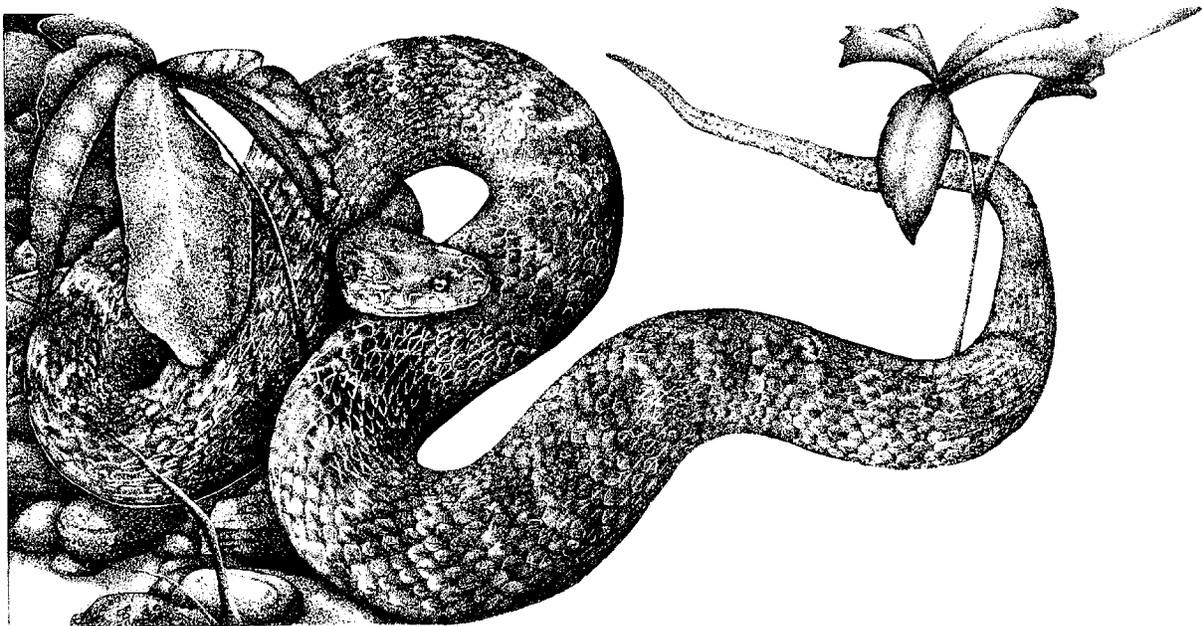


U.S. Fish & Wildlife Service

Lake Erie Watersnake Recovery Plan

(Nerodia sipedon insularum)



September 2003



Department of the Interior
U. S. Fish and Wildlife Service
Great Lakes-Big Rivers Region (Region 3)
Fort Snelling, MN



Lake Erie Watersnake
(*Nerodia sipedon insularum*)
Recovery Plan

September 2003

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LITERATURE CITATION

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EXECUTIVE SUMMARY

Current Species Status: The Lake Erie Watersnake (*Nerodia sipedon insularum*) occurs on portions of the Ohio mainland, and on the near-shore and offshore islands and in the waters of the western Lake Erie basin of Ohio and Canada. Based on extirpation events on several small islands and significant declines from historic population estimates due to habitat loss and human persecution, the snake was listed as a threatened species under the Endangered Species Act in 1999. This listing extended only to the subpopulations found on the western Lake Erie offshore islands and adjacent waters of the United States. The Province of Ontario, Canada designated the Lake Erie Watersnake an endangered species in 1977 based on similar threats.

Habitat Requirements and Limiting Factors: The Lake Erie Watersnake spends summers basking on the rocky shorelines of the limestone and dolomite islands in the western Lake Erie basin. Both natural shoreline and some portions of developed shoreline provide suitable summer habitat for the snake. Hibernation habitat for the snake is composed of areas inland from the shore, which typically have soil and rock substrates and consist of natural openings or fissures. Additionally some snakes hibernate in human-made structures such as foundations and drainage tile. The primary limiting factor is accidental and intentional human persecution, with loss and alteration of suitable summer and hibernation habitat through development as a secondary factor.

Recovery Strategy: The primary strategy for the recovery of the Lake Erie Watersnake in the U.S. is to sustain multiple subpopulations of the snake, including a stable, persistent subpopulation of snakes on each of the four largest U.S. islands, by significantly reducing deliberate and accidental human-induced mortality, and by maintaining enough essential habitat to support these subpopulations in perpetuity. This strategy will be accomplished by working with government agencies to develop management plans for public lands on the islands, continuing a vigorous outreach campaign targeting residents and visitors to the islands, encouraging private land actions that benefit snake habitat, and conducting additional research to assess other potential threats to the continuing existence of the Lake Erie Watersnake population.

Recovery Objective: The goal of this recovery plan is to ensure multiple viable subpopulations of the Lake Erie Watersnake on the U.S. islands such that the snake can be removed from the Federal list of *Endangered and Threatened Wildlife*. Realization of this goal will occur by undertaking the following actions: achieving a total U.S. population size such that the snake has a reasonable certainty of persisting over time; perpetuating multiple, viable, persistent subpopulations of the Lake Erie Watersnake; achieving viable population goals for each of the four largest U.S. islands, Kelleys, South Bass, Middle Bass, and North Bass; sustaining enough essential summer and hibernation habitat in perpetuity to support viable persistent subpopulations; and reducing or eliminating the threat posed by intentional and accidental human-induced mortality.

Recovery Criteria: Recovery of the snake will be accomplished when a minimum of 5,555 adult snakes exists on nine U.S. islands combined for six or more consecutive years, including at least 900 snakes on Kelleys Island, 850 snakes on South Bass Island, 620 snakes on Middle Bass Island, and 410 snakes on North Bass Island, with the remaining snakes occurring on any of the nine islands. Additionally, a total of 7.4 km of shoreline habitat and 51 hectares of hibernation habitat distributed proportionately among the four largest U.S. islands must be protected in perpetuity by a written agreement approved by USFWS. Finally, objective analysis of public attitude indicates that human persecution is no longer a threat to the continued existence of the snake, and accidental human-induced mortality no longer poses a significant threat to the population.

Actions Needed:

1. Ensure population persistence
2. Habitat protection and management
3. Reduction of human-induced mortality
4. Identification of additional threats, constraints, and limiting factors
5. Review and track recovery progress

Total Estimated Cost of Recovery (in \$1,000's):

Year	Action 1	Action 2	Action 3	Action 4	Action 5	Total
2004	55	84	34.5	24	0	197.5
2005	70	75	37.5	29	2	213.5
2006	50	78.5	49.5	25	0	203
2007	70	73.5	34.5	0	4	182
2008	50	74.5	34.5	0	5	164
Total	295	385.5	190.5	78	11	960

Date of Recovery: Full recovery of the Lake Erie Watersnake is anticipated to require approximately 10 years, until about 2013, if fully funded.

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Abbreviations and Acronyms Used in Recovery Plan

ac-acres

CFR-Code of Federal Regulations

cm-centimeter

COSEWIC- Committee on the Status of Endangered Wildlife in Canada

CWS-Canadian Wildlife Service

DOW-Division of Wildlife

ERCA-Essex Region Conservation Authority

ESA-Endangered Species Act of 1973, as amended

ft-feet

FR-Federal Register

ha-hectares

HCP-Habitat Conservation Plan

in-inches

IUCN-International Union for Conservation of Nature and Natural Resources

km-kilometer

LEWS-Lake Erie Watersnake

m-meter

mi-mile

NEPA-National Environmental Policy Act

OAC-Ohio Administrative Code

ODNR-Ohio Department of Natural Resources

OEPA-Ohio Environmental Protection Agency

OMNR-Ontario Ministry of Natural Resources

PCB-polychlorinated biphenyls

SHA-Safe Harbor Agreement

SVL-snout-vent length

USFWS-United States Fish and Wildlife Service

I. INTRODUCTION

LEGAL STATUS, CRITICAL HABITAT, AND RECOVERY PRIORITY

The U.S. Fish and Wildlife Service (USFWS) designated the Lake Erie Watersnake (*Nerodia sipedon insularum*) a threatened species on August 30, 1999 (50 CFR Part 17). The State of Ohio, Department of Natural Resources (ODNR), Division of Wildlife listed the Lake Erie Watersnake as endangered on May 3, 2000 (OAC 1501:31-23-01). The Province of Ontario, Canada designated the Lake Erie Watersnake an endangered species under their Endangered Species Act in 1977 (RRO 1990), while the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2002) listed the snake as endangered in April, 1991.

At the time of listing, it was determined that designating critical habitat for the Lake Erie Watersnake was not prudent for the following reasons, pursuant to 50 CFR 424.12 (a)(1):

Such designation of critical habitat would not be beneficial to the species

The species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species

The USFWS has developed guidelines for assigning priorities to the development and implementation of recovery plans for listed species (48 FR 43098). The recovery priority of the Lake Erie Watersnake is 9C, indicating that it is: (1) taxonomically, a subspecies; (2) facing a moderate degree of threat; (3) rated high in terms of recovery potential; and (4) in conflict with construction or other development project(s) or other forms of economic activity. The USFWS regularly reviews the taxonomy, threats, recovery potential, and degree of associated conflict(s) and may change the recovery priority based on that review.

DESCRIPTION

The Lake Erie Watersnake (*Nerodia sipedon insularum*), a nonvenomous snake, is a member of the family Colubridae. Lake Erie Watersnakes were briefly described by Morse (1904) as *Natrix fasciata erythrogaster*. Conant and Clay (1937, 1963) later formally described the Lake Erie Watersnake as a subspecies of the Northern Watersnake (*Nerodia sipedon sipedon*). The common name “Lake Erie Watersnake” follows the naming convention set forth by Crother et al. (2000). The dorsal color pattern of the Lake Erie Watersnake is highly variable, ranging from uniformly gray and unpatterned to regularly patterned with a series of dorsal and lateral blotches (Conant and Clay 1937; Camin and Ehrlich 1958; Conant and Clay 1963; Conant 1982; Kraus and Schuett 1982; King 1987b, 1991). Between these extremes, a variety of intermediate patterns exist in which dorsal and lateral blotches are reduced in size or number or irregular in shape. Typically, the ventral surface is uniform white or yellowish white except for the bases of the ventral scales, which are often of the same color as the dorsum (Conant and Clay 1937). Variation in color pattern is genetically based and the size and position of color pattern elements remain fixed over the life of an individual snake (King 1993a). Color pattern variation among Lake Erie Watersnakes results from the combined effects of both natural selection and gene flow (King 1993b, 1993c; King and Lawson 1995). On the rocky shorelines of the western

Lake Erie islands, watersnakes with unbanded or reduced patterns have a survival advantage compared to fully patterned watersnakes (Camin and others 1954; Camin and Ehrlich 1958; Ehrlich and Camin 1960; King 1992a). Gene flow from mainland populations of Northern Watersnakes (*N. s. sipedon*) is responsible for the persistence of regularly patterned individuals in island populations despite this selective advantage (King and Lawson 1995).

