats: Habitat loss in southwestern Ontario has been a major threat historically. Traffic mortality and persecution by humans are also major threats. Conversion of Highway 69 in the Georgian Bay area to a four-lane highway threatens the largest extant population of massasaugas. The highway expansion will not simply be a twinning of the current road. The two parts of the highway will diverge in some areas because of geography, and the new section will go through undisturbed habitat.

Reproductive capacity to rebound: Moderate. Females give birth to an average of 12 young, every 2 to 3 years. Maturity is reached in 3 to 4 years.

Recovery plan objectives: The recovery plan has two goals:
1. Achieve viable populations of massasaugas in tall-grass prairie and peatland ecosystems.
2. Retain the current distribution, structure, and connectivity between local (sub)populations throughout the Bruce Peninsula and Georgian Bay population regions.

Management actions completed or under way:
- The eastern massasauga has been designated as threatened by the Ontario government.
- This species occurs in a number of protected areas: Bruce Peninsula and Georgian Bay Islands National Parks; Killbear, Grundy Lake, and Sturgeon Bay Provincial Parks; and Wainfleet Bog.
- A video entitled “Living with Wildlife: The Eastern Massasauga Rattlesnake” has been produced.
- In areas of high traffic mortality, “Brake for Snakes” signs have been erected in Killbear Provincial Park.
- Metro Toronto Zoo has coordinated an ambitious community awareness program, which involves workshops for cottage associations, training volunteers in snake relocation, education programs for schools, and a newsletter, “Rattlesnake Tales.”
- The viability of populations at Windsor and Wainfleet Bog was examined during the summers of 1999 and 2000. Restoration planning is under way at Wainfleet Bog.

- Research is being undertaken on potential ways to mitigate the effects of the expansion of Highway 69.

Management actions required:

- Ongoing public education about the docile nature of the massasauga is required as more development occurs within rattlesnake habitat. Living in rattlesnake country is safe.
- Reduce senseless killings. At least three massasaugas were purposely beaten to death in Georgian Bay Islands National Park in the late 1990s. More park education programs are needed.
- Identify and protect nesting sites and hibernacula.
- In parks with high levels of traffic mortality, consider reducing speed limits or increasing signage to alert motorists to the presence of massasaugas.
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- Explore options for cooperative efforts to reintroduce the massasauga and restore tall-grass prairie.

Scientific contacts: Bob Johnson, Kent Prior, Pat Weatherhead

References: Weller and Parsons 1991, Johnson and Menzies 1993, Prior and Weatherhead 1995, Prior et al. 1997, Johnson and Wright 1999

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The Canadian Amphibian and Reptile Conservation Network is working to reverse the trends in habitat loss and to better understand these cryptic creatures. Our organization represents the Canadian biologists who study, protect and educate people about amphibians and reptiles. We help to coordinate public involvement in frog and toad monitoring programs across Canada. We are currently developing a system to recognize Important Reptile Areas and Important Amphibian Areas in Canada to raise awareness about the areas that are special for these animals.

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