The Lake Erie Watersnake and the Northern Watersnake are separate subspecies. Northern Watersnakes (*N. s. sipedon*) are widely distributed in eastern North America, including the Ohio and Ontario mainland, whereas Lake Erie Watersnakes (*N. s. insularum*) occur primarily on the offshore islands of western Lake Erie (Schmidt and Davis 1941; Conant 1982; Kraus and Schuett 1982; King 1986, 1987b, 1989a, 1989b, 1991, 1993b, 1998a; King and Lawson 1995; King and others 1997). In contrast to the color pattern variation seen in Lake Erie Watersnakes, Northern Watersnakes have sharply defined band patterns (Conant and Clay 1937, 1963; Camin and Ehrlich 1958; Conant 1982; Kraus and Schuett 1982; King 1987b, 1991). Lake Erie Watersnakes occur on rocky limestone and dolomite shorelines; Northern Watersnakes use more heavily vegetated locations with soil, mud or clay (Conant 1951; Conant and Collins 1991; Harding 1997). Lake Erie Watersnakes also have a different diet, a larger adult body size, lower growth rates, and shorter tails compared to Northern Watersnakes (Conant 1951; Hamilton 1951; Langlois 1964; Drummond 1983; King 1986, 1989a, 1993a).

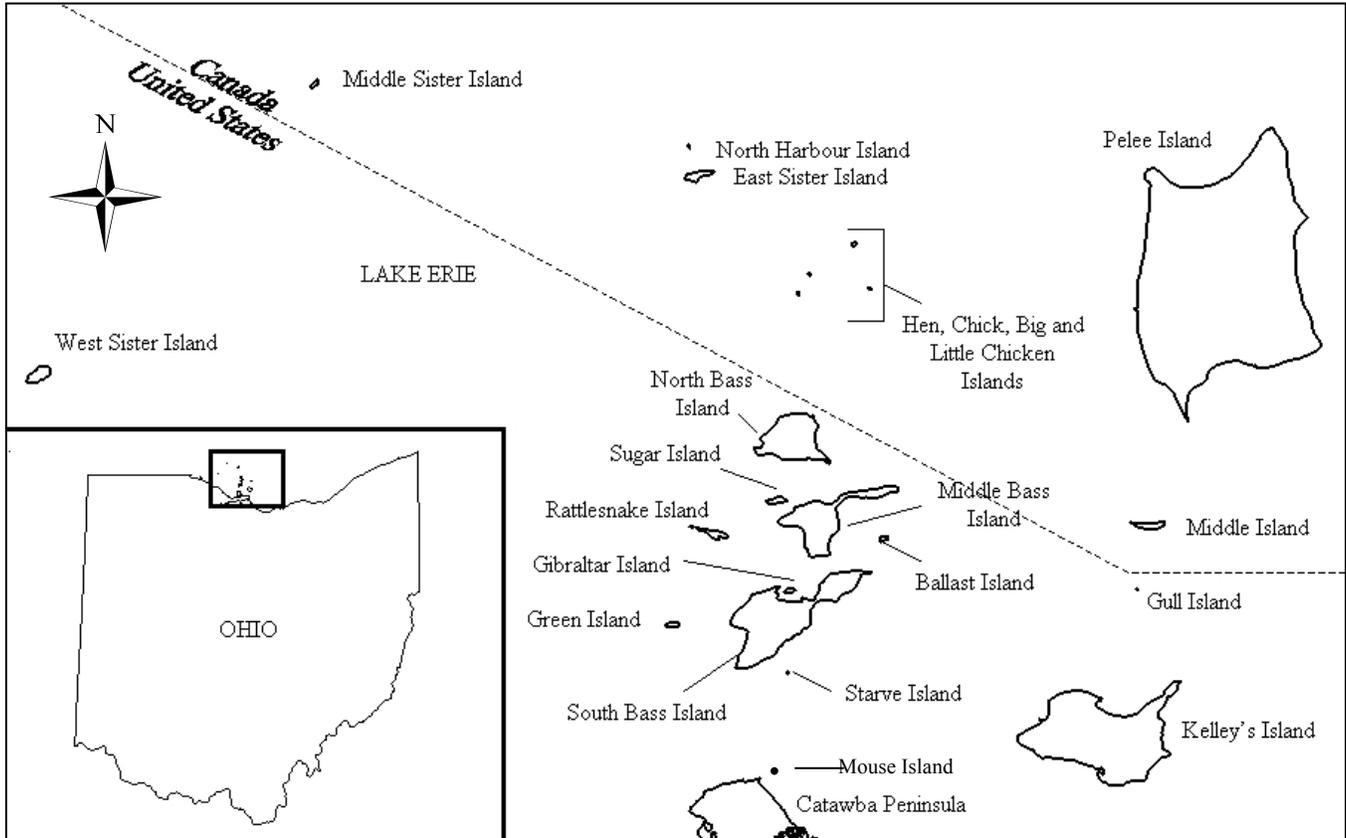
POPULATION STATUS AND DISTRIBUTION

Distribution

The distribution of the Lake Erie Watersnake is closely tied to the underlying geology of the island region of western Lake Erie. Lake Erie Watersnakes inhabit exposed limestone and dolomite shorelines. Differences in color pattern between Lake Erie Watersnakes and Northern Watersnakes are the result of natural selection acting to enhance the match between snakes and backgrounds in these different habitats. The exposed dolomite and limestone shorelines that characterize the Lake Erie islands also occur on the Catawba/Marblehead peninsula on the Ohio mainland. Individual watersnakes with reduced color patterns like that seen in island populations have been reported from this peninsula (Conant and Clay 1937) and Johnson Island in Sandusky Bay (King 1986). The Federal Endangered Species Act of 1973, as amended, (ESA) protection extends only to the Lake Erie Watersnakes located on western Lake Erie offshore islands and adjacent waters of the United States. We define offshore islands and waters as those located greater than 1.6 km (1 mi) from the Ohio mainland and Ontario mainland. Federal protection does not include watersnakes found on the U.S. mainland or adjacent near-shore islands, due to those areas having a high occurrence of Northern Watersnakes (*N. s. sipedon*), intergrades between the two subspecies, and the low occurrence of Lake Erie Watersnakes (50 CFR Part 17). This means watersnakes located on Ohio's Catawba/Marblehead Peninsula, Mouse Island and Johnson Island (also referred to as Johnson's Island) are not protected under the ESA. The islands and rock outcrops and their adjacent waters that support the listed population of Lake Erie Watersnakes are located within boundaries roughly defined as 82° 22' 30" North Longitude, 83° 07' 30" North Longitude, 41° 33' 00" West Latitude, and 42° 00' 00" West Latitude. The U.S. Lake Erie offshore islands and rock outcrops include, but are not limited to, the islands called Kelleys, South Bass, Middle Bass, North Bass, Sugar, Rattlesnake, Green, Gibraltar, Starve,

Gull, Ballast, Lost Ballast, and West Sister. Canadian Lake Erie offshore islands and rock outcrops of Lake Erie include, but are not limited to, the islands called Pelee, Middle, East Sister, Middle Sister, North Harbour, Hen, Chick, Big Chicken, and Little Chicken (Figure 1).

Figure 1. Historic range of the Lake Erie Watersnake on the western basin Lake Erie islands. Scale: 1 cm≈2.5km



The current distribution of Lake Erie Watersnakes is reduced compared to their historic distribution. The historic range of the Lake Erie Watersnake included 22 or more offshore islands and rock outcrops (12 U.S. offshore islands, 9 Canadian islands, and various rock outcrops) of western Lake Erie, and shorelines of the Catawba/Marblehead Peninsula, and nearshore islands (Mouse and Johnson) in Ohio (Conant and Clay 1937; Conant 1938; Conant and Clay 1963; Kraus and Schuett 1982; King 1986, 1987a, 1987b, 1998a). Today, Lake Erie Watersnakes no longer occur on three islands: Middle Sister Island (Ontario), North Harbour Island (Ontario), and West Sister Island (U.S.), and population sizes have declined significantly on the remaining islands (Ehrlich and Camin 1960; Kraus and Schuett 1982; King 1986, 1998a, 1998b; Conant 1997). Lake Erie Watersnakes are known from West Sister Island based on specimens collected there in 1938 and 1939 (King and others 1997). However, no watersnakes were found on this island during repeated searches in the 1980s and early 1990s (King 1998a). A visit to this island on 26 July 2002 resulted in the capture of one adult female watersnake. The color pattern of this watersnake was dark and distinctly banded as is seen in mainland populations. Given that West Sister Island is about equally isolated from the mainland and from the next nearest island, this snake might represent an immigrant from a mainland Northern

Watersnake population (King 2002c). Lake Erie Watersnakes are known from Green Island based on specimens collected there in 1930 and 1948 (King and others 1997). However, no watersnakes were found on this island during repeated searches in the 1980s and early 1990s (King 1998a). During a visit to the island on 25 June 2002, ODNR, Division of Wildlife personnel reported counting 20 individual Lake Erie Watersnakes on the rocky shore, inland, and foraging just offshore. The presence of Lake Erie Watersnakes was confirmed during a second visit to the island by USFWS personnel and others in July 2002. These observations suggest that Lake Erie Watersnakes have recently recolonized this island after an absence of 10 or more years (King 2002c).

Subpopulations

Nine U.S. islands currently support subpopulations of the Lake Erie Watersnake year-round (Kelleys, South Bass, Middle Bass, North Bass, Rattlesnake, Gibraltar, Sugar, Ballast, and Green Islands), while two U.S. islands provide only summer habitat (Starve and Gull Islands). The four largest U.S. islands (Kelleys, South Bass, Middle Bass, and North Bass) support the vast majority of the U.S. Lake Erie Watersnake population. For the purpose of this recovery plan, a subpopulation is defined as a geographically distinct division of a larger population. A summary of the islands and the size of their adult Lake Erie Watersnake subpopulations can be found in Table 1. Appendix E contains a brief description of each of the islands, including the most recent adult Lake Erie Watersnake population estimates available for each.

Table 1. Summary of U.S. islands capable of supporting year-round Lake Erie Watersnake subpopulations. All population estimates are based on the 1999-2002 field seasons except for those marked with an asterisk (*), which are based on the 1996-1998 field seasons (King 2002c). Numbers for area and shoreline have been calculated using ODNR Geographic Information Systems (GIS) data sets.

Island	Area- km2 (acres)	Shoreline- km (miles)	Area of Public land- km2 (acres)	Shoreline of Public land- km (miles)	Estimated adult LEWS Population
Kelleys	11.3 (2785)	23.4 (14.5)	2.74 (677.1)	1.88 (1.2)	1942
South Bass	5.95 (1470)	20.4 (12.7)	0.25 (61.8)	0.57 (0.35)	1145
Middle Bass	2.89 (714)	16.9 (10.5)	0.5 (123.5)	0.89 (0.55)	1387
North Bass	2.61 (644)	10.7 (6.7)	0.016 (3.9)**	0.38 (0.24)	583
Green	0.069 (17)	1.2 (0.75)	0.069 (17)	1.2 (0.75)	102
Rattlesnake	0.24 (60)	2.6 (1.6)	0 (0)	0 (0)	20*
Sugar	0.16 (40)	1.7 (1.1)	0 (0)	0 (0)	314
Ballast	0.049 (12)	1.0 (0.62)	0 (0)	0 (0)	44*
Gibraltar	0.024 (6)	0.9 (0.56)	0 (0)	0 (0)	44*
West Sister	0.28 (70)	2.4 (1.5)	0.28 (70)	2.4 (1.5)	0
Total	23.57 (5818)	81.2 (50.53)	3.855 (953.3)	7.32 (4.59)	5581

Notes: **State of Ohio pursuing purchase of additional property on North Bass Island

Population status

The historic abundance of watersnakes on the Lake Erie islands was first noted in descriptions by early travelers (McDermott 1947; Parker 1976). During the 1700s, the islands of western Lake Erie were called “Les Iles aux Serpentes,” the “islands of snakes” (McDermott 1947; Langlois 1964). Other accounts by early travelers describe islands with “myriads (or “wreaths”) of watersnakes basking in the sun” or with watersnakes “sunning themselves in heaps, knots and snarls” (Ballou 1878; Hatcher 1945; McDermott 1947; Wright and Wright 1957; Parker 1976).

The Lake Erie Watersnake population has declined over the past 150 years due to persecution and habitat alteration (Hatcher 1945; Ehrlich and Camin 1960; Langlois 1964; Campbell 1977; Conant 1982; Kraus and Schuett 1982; King 1986, 1987a, 1987b, 1990, 1998a, 1998b; King and Lawson 1995; King and others 1997). One example is Middle Island, Ontario, where Thomas (1949) observed up to seven snakes per “clump” of shrubbery at “close intervals” over a distance of several hundred yards of limestone shoreline. King’s “Population Ecology of the Lake Erie Watersnake” (1986) estimated a population size for Middle Island that is three to five times lower than the number of watersnakes collected in a single day by Camin and others (1954) or in two days by Ehrlich and Camin (1960). In another example, it took King (1986) a month or more on several islands to achieve sample sizes similar to that achieved by Conant and Clay (1937) or Camin and Ehrlich (1958) in a single day. Finally, in terms of numbers of watersnakes per investigator hour, King (USFWS 1994) noted that Lake Erie Watersnake capture rates declined from 10 snakes per hour (during the 1930s through 1950s) to less than one snake per hour (during the early 1980s), a ten-fold decline over 30 to 50 years.

Recent data show fluctuations in population density (i.e., number of Lake Erie Watersnakes per km of shoreline). Comparisons of population density estimates over time suggest that population sizes generally decreased from 1980-85 to 1988-92 (by 33 adults/km at 3 sites), and from 1988-92 to 1996 (by 13 adults/km at 4 sites) (King 2002c). Comparisons of population density estimates also suggest that population sizes generally increased from 1988-92 to 2000-02 (by 23 adults/km at 3 sites), and from 1996-98 to 2000-02 (by 88 adults/km at 10 sites) (King 2002c).

In summary, the Lake Erie Watersnake has declined in population abundance and in distribution from historic levels. At the time of listing, the estimate for the U.S. population ranged from 1,530 to 2,030 adults, and U.S. populations of the Lake Erie Watersnake were restricted to only 8 islands (King 1998a, 1998b). Population fluctuations during the late 1990’s and early 2000’s, which coincide with intensive public outreach efforts and Federal listing of the snake, have resulted in increases and decreases in local populations, but in general, populations appear to be increasing. Results of censuses on Kelleys, South Bass, Middle Bass, North Bass, Green, and Sugar Islands conducted from 2000-2002 estimate that the current U.S. population of Lake Erie Watersnakes on these islands is approximately 5,473 adults (King 2002c); this estimate does not include the population estimates for Rattlesnake, Ballast, and Gibraltar because we believe these estimates to be less accurate than the 1999-2002 population estimates (see Table 1). In the four years since listing, the adult population estimate has more than doubled,

likely due to increases in the actual snake population as well as improved census data. Also since the time of listing, Lake Erie Watersnakes have recolonized Green Island, from which the snakes had previously been extirpated. These two events demonstrate that recovery of the snake population is already well underway.

LIFE HISTORY

Activity

Lake Erie Watersnakes are active primarily between early May and early October, depending on seasonal temperatures and weather. Snakes typically enter hibernation between mid-September and mid-October (King 2003). They emerge from hibernation between late-April and late-May (King 2003). Snakes will sometimes remain active on warm days through October, and may emerge from hibernation early to bask on warm days (Table 2 in King 2003). Seasonal activity correlates with reproductive behavior, resulting in males being more active from May until late June, and females being more active after late June (King 1986).

Movement patterns

Lake Erie Watersnakes remain near shore during the summer active season. King (2003) found that 75% of Lake Erie Watersnakes stayed within 13 m (42.7 ft) of the shoreline. The extent (length) of shoreline used by 75% of individual snakes during the summer active season is 437 m (1434 ft) or less (King 2003). Hibernation sites for the snakes vary in distance from the shoreline, but 75% of snakes hibernated within 69 m (226.4 ft) of the shoreline (King 2003). Typically, Lake Erie Watersnakes demonstrate site fidelity, returning to the same area of shoreline each summer and the same hibernation location each year (King 2003). Details of site fidelity are discussed further in the “Habitat Requirements” section. King (1987b) estimates that less than 3 percent of adult watersnakes move among islands or among sites on a given island, each year, and thus, by inference, movement between near-shore islands/mainland and off-shore islands is likely very limited. Based on patterns of protein variation, King and Lawson (1995) estimated that, for each generation, an average of 9.2 watersnakes migrate between the islands and the Ontario mainland, and 3.6 watersnakes migrate between the islands and the Ohio mainland. Lake Erie Watersnakes have been documented to move between the off-shore islands occasionally. Two snakes have been documented moving between Sugar Island and Middle Bass Island, a distance of approximately 300 m (0.19 mi) (King 2002b). Another snake moved from Green Island to South Bass Island, a distance of approximately 1.61 km (1 mi) (King 2002b, 2002c). Recently, a female Lake Erie Watersnake that was marked on the south shore of Kelleys Island on 18 May 2001 was recaptured on Middle Island on 23 May 2002 (D Jacobs, Ontario Ministry of Natural Resources, pers. comm. 2002; King 2002b). Available data, evidenced by the examples above, indicate that Lake Erie Watersnakes are not a fragmented population, meaning that gene flow exceeds one individual per generation (King and Lawson 1995).

Feeding

The Lake Erie Watersnake’s diet is composed mainly of fish and amphibians found in the nearshore waters of the lake. Little has been documented about foraging behavior or locations

and composition of suitable foraging habitat. It is suspected that the Lake Erie Watersnake forages for food in and around rocks and vegetation near the shore of the islands, but more research is necessary to substantiate this observation. King (1993a) noted that species of fish included in the Lake Erie Watersnake diet include sculpin (*Cottus bairdi*), minnow (*Notropis* spp.), catfish (*Ictalurus* spp.), stonecat madtom (*Noturus flavus*), burbot (*Lota lota*), and darter (*Percina* spp. and *Etheostoma* spp.). Recent observations (King and others 1999; K Stanford, Northern Illinois University, pers. comm. 2002) suggest that currently a large portion of the Lake Erie Watersnake's diet is composed of the round goby (*Neogobius melanostomus*), an exotic introduced species that was first reported in the Ohio portion of Lake Erie in 1993 (Knight 1994). The importance of amphibians as prey is somewhat disputed. In a 1948 study, amphibians were preyed upon by 52% of Lake Erie Watersnakes (Hamilton 1951); however, in a 1993 study, only 22% of snake stomachs contained amphibians (King 1993a). King and others (1999) found that amphibians consumed included salamander (*Ambystoma* spp.) and mudpuppy (*Necturus maculosus*) (King 1993a). Hamilton (1951) noted that the Lake Erie Watersnake diet also included northern leopard frog (*Rana pipiens*), green frog (*Rana clamitans*), toad (*Bufo* spp.), and newt (*Triturus* spp.). Additional dietary studies proposed in 2003 will help to clarify current dietary composition of the Lake Erie Watersnake.

Prey size is dependent on the mass of the snake consuming the prey. King (1993a) found that all measures of prey size were significantly positively correlated with snake snout-vent length (SVL). King (1986) also observed that male snakes were more commonly seen foraging from early June until early July, while females were seen foraging throughout the active season. Young of year snakes, less than one year old, were observed foraging from early May until late July (King 1986).

Reproduction

Female Lake Erie Watersnakes reach sexual maturity at approximately 3 years of age, while males typically become mature at 2 years of age. In Lake Erie Watersnakes, sexual maturity is achieved when females reach a length of at least 60 cm (23.6 in) SVL, and when males reach a length of at least 44 cm (17.3 in) SVL (King 1986). The Lake Erie Watersnake participates in courtship behavior from early May to early June. Often, several males will simultaneously court the same female, and the group will form a large "ball" of snakes. Langlois (1964) noted that most courting groups are composed of "a single large-bodied female and as many as a dozen males." Referred to as scramble competition, this form of mating is similar to other natricine snakes (watersnakes, garter snakes, and their allies).

At least some female watersnakes experience annual mating success, and King (1986) determined that annual reproduction is body size dependent, stating that the proportion of gravid females increases with the females' SVL. Parturition occurs between mid August and late September, with females giving birth to an average of 23 live young per litter (King 1986). Litter sizes from 9 to 50 neonates have been reported. In his 1986 study, King reported that the average newborn snake weighed 4.8 g (0.17 oz), and measured 18.1 cm (7.1 in) SVL. Both the number of offspring per litter, and the size of offspring in a given litter are positively correlated with the female's body size (King 1986; Rouse and Bishop 2002).

Growth and maturity

At birth, neonate Lake Erie Watersnakes average 18.1 cm (7.1 in) SVL and 4.8 g (0.17 oz) (King 1986). Neonate snakes grow very little before entering hibernation, and typically emerge from hibernation the same size as when they entered. Young of year snakes, those less than one year old, are typically less than 27 cm (10.6 in) SVL (King 1986). Juvenile snakes, those between the ages of 1 and 3 years old, range from 27 cm (10.6 in) to 43 cm (16.9 in) SVL for males, and from 27 cm (10.6 in) to 59 cm (23.2 in) SVL for females (King 1986). Lake Erie Watersnake females grow more rapidly and mature at larger sizes than males, producing a significant size difference between sexes (King 1986). Adult females average 82.1 cm (32.3 in) SVL, and adult males average 62.5 cm (24.6 in) SVL (King 1986).

The weight of individual watersnakes is length dependent, expressed in the relationship: $Wt=0.0005SVL^{3.07}$ ($r^2=0.96$, $P<0.001$, $N=995$). Males typically lose weight during the spring mating period, and gain weight the rest of the summer, while females typically gain weight from spring until parturition (King 1986).

Adult snakes are long-lived; several mark-recapture studies have identified snakes estimated to be up to 10 years old (RB King, Northern Illinois University, pers. comm. 2003). However, little is known about annual survivorship in Lake Erie Watersnakes, or about how the population growth rate is affected by changes in survival, growth, development, or reproduction. Studies to quantify these relationships are recommended to better understand fluctuations in population size.

Predators

Few predators of the Lake Erie Watersnake have been documented. These include herring gulls (*Larus argentatus*), great blue herons (*Ardea herodias*), robins (*Turdus migratorius*), raccoons (*Procyon lotor*), red fox (*Vulpes vulpes*), and blue racers (*Coluber constrictor*) (Camin and Ehrlich 1958; Goldman 1971; Hoffman and Curnow 1979; King 1986, 1987b, 1989a, 1993c). Other potential predators include domestic animals such as cats and dogs (King 1989a). Neonates and immature snakes are more likely to succumb to predation than are adult snakes, due to the significant difference in body size. Predation comprises only a small percentage of known sources of mortality.

Genetic Population Structure

Approximately 95 percent of the Lake Erie Watersnake population's gene pool occurs on the offshore islands of western Lake Erie (King 1998a, 1998b). The offshore islands are isolated from the Ohio and Ontario mainland by approximately 5 to 14 km (3 to 9 mi) of water. Although not a complete barrier, the distance from offshore islands to the mainland (and the near-shore islands) creates a natural barrier. This barrier maintains the integrity of the Lake Erie Watersnake gene pool by limiting interbreeding between offshore island Lake Erie Watersnakes and mainland and near-shore Northern Watersnakes. Thus, species experts believe that the genetic pool on the western Lake Erie offshore islands is primarily Lake Erie Watersnake (Conant and Clay 1963 using data from Cliburn 1961; King 1986, 1987b, 1992a, 1992b, 1998a),

and the genetic pool on the mainland and near-shore islands is predominately Northern Watersnake.

As discussed under “Movement Patterns”, individual snakes have been documented moving among islands, and between islands and the mainland. Thus, significant gene flow occurs among islands and between islands and the mainland (King and Lawson 1995), therefore maintaining greater genetic variation than if populations were more fully isolated. Although the Lake Erie Watersnake is subdivided into a number of island populations, available data indicate that rates of gene flow exceed 1 individual per generation (King and Lawson 1995), therefore accelerated loss of genetic variation due to population subdivision is not anticipated (Mace and Lande 1991).

HABITAT REQUIREMENTS

Essential Summer Habitat

Lake Erie Watersnakes use habitat composed of shorelines that are rocky or contain limestone/dolomite shelves and ledges for sunning and shelter (Conant and Clay 1937; Thomas 1949; Conant 1951; Camin and Ehrlich 1958; King 1986, 1987b). Shelter (refugia) occurs in the form of loose rocks, piled rocks, or shelves and ledges with cracks, crevices, and nearby sparse shrubbery (Thomas 1949; King 1986, 1992a). Lake Erie Watersnakes are found less often on shorelines composed of small stones, gravel or sand (Conant and Clay 1937; Conant 1938; King 1986). King (2003) found that during the summer, 75% of Lake Erie Watersnakes are found within 13 m (42.7 ft) of the water’s edge. For the purpose of this recovery plan, “shoreline” is defined as the water’s edge to 13 m (42.7 ft) inland (Figures 2-5).

Certain types of human-made structures serve as shelter for Lake Erie Watersnakes (Conant and Clay 1937; Conant 1938, 1982; King 1990; USFWS 1994) provided adequate space exists in these structures that is above Lake Erie’s water and ice levels. Observations indicate that the Lake Erie Watersnake will use rock-filled timber or steel crib docks for summer basking and resting habitat, while sheet steel docks provide no habitat for the snake. In addition, shoreline erosion protection, such as riprap, provides some summer habitat for the snake, while sheet steel or poured concrete erosion protection does not provide summer habitat. The extent to which such artificial refugia benefits the Lake Erie Watersnake is currently unquantified; however, incidental observations indicate that a significant number of snakes use these structures for basking, shelter, and escape cover on a daily basis. Radio transmitters have been implanted in a number of watersnakes captured on crib docks along the south shore of Kelleys Island. These snakes remained in or near these docks throughout the summer, and returned to the same docks each year after emerging from hibernation (King 2001). The south shore of Kelleys Island is one of the most heavily developed areas of the island, but also supports the most dense concentration of the Lake Erie Watersnake on the island. Lake Erie Watersnake appears to be highly adaptable to modified shoreline habitat, provided that construction and design of the project considers the seasonal needs of the snake. The evidence above indicates that the Lake Erie Watersnake can thrive in close proximity to human beings and human activity provided they are not persecuted and provided seasonal needs of the snake are considered and are compatible with human activities.

Ponds or wetlands, including quarries, found within the interior portions of the islands also provide summer habitat for a small number of Lake Erie Watersnakes (R. King, pers. comm. 2003). Examples of these include Kuehnle Wildlife Area on Middle Bass Island, and North Pond on Kelleys Island (Figures 4 and 2). Specific wetlands may or may not provide suitable habitat for snakes; suitable habitat is dependent on many factors, including availability of prey, presence of predators, and presence of suitable basking and escape cover.

Unique shoreline communities called alvars exist on many of the islands in the western basin of Lake Erie. Alvars are composed of areas of relatively flat limestone or dolomite bedrock exposed by glaciers and scoured by ice, wind, and water. Alvars have no soil but support populations of specially adapted plants that can survive in this hostile terrain. Vegetation supported by alvars on Lake Erie islands include northern bog violet, balsam squawweed, Kalm's lobelia, Pringle's aster, mosses, lichens, grasses, sedges, and some stunted trees. Alvar communities provide suitable summer habitat for Lake Erie Watersnakes on some islands where habitat would otherwise be limited, such as Green Island. Green Island is mainly composed of young forest, and only portions of the periphery of the island, where the alvar habitat is found, provide suitable summer habitat for the snake (MM Seymour, USFWS, pers. comm. 2002).

Shoreline vegetation plays an important role in providing cover for the Lake Erie Watersnake (Thomas 1949; King 1986, 1992a). The exact type of vegetation does not appear to be important, but its use depends on vegetation density and proximity to the shoreline and basking areas. Dense shrubs, brush, and vines such as grape (*Vitis* spp.), Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Toxicodendron radicans*), and red cedar (*Juniperus virginiana*) all provide good sources of cover when located in proximity to the shoreline. Incidental observations indicate that the Lake Erie Watersnake can tolerate removal of some shoreline vegetation, provided other forms of cover are present in the area (MM Seymour, pers. comm. 2002). Brush piles composed of branches, sticks, twigs, and lawn clippings located close to the shore are also noted to provide suitable refugia for snakes during the summer (MM Seymour, pers. comm. 2002).

Watersnakes stay close to the shoreline during the majority of the active season. King (2003) found that 75% of Lake Erie Watersnakes could be found within 13 m (42.7 ft) of the shoreline during the summer. Individual snakes seem to establish home ranges along portions of the shore, and typically remain within a given length of shore. Seventy-five percent of the population studied used 437 m (1433 ft) of shoreline or less (King 2003). The Lake Erie Watersnake typically demonstrates site fidelity, returning to the same area of shoreline each summer (King 2003).

Essential Hibernation Habitat

Lake Erie Watersnake hibernation sites are typically located in rocky substrates and are sometimes covered with soil, leaf litter, decaying wood, and grass (King 2003). Hibernation sites include both open and wooded areas. Some watersnakes select hibernation sites in shoreline habitats close to where they spend the summer, while others move long distances along the shore

(up to 1400 m (4593 ft)) to hibernate (King 2002c). King (2003) reported that 75% of the population studied hibernated within 69 m (226 ft) of shore (Figures 2-5). In this same study, the elevation above lake level of the ground surface over hibernating snakes was estimated to range from 1-10 m (3.28-32.8 ft). Of 12 Lake Erie Watersnakes for which multiple years of hibernation data are available, 11 of the 12 demonstrated site fidelity, returning to the same or nearly the same hibernation site repeatedly, with distances between successive hibernation sites estimated to be 10 m or less (King 2003; R. King, pers. comm. 2003). The single exception was a watersnake whose hibernation sites were separated by 220 m (721 ft) (King 2003), and who did not emerge from hibernation the second year. Between- island movements suggest that some snakes do relocate their hibernation sites. The timing of recaptures of two snakes which moved between islands in two successive years indicates that both of these snakes likely selected different hibernation locations when they switched islands R. King, pers. comm. 2003).

King's 1999-2002 study is the first to document characteristics of hibernation sites. Hibernation sites include both natural areas and human-made structures. Most identified hibernation sites have soil and rock substrates and consist of natural openings or fissures. Some of the natural areas that provided hibernation sites include cracks and crevices in bedrock, rock piles, tree root masses, and mammal burrows. Some hibernation sites have been identified in or near human-made structures. These include old building foundations, drainage tiles, sewer lines, concrete shoreline protection, and cellars (King 2002a, 2003).

Radio transmitters were implanted in four watersnakes captured on crib docks along the south shore of Kelleys Island. These snakes remained in or near these docks throughout the summer, but all four moved ashore to hibernate. This suggests that crib docks provide useful watersnake habitat during the summer, but they may not provide appropriate hibernation sites (King 2001).

King (2003) observed that typically, the Lake Erie Watersnake hibernates individually at a given location, but that on several occasions snakes were noted to hibernate within 10 m (32.8 ft) of other snakes. Recent research on Lake Erie Watersnakes on Canadian islands indicates that often snakes hibernate together in groups of at least 2 or 3 (D Jacobs, pers. comm. 2003). Documentation and characterization of high-quality hibernation areas that support multiple snakes in close proximity would facilitate actions to protect and enhance these areas, further contributing to the long-term survival of the Lake Erie Watersnake.

Figure 2. Kelleys Island map, including public property and 75% limits of Lake Erie Watersnake summer and hibernation habitats

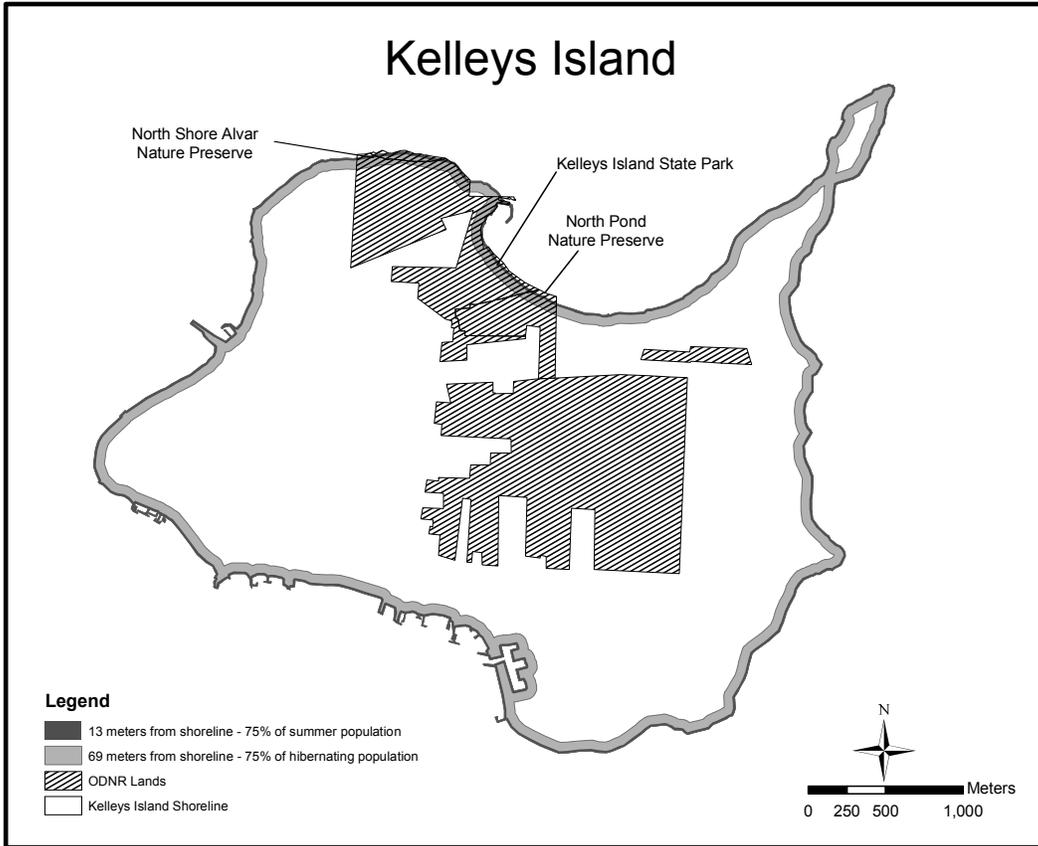


Figure 3. South Bass Island map, including public property and 75% limits of Lake Erie water snake summer and hibernation habitats

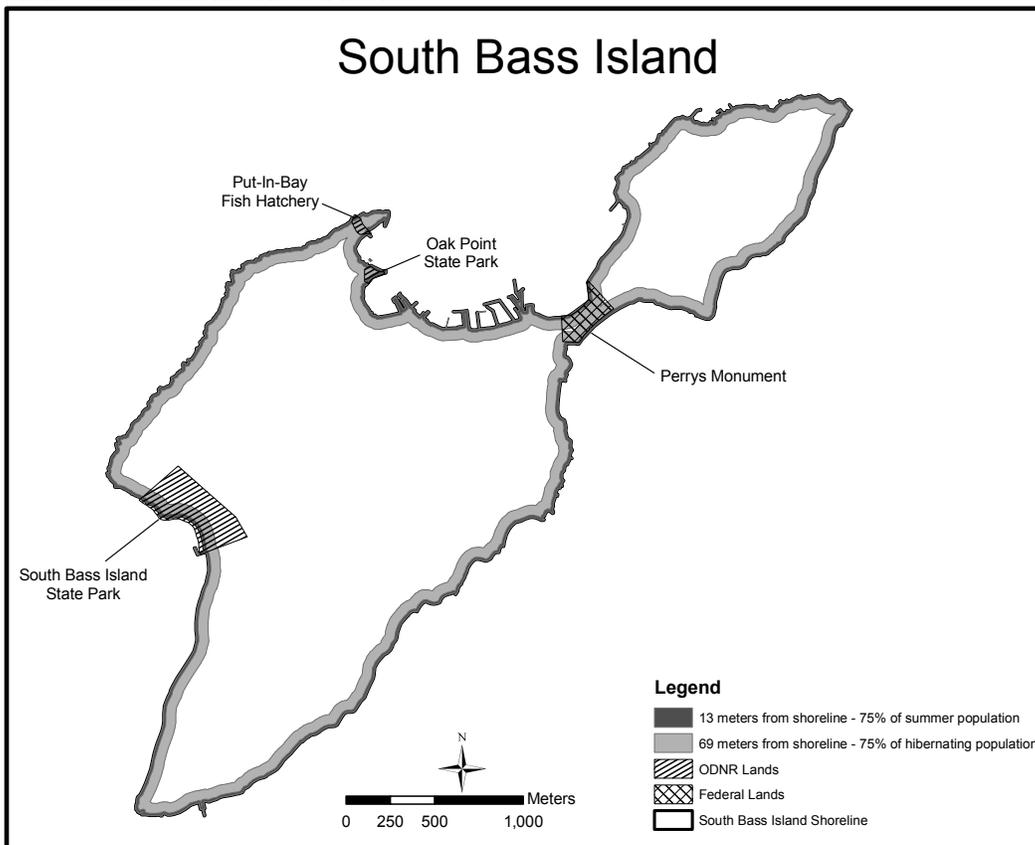


Figure 4. Middle Bass Island map, including public land and 75% limits of Lake Erie water snake summer and hibernation habitats

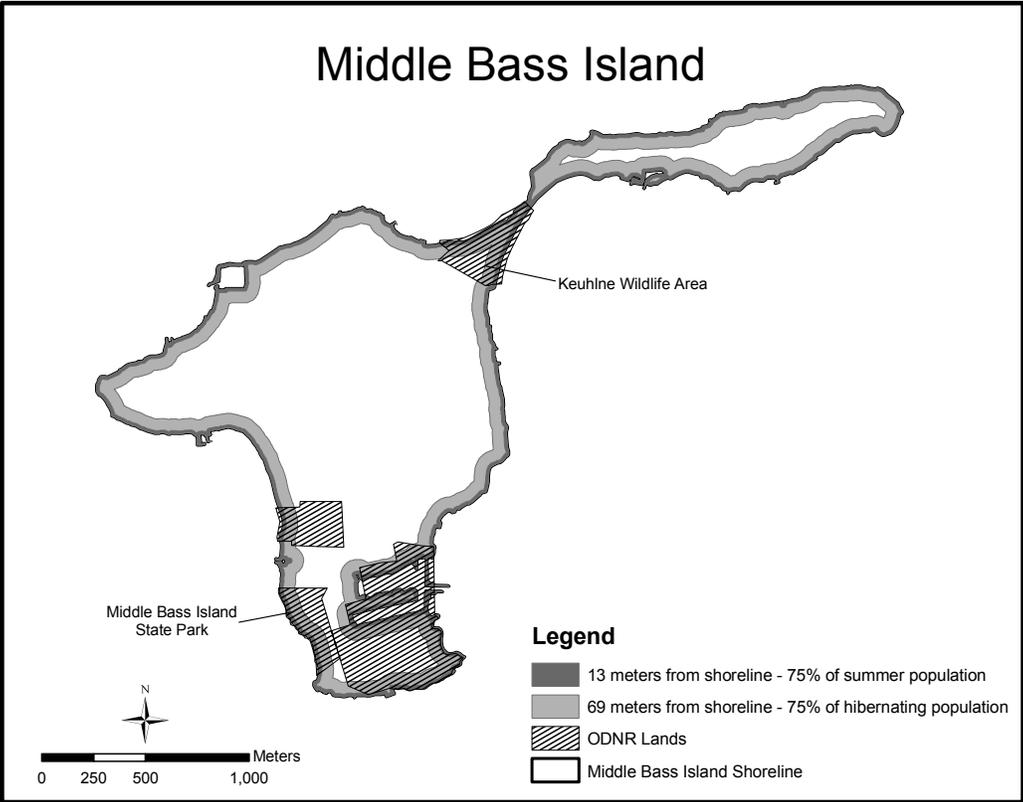
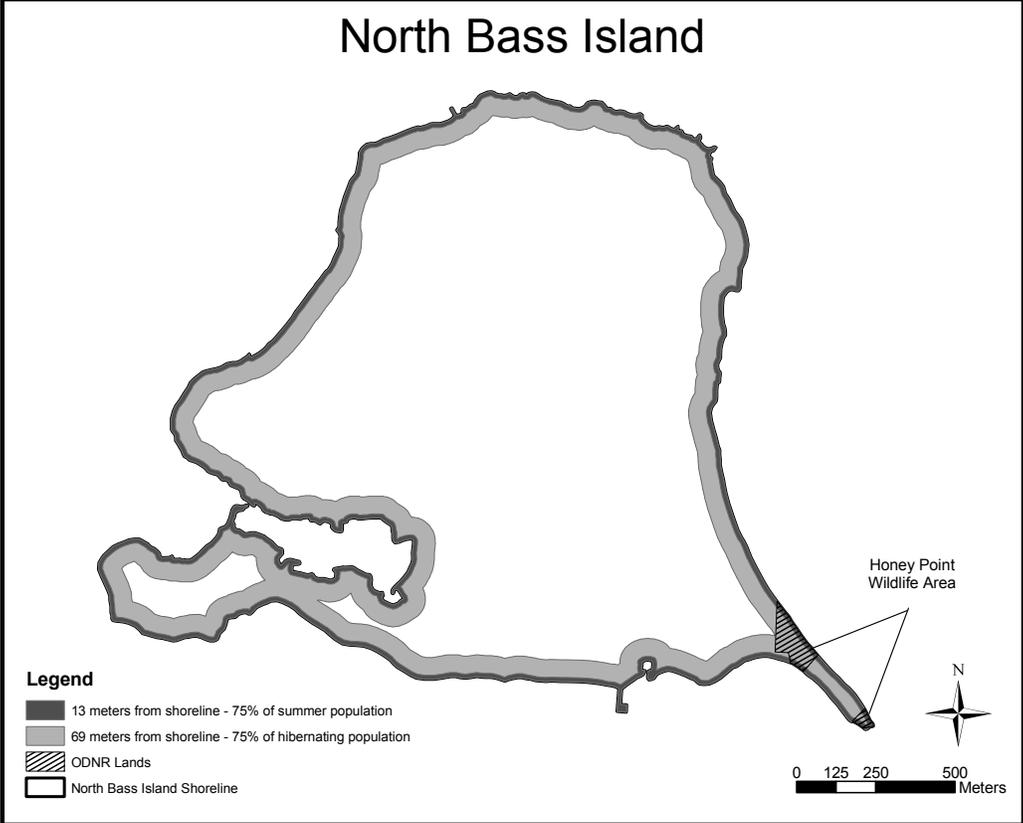


Figure 5. North Bass Island map, including public land and 75% limits of Lake Erie Watersnake summer and hibernation habitats



CRITICAL HABITAT

Section 3 of the ESA defines critical habitat as: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. "Conservation" means the use of all methods and procedures needed to bring the species to the point at which listing under the Act is no longer necessary. At the time of listing, it was determined that designation of critical habitat would not be prudent for the Lake Erie Watersnake because of the following reasons: (1) the species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species; and (2) such designation of critical habitat would not be beneficial to the species because the snake is a semi-aquatic species, and most activities that would occur in its habitat would be subject to review under section 7(a)(2) of the Act, regardless of whether critical habitat was designated (50 CFR Part 17). Furthermore, the snake has become so restricted in distribution that any significant adverse modification or destruction of occupied habitats would likely jeopardize the continued existence of this species. Therefore habitat protection for the snake can be accomplished through the section 7 jeopardy standard (50 CFR Part 17). We also concluded that any potential benefit from designation of critical habitat would be offset by an increased level of vulnerability to collecting, persecution, and by a possible reduction in landowner cooperation to manage and recover this subspecies (50 CFR Part 17).

If, following completion of this plan, we find that it is prudent and determinable to designate critical habitat for this species, the USFWS will prepare a critical habitat proposal in the future, at such time as our available resources and other listing priorities under the Act allow. This proposal will be based on the essential habitat features needed to ensure the conservation and recovery of the species, many of which have been documented earlier under the Habitat Requirements section.

THREATS

The Lake Erie Watersnake occupies a restricted geographic range on the islands in the western basin of Lake Erie. Optimal summer habitat for the species includes the islands' rocky shoreline and nearshore waters, while inland areas up to approximately 69 m (226 ft) from the shore provide hibernation habitat for 75% of the U.S. population (King 2003). At the time of listing, the most severe threats to the Lake Erie Watersnake were thought to be habitat loss and degradation, due to development of the snake's summer and hibernation habitat, and both intentional and accidental human-induced mortality. Current research and observations indicate that human persecution may have been the most significant factor in population declines, with habitat loss and degradation playing a more peripheral role. Natural threats to the survival of the snake include extreme weather conditions, and the insular nature of the population. Additional threats may also exist, but generally these other factors have not been adequately investigated to determine the significance of the impact to the snake's population. A summary of threats to the snake can be found in Table 2.

Habitat Loss, Alteration, and Degradation

Habitat loss and alteration is a cause of the decline of the Lake Erie Watersnake (Ashton 1976; Kraus and Schuett 1982; King 1986; King and others 1997). During the past 60 years, shoreline habitat important to the watersnake has been significantly altered, degraded, and developed through the construction of shoreline cottages, marinas, sheet steel docks, and sea walls, the filling of wetlands, and the mining of quarries (Hatcher 1945; Core 1948; Kraus and Schuett 1982; King 1985, 1986; King and others 1997). Current development on both Canadian and U.S. Lake Erie islands (e.g., Kelleys, Middle Bass, South Bass, Pelee) is resulting in continued alteration and degradation of Lake Erie Watersnake habitat.

Examples of recent development projects occurring within Lake Erie Watersnake summer and/or hibernation habitat on the U.S. islands include the following: shoreline cottage and commercial construction; dock, revetment, breakwater, and seawall projects; construction and rehabilitation of marinas; construction of roads; construction of airports; and quarrying projects. Indeed, since the Lake Erie Watersnake was listed in August 1999 until February 2003, the USFWS has consulted on more than 22 projects occurring on 5 U.S. islands under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act, administered by the U.S. Army Corps of Engineers (MM Seymour, pers. comm. 2003). As discussed under “Essential Summer Habitat,” the Lake Erie Watersnake appears to be highly adaptable to modified shoreline habitat, especially if the structures are designed and constructed while considering the biology and habitat needs of the snake. With some simple design implementations and time restrictions, some of the shoreline projects (for example docks, revetments, and breakwaters) can be constructed in a manner that eliminates adverse effects on the snake and its habitat, and may benefit the snake by creating artificial summer habitat.

Further exacerbating the alteration of habitat due to impacts from construction are the indirect effects related to these construction projects, such as habitat fragmentation. Recent studies indicate that 75% of individual Lake Erie Watersnakes use 437 m (1433 ft) or less shoreline for summer habitat (King 2003). Construction of a large dock, breakwater, or seawall within the range of the shoreline used by the snake can result in fragmentation of the snake’s habitat. Since the snake is mobile and can readily swim around some barriers, habitat fragmentation along the shoreline is likely to be less significant than habitat alteration, but further studies to quantify the impact of fragmentation on Lake Erie Watersnakes are recommended.

In addition to commercial, residential, and recreational development projects, habitat is also being degraded by shoreline management practices that are incompatible with Lake Erie Watersnake habitat needs. Shoreline vegetation is regularly cleared or mowed at many locations on the U.S. islands in order to provide a clear vista of the lake, easy access to the water, or for aesthetic reasons. As discussed under “Essential Summer Habitat,” shoreline vegetation, specifically herbaceous vegetation, is an important component of summer habitat, and removal of this vegetation reduces the suitability of the habitat for snakes. Incidental observations

indicate that the Lake Erie Watersnake can tolerate removal of some shoreline vegetation, provided other forms of cover are present in the area (MM Seymour, pers. comm. 2003).

Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The USFWS knows of no current commercial, recreational, or educational overutilization of the Lake Erie Watersnake. The impact of scientific collecting on the Lake Erie Watersnake population is not known, but negative impacts from possible over-collecting cannot be discounted. The historical collection of Lake Erie Watersnakes is well documented, with reports of from 40 watersnakes (Hamilton 1951; Langlois 1964; Conant 1982; ODNR Division of Natural Areas and Preserves, *in litt.*, 1993) to hundreds of watersnakes (Conant and Clay 1937; Conant 1938, 1951; Camin and Ehrlich 1958; Conant and Clay 1963; Conant 1982) collected per island during repeated visits. The Lake Erie Watersnake is not likely to be collected for commercial purposes, and this form of overutilization has not been documented. Present day collection of the snake for any purpose is prohibited under the ESA without a permit issued by the USFWS. Currently, collection is not considered a significant factor in population declines.

Disease or Predation

Little is known about the impacts of disease on watersnakes (*N. sipedon*). The USFWS believes disease is currently not a significant problem for Lake Erie Watersnakes. The USFWS recognizes, however, that the synergistic effects of pollutants, other environmental stress (such as habitat loss), and the locally dense nature of some localized subpopulations could expose watersnakes to significant disease problems. Very little research has been conducted on disease in Lake Erie Watersnakes, so the significance of this factor as a threat to the snake cannot be definitively stated. Further studies to quantify the types of diseases and the impacts of disease on the Lake Erie Watersnake population are recommended.

The USFWS is not aware of any evidence showing that natural predation has contributed significantly to the decline of the Lake Erie Watersnake. Although predation by herring gull (*Larus argentatus*), great blue heron (*Ardea herodias*), robin (*Turdus migratorius*), raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*) and blue racer (*Coluber constrictor*) has been documented (Camin and Ehrlich 1958; Goldman 1971; Hoffman and Curnow 1979; King 1986, 1987b, 1989a, 1993c), this very low level of mortality is not likely to have a significant affect on the Lake Erie Watersnake population; however, populations that occur at low densities, like the Lake Erie Watersnake, can be adversely impacted by any mortality factor, whether natural or human-induced.

Inadequacy of Existing Regulatory Mechanisms

At the time of listing, the Lake Erie Watersnake had no legal protection from take, harm, or habitat loss within the United States. The ODNR, Division of Wildlife had granted threatened status to the snake in 1990, but this is an administrative designation that does not confer legal protection. Portions of the land area on the western Lake Erie islands comprise public land and are inhabited by Lake Erie Watersnakes, and thus are minimally protected from habitat destruction, however these properties were not necessarily managed in a manner compatible with

the snake's habitat needs. The majority of the subspecies' island habitat was unprotected and managed incompatibly with the snake's needs.

The State of Ohio designated the Lake Erie Watersnake as an endangered species in May, 2000, and while this designation protects the snake from direct take, provisions for protection and management of the snake's habitat are non-existent. This is an important gap in that loss and degradation of suitable habitat is a cause of population declines, and recovery of the species will depend on ensuring an adequate base of suitable habitat. Each of the four largest U.S. islands contains significant parcels of land owned and managed by the ODNR Division of Parks and Recreation, Division of Wildlife, or Division of Natural Areas and Preserves (Figures 2-5). The majority of Green Island is owned by the ODNR, Division of Wildlife. Additional parcels on several islands are owned by non-government organizations, such as the Cleveland Museum of Natural History and The Ohio State University. Federal land ownership on the islands includes a parcel on South Bass Island owned by the National Park Service, and West Sister Island, owned by the USFWS. Creation and implementation of management agreements or the purchase of conservation easements on both publicly and privately owned areas could be used to ensure habitat conservation that would benefit the Lake Erie Watersnake. Other, more flexible regulatory mechanisms could be developed to ensure this habitat base as well.

Populations of the Lake Erie Watersnake that occur on Federal and state lands are protected from destruction, but Federal and State land managers might not manage essential summer and hibernation habitat appropriately. Developing streamlined procedures for incorporating concerns for Lake Erie Watersnakes into current management plans is recommended in this plan. One example of this type of streamlining is the "Lake Erie Watersnake Habitat Management Planning" document (Appendix B), written by ODNR for the development of Middle Bass Island State Park.

Other Natural or Manmade Factors

Persecution by humans is the most significant and well-documented factor in the decline of Lake Erie Watersnakes (Conant 1982; Kraus and Schuett 1982; King 1986; King and others 1997). During the 1800s, pigs were released on some islands to exterminate snakes (Hatcher 1945; McDermott 1947). All snake species were eradicated from Rattlesnake Island by 1930 (Conant 1982); however, snakes have recently recolonized this island (King 1987b; King and others 1997). Ehrlich and Camin (1960) told of a campaign of extermination waged against watersnakes on Middle Island. Conant and Clay (1963) noted that persecution of island watersnakes was severe. Persecution by humans was still a serious problem until just before the snake was listed under the ESA. The common misconceptions that the Lake Erie Watersnake is dangerous or poisonous resulted in much persecution, and an unfounded human fear of snakes in general lead to additional eradication efforts. Since listing the snake as a federally threatened species in 1999 and implementing a public education and outreach program targeting snake awareness and conservation, reports of intentional killing of snakes seem to have decreased somewhat; however, the effects of past and current persecution are evident today and are a threat to the continued existence of the watersnake.

Three of the four largest U.S. islands currently have, or are in the process of developing, tourism-based economies. The islands are often considered resort areas and are major destination areas for boaters and tourists within and outside of the region. The past and future impacts from tourism continue to threaten the Lake Erie Watersnake subpopulations on these islands. The great number of visitors to the islands and the high visibility of the Lake Erie Watersnake along the shoreline result in many tourist-snake confrontations. This, coupled with the general fear of snakes discussed above, has resulted in high human-induced mortality.

Mortality due to roadkill also represents a significant threat to the Lake Erie Watersnake population. Roadkilled snakes, especially neonates, are regularly reported throughout the summer on most of the islands (K Stanford, pers. comm. 2003). Many roads have been constructed along the shoreline of the islands to facilitate access to shoreline property. Although Lake Erie Watersnakes typically stay close to the shore during the summer, most snakes move inland to hibernate (King 2002c), and must cross roads to do so. Furthermore, increased visitation to the islands by vacationers and tourists aggravates the roadkill problem by introducing even more vehicles to the islands. In addition to car traffic, the Lake Erie Watersnake is occasionally struck by other vehicles, such as boats, lawn mowers, and construction equipment (MM Seymour, pers. comm. 2002). As the tourism industry grows, it is expected that mortality from vehicles will increase, constituting a threat to the survival of the Lake Erie Watersnake population.

Lake Erie constitutes a significant national and international fishery resource. Snakes are known to use boats as basking and resting spots and may occasionally become entangled in fishing gear or inadvertently caught on fishing hooks (J Hageman, The Ohio State University Stone Laboratory, pers. comm. 2003; K Stanford, pers. comm. 2003). Although this is a documented form of mortality, it is unlikely that this represents a significant threat to the population.

Lake Erie and the rest of the Great Lakes have recently been plagued by an onslaught of invasive species, including the zebra mussel (*Dreissena polymorpha*), and round goby (*Neogobius melanostomus*), among others. At this time it is unclear to what extent these invasions may be affecting the Lake Erie Watersnake population. Recent observations indicate that Lake Erie Watersnakes may be consuming round gobies at very high rates (K Stanford, pers. comm. 2002). This may indicate that gobies are replacing the traditional food sources of watersnakes. Round gobies feed on zebra mussels, which filter contaminants out of the lake water and sediments, thereby introducing these toxins into the food chain. Any watersnakes that consume gobies that have consumed zebra mussels may be ingesting higher levels of contaminants than previous food sources supported. Further research should be conducted to determine whether this issue presents a serious threat to the Lake Erie Watersnake population.

Contaminants such as polychlorinated biphenyls (PCBs) and organochlorine pesticides are known to bioaccumulate in fat cells of mammals, birds, and reptiles. PCBs and pesticides are accumulated by consuming food sources contaminated by the chemicals, or by passing the chemicals from females to offspring. Contaminants persist in lake water and sediments, and can be consumed by aquatic-feeding organisms. The contaminants then accumulate in the fat cells of the organism and can contribute to problems with reproduction and metabolism. PCBs are

known to adversely affect some reptiles (Wojcik and others 1995), while organochlorine pesticides have been implicated in deaths (Koeman and others 1978; George and Stickel 1949) and declines in snake populations in the southern United States (Fleet and others 1972; Fleet and Plapp 1978). The few studies that have been completed documenting levels of contaminants in Lake Erie Watersnakes indicate that PCBs can be found in significant levels in certain subpopulations, while organochlorine pesticides were below detection limit or were detected at trace concentrations (Rouse and Bishop 2002). Bishop and Rouse (2000) found that male Lake Erie Watersnakes from Pelee Island, Ontario had a summed concentration of PCBs measuring 167 ng/g (wet weight). These levels equal or exceed, on a lipid weight basis, those levels reported in some fish and raptorial birds in North America (Bishop and Rouse 2000). A later study by Rouse and Bishop (2002) found that females had a mean summed concentration of PCBs averaging 90 ng/g wet weight at three different sites on Pelee Island. Although PCBs were detected in female watersnakes, the presence of these contaminants did not correlate with embryonic mortality or number of embryos produced by the snakes. This study found that embryonic survivorship appears to be relatively insensitive to the PCB contamination levels experienced in female Lake Erie Watersnakes on Pelee Island. It also documented, however, that Lake Erie Watersnakes can readily accumulate PCBs from their diet, and that males accumulate relatively high levels, therefore PCBs cannot be discounted as a possible contributing factor to loss of snakes. Further research is necessary to determine what, if any, effect contamination is having on the Lake Erie Watersnake population.

Other forms of pollution may be contributing to Lake Erie Watersnake mortality and population declines as well. An island resident reported to the USFWS a dead snake found with its head lodged in the opening of a beverage can (J Hageman, pers. comm. 2003). Additional encounters between Lake Erie Watersnakes and human pollution likely occur occasionally, although it is unlikely that this form of mortality represents a significant threat to the population.

Stochastic events, such as severe weather, can detrimentally affect Lake Erie Watersnake populations. Extremely severe winters can result in high mortality during the hibernation period. Forces of nature such as storms and wave-induced erosion can destroy watersnake habitat and contribute to mortality. These natural events are unpredictable and unstoppable, representing a threat that cannot be managed. Although these events could have a significant detrimental effect on the population that could last for several years, it is possible for the population to recover if patches of undisturbed habitat remain.

The threats and potential threats discussed above are further exacerbated by a population size that is much smaller than historic numbers and by the insular distribution of the Lake Erie Watersnake. These factors make the snake more vulnerable to extinction or extirpation from catastrophic events, demographic variation, negative genetic effects, and environmental stresses such as habitat destruction and extermination than if they were not a small, island-based population (Shaffer 1981; King 1987b, 1998b; Dodd 1993; Nunney and Campbell 1993; King and others 1997). Though all populations naturally fluctuate, small populations are more likely to fluctuate below the minimum viable population threshold needed for long-term survival (Gilpin and Soulé 1986; Soulé 1987). Likewise, chance variation in age and sex ratios can cause death rates to exceed birth rates, causing a higher risk of extinction in small populations. Finally, decreasing genetic variability in small populations increases the vulnerability of a species to

extinction due to inbreeding depression (decreased growth, survival, or productivity caused by inbreeding) and genetic drift (loss of genetic variability that takes place as a result of chance) (Soulé 1987). A recent study of snakes (adders) in Sweden found that inbreeding depression in isolated populations resulted in smaller litter size, higher proportion of deformed and stillborn offspring, and lower degree of genetic heterozygosity (Madsen and others 1996), which in turn cause reduced fertility and survivorship. Thus, in small populations, environmental, demographic, and genetic changes can result in an accelerating slide toward extinction. Furthermore, the theory of island biogeography states that island species are more likely to go extinct than mainland species because they occupy a physically restricted area and are less able to adapt to changing environments (such as the introduction of exotic species or the loss of some habitat) (MacArthur and Wilson 1967). Once habitat has been destroyed, there is no place for the species to migrate because islands have a finite amount of space: the smaller the island, the more severe this effect (MacArthur and Wilson 1967). This may indicate why some of the smaller islands, such as West Sister, Green, and Rattlesnake Islands, have experienced extirpation of the Lake Erie Watersnake. Since watersnakes can and do occasionally migrate between islands, the island effect may not be as severe because recolonization is still possible, as occurred on Green and Rattlesnake Islands.

Table 2. Assessment of threats to the Lake Erie Watersnake. Threats were scored based on level of severity and feasibility of restoration. The score of the stress increases as severity increases and restoration feasibility decreases. Scores for Severity are as follows: low=1; medium=2; high=3. Scores for Restoration Feasibility are as follows: low=3; medium=2; high=1. Scores are achieved by adding the value of the Severity and Restoration Feasibility columns. A score of 6 represents the most severe threat, while 2 represents the least severe threat.

Stress	Source of Stress	Severity	Restoration feasibility	Score
Mortality	intentional human-induced killing	high	medium	5
Hibernation habitat alteration	interior island development-homes, roads, commercial development	medium	low	5
Summer habitat alteration	shoreline development—construction of docks, marinas, erosion protection, etc.	low	low	4
Summer habitat degradation	incompatible shoreline management practices	low	medium	3
Habitat loss	weather events	low	low	4
Mortality	weather events	low	low	4
Mortality	roadkill	low	medium	3

CONSERVATION MEASURES

Since before the Lake Erie Watersnake was listed as a threatened species in 1999, many efforts have been initiated to conserve and recover the species. These activities are briefly described below.

Federal Regulatory Protection

“Take”

Section 9 of the ESA prohibits any person subject to the jurisdiction of the United States from “taking” federally listed threatened and endangered species. “Take” is defined as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting these species. It is also unlawful to attempt such acts, solicit another to commit such acts, or cause such acts to be committed. Regulations implementing the ESA (50 CFR 17.3) further define harm to include significant habitat modification or degradation that results in the killing or injury of wildlife by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. “Harass” means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to breeding, feeding, or sheltering.

Federal Permits under the ESA

Section 10 of the ESA provides for the issuance of two types of permits that may be granted to authorize activities prohibited under Section 9:

Section 10(a)(1)(A): permits for scientific purposes or to enhance the propagation or survival of a listed species;

Section 10(a)(1)(B): permits for take that is “incidental to, and not the purpose of, carrying out an otherwise lawful activity.”

One Section 10(a)(1)(A) permit has been issued for scientific research on the Lake Erie Watersnake, and additional permits are expected to be issued in the near future. One Section 10(a)(1)(B) permit has been issued to the Long Point Homeowner’s Association, LLC after development of a Habitat Conservation Plan for the Lake Erie Watersnake on the Association’s property.

Section 7 Consultation

Section 7(a)(2) of the ESA requires Federal agencies to consult with the USFWS prior to authorizing, funding, or carrying out activities that may affect federally listed species. Section 7(a)(1) also requires that these agencies use their authorities to further the conservation of federally listed species. Section 7 obligations relative to the Lake Erie Watersnake have resulted in a number of informal consultations for projects such as dock, revetment, and seawall construction, marina development, airport construction, and land management activities administrated by Federal agencies including the U.S. Army Corps of Engineers, Federal Highway Administration, and USFWS.

Other Federal Permits

All of the islands in Ohio's Lake Erie waters are located within Ohio's designated Coastal Zone. Pursuant to the Coastal Zone Management Act of 1972 and 15 C.F.R. 930, federal agency permits in Ohio's Coastal Zone are subject to a consistency determination by the ODNR. As such, applicants for Section 7 ESA permits, Section 404 of the Clean Water Act permits, and Section 10 of the Rivers and Harbors Act permits must coordinate with ODNR Office of Coastal Management prior to issuance of the permit. This permitting process regulates nearshore development, and applies to much of the snake's summer habitat.

Development below the ordinary high water mark of Lake Erie and development impacting streams or wetlands on the islands are subject to the Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act, respectively. These Acts are administered by the U.S. Army Corps of Engineers. Indeed, since the Lake Erie Watersnake was listed in August 1999 until February 2003, the USFWS has completed Section 7 consultation for more than 22 projects occurring on 5 U.S. islands under Sections 404 and 10 (MM Seymour, pers. comm. 2003). Again, this permitting process applies to much of the snake's summer habitat and provides opportunities for review of shoreline projects and protection or enhancement of summer habitat.

State Protection

The Lake Erie Watersnake is listed as endangered by the State of Ohio, which protects the snake from direct take. The ODNR, Division of Parks and Recreation and Division of Natural Areas and Preserves own and manage a number of large land parcels on each of the four largest U.S. islands. At least one of these parcels is currently actively managed for Lake Erie Watersnake conservation and protection, guided by the "Lake Erie Watersnake Habitat Management Planning Document" (Appendix B), a management document created by ODNR and approved by the USFWS. This plan addresses actions ODNR will undertake to avoid and minimize adverse impacts to the snake and its habitat while undertaking daily land management activities.

Canadian Protection

A National Recovery Team for the Lake Erie Watersnake has been established in Canada, and a recovery plan for the snake in the province of Ontario is expected to be developed within the next several years to guide recovery of the snake in Canada. Research projects on the Canadian islands studying hibernation habitat, movement patterns, and impacts from contaminants have been undertaken recently. Habitat management for the Lake Erie Watersnake on public lands is ongoing, as are education and outreach efforts.

Several areas exist on the Ontario, Canada islands which are inhabited by the Lake Erie Watersnake and protected from habitat loss. On Pelee Island, Ontario, the Lake Erie Watersnake is protected by Provincial Nature Reserves at Fish Point (0.115 km², 284 ac) and Lighthouse Point (0.90 km², 222 ac) (I Bowman and P Prevett, Ontario Ministry of Natural Resources, pers.

comm. 1994). The Essex Region Conservation Authority (ERCA) also set aside the 2.20 km² (544 ac) Stone Road Complex preserve on Pelee Island which benefits watersnakes and local plant species (D Krouse, ERCA, pers. comm. 1994). East Sister Island (0.15 km², 37 ac) is a Lake Erie Watersnake Provincial preserve, but the population of watersnakes on the island is small and likely declining (King 1986; I Bowman and P Prevett, pers. comm. 1994; RB King, pers. comm. 1998). Middle Island was recently obtained by Point Pelee National Park, and provides 0.185 km² (46 ac) of protected Lake Erie Watersnake habitat (D Jacobs, pers. comm. 2003).

Research

After listing the Lake Erie Watersnake as a federally threatened species, the ODNR, Division of Wildlife and USFWS jointly funded a 3-year study to research the population size, movement patterns and hibernation sites of the Lake Erie Watersnake on the U.S. islands. Dr. Richard King, Northern Illinois University and graduate student Kristin Stanford spent three summers on the islands gathering data, working with island residents and visitors on snake-related issues, and identifying current issues affecting the Lake Erie Watersnake. Much of the data gathered from this study has been indispensable in writing this recovery plan.

Education and Outreach

Beginning in 1994, prior to Federal listing, the USFWS and ODNR, Division of Wildlife began undertaking a number of pro-active public outreach activities to familiarize island residents and visitors with the status, biology, and significance of the Lake Erie Watersnake. These efforts were continued and expanded after listing the snake as a federally threatened species in 1999. The following section summarizes these outreach and education efforts.

“Watersnakes welcome here” signs are distributed free-of-charge to any island resident that requests them from the USFWS. To date, the USFWS has distributed approximately 200 signs that are displayed island-wide throughout the U.S. islands. Additional signs describing the protected status of the snake, and how to report violations of the ESA were posted in public locations, such as ferry docks, public marinas, state parks, and local parks. The signs provide a highly visible means of making the public aware that the snake exists and is a protected species, and are a way for island residents to show their support for the Lake Erie Watersnake.

Since the snake was listed, the USFWS and ODNR, Division of Wildlife have jointly produced a bi-annual newsletter, LEWS News, that is mailed to island residents, interested state, federal, and local government agencies, and other interested parties. Current distribution includes approximately 1200 homes and 50 organizations, and website availability (<http://midwest.fws.gov/Reynoldsburg/>). Copies of the newsletter are also available at the State Parks on the islands. This newsletter addresses many issues related to the Lake Erie Watersnake, including the ongoing research project, recommendations on designing projects and managing land to benefit the snake, the biology and life history of the snake, and photos of the snake. By increasing awareness among individuals that regularly come in contact with the snake, the agencies hope to address some of the misconceptions about the snake, make the public aware of the snake’s protected status, and encourage conservation of the snake and its habitat. It is

anticipated that as people come to understand the snake better, they will be less inclined to kill or harass the animals, resulting in less take and better stewardship, and overall contributing towards recovery of the species.

The USFWS, ODNR, and researchers have participated in festivals, workshops, and presentations on many occasions since the snake was listed. Some of these presentations occurred at the following events: South Bass Island Historic Festival; Legislature Day at Stone Laboratory on Gibraltar Island; Lake Erie Days at the Great Lakes Science Center; Kelleys Island Butterfly Festival; weekly “Snake Walks” at Kelleys Island State Park; Elder Hostel presentations on South Bass Island; numerous school presentations; meeting of the Kelleys Island Audubon Society; meeting of The Nature Conservancy; meetings for youth scouting groups; and group gatherings at the Put-In-Bay Fish Hatchery. Participation in these events has exposed a wide variety of people to information about the Lake Erie Watersnake, and to people who can answer questions about the snake. These activities have occurred on the islands and the mainland, and encourage understanding and tolerance of snakes.

The USFWS and ODNR have provided permanent Lake Erie Watersnake displays that are showcased at the Lake Erie Islands Historical Society Museum and Division of Wildlife Aquatic Visitors Center, both on South Bass Island. A similar display was showcased at Kelleys Island State Park for one year. These displays are located in areas frequented by visitors to the island, targeting a group of people that may otherwise not be aware of the snake’s existence or protected status.

The USFWS and ODNR, Division of Wildlife jointly sponsored Lake Erie Watersnake poster and essay contests for the island schools to foster awareness of the snake among school children. The winning poster entry was used to create a widely distributed Lake Erie Watersnake poster and was featured on the cover of a Lake Erie Watersnake brochure. The winning poetry and essay entries were published in Volume II of LEWS News. The agencies expect that by fostering understanding of the species among younger island residents, the children will learn to appreciate the snake and will, in turn, be more willing to conserve the snake and its habitat now and into the future.

The ODNR, in consultation with the Ohio Environmental Protection Agency (OEPA) and USFWS, published Coastal Guidance Sheet No.9, entitled, “Shore Structures and the Lake Erie Watersnake” (Appendix C). This document briefly describes the life history and habitat of the snake, and types of shoreline projects that can be designed to benefit the Lake Erie Watersnake. Since the snake was listed under the ESA, the most common type of projects that the USFWS reviews on the islands are private docks. The conservation of Lake Erie Watersnakes can be aided by incorporating rock-oriented designs into shoreline developments and associated erosion control structures. Research indicates that Lake Erie Watersnakes will use rock-filled timber or steel crib docks for summer basking and resting habitat, while sheet steel docks provide no habitat for the snake. In addition, erosion protection such as riprap provides some summer habitat for the snake, while sheet steel or poured concrete erosion protection does not provide habitat for the snake. The guidance sheet provides recommendations to use “snake-friendly” designs to benefit both the landowner and the snake. Such measures have already been adopted by many construction projects on the U.S. islands. By designing these projects in snake-friendly

ways, summer habitat for the snake can be increased or enhanced, further aiding in recovery of the species.

Soon after listing, the USFWS developed “Interim Lake Erie Watersnake Guidelines,” which have recently been revised and renamed “USFWS Lake Erie Watersnake management guidelines for construction, development and land management activities” (Appendix D) to distribute to island residents that are considering a development project on the islands. Additionally, this document was made available to local government agencies and was published in LEWS News. This document describes the habitat of the snake, as well as types of projects that could potentially affect the snake. The document describes ways to minimize development-related impacts on the snake and establishes time-frames to work within to minimize disturbance of the snake during hibernation periods. Furthermore, the document establishes points of contact for questions regarding development projects and the Lake Erie Watersnake. These guidelines provide simple recommendations that can be easily implemented on a number of island projects to limit otherwise significant impacts to the Lake Erie Watersnake. Additionally, the document recommends early coordination with the USFWS to identify any project that could potentially result in take of the snake. The USFWS believes that this guidance document will continue to result in improved coordination between residents and the USFWS, and better protection of the snake and its habitat.

In the years prior to listing, and since the snake was listed as a federally threatened species, the Lake Erie Watersnake has received considerable media coverage. Television shows such as “Wild Ohio,” radio broadcasts by WOSU (The Ohio State University’s radio station) and the Great Lakes Radio Consortium, and articles in numerous newspapers, magazines, and newsletters have contributed towards public awareness of the Lake Erie Watersnake. The USFWS and ODNR have prepared a number of press releases about current Lake Erie Watersnake issues in an effort to keep the public informed. The USFWS believes that keeping people aware of the snake and its status will help to promote increased stewardship of this subspecies.

BIOLOGICAL CONSTRAINTS AND NEEDS

Biological constraints to recovery of the Lake Erie Watersnake include the extremely small geographic range historically occupied by this subspecies, and the insular nature of the population. The highest species extinction rates during historic times have occurred on islands (Primack 1998), because island species occupy a physically restricted area and are less able to adapt to changing environments (such as the introduction of exotic species or the loss of some habitat) (MacArthur and Wilson 1967). Extinction of island species historically peak soon after humans occupy an island (Primack 1998). Furthermore, the theory of island biogeography states that extinction rates will be greater on small islands (such as the Lake Erie islands) than on larger islands because large islands have greater habitat diversity and a greater number of populations (MacArthur and Wilson 1967). This may indicate why some of the smaller islands, such as West Sister, Green, and Rattlesnake Islands, have experienced extirpation of the Lake Erie Watersnake. Since watersnakes can and do occasionally migrate between islands, the island effect may not be as severe because recolonization is still possible, as occurred on Green and Rattlesnake Islands.

The limitations of island species discussed above are further exacerbated by a limited population size and restricted range (the western basin Lake Erie islands only), and a population size that is smaller than historic numbers. Though all populations naturally fluctuate, small populations are more likely to fluctuate below the minimum viable population threshold needed for long-term survival (Gilpin and Soulé 1986; Soulé 1987). As discussed previously, these factors make the snake more vulnerable to extinction or extirpation from catastrophic events, demographic variation, negative genetic effects, and environmental stresses such as habitat destruction and extermination than if they were not a small, island-based population (Shaffer 1981; King 1987b; Dodd 1993; Nunney and Campbell 1993; King and others 1997; King 1998b). Likewise, chance variation in age and sex ratios can cause death rates to exceed birth rates, causing a higher risk of extinction in small populations. Finally, decreasing genetic variability in small populations increases the vulnerability of a species to extinction due to inbreeding depression (decreased growth, survival, or productivity caused by inbreeding) and genetic drift (loss of genetic variability that takes place as a result of chance) (Soulé 1987). As discussed under “Movement Patterns”, individual snakes have been documented moving among islands, and between islands and the mainland. Thus, significant gene flow occurs among islands and between islands and the mainland (King and Lawson 1995), therefore the chance for accelerated loss of genetic variation due to population subdivision is reduced (Mace and Lande 1991).

The most significant needs of the Lake Erie Watersnake that must be taken into account in planning and managing for the species include the juxtaposition of both summer and hibernation habitat. Lake Erie Watersnakes remain near shore during the summer active season. King (2003) found that 75% of Lake Erie Watersnakes stayed within 13 m (42.7 ft) of the shoreline. The extent (length) of shoreline used by 75% of individual snakes during the summer active season is 437 m (1434 ft) or less (King 2003). Hibernation sites for the snakes vary in distance from the shoreline, but 75% of snakes hibernated within 69 m (226.4 ft) of the shoreline (King 2003). Typically, Lake Erie Watersnakes demonstrate site fidelity, returning to the same area of shoreline each summer and the same hibernation location each year (King 2003). To encompass both summer and hibernation habitat needs of the snake, appropriate management of land within 69 m (226.4 ft) of the water’s edge is necessary on every island supporting a year-round snake population. In addition, much of the natural habitat of the Lake Erie islands has been developed with residential and commercial buildings, leaving only portions of historic habitat available to the snake, so appropriate management of remaining habitat (both natural and human-made) is important for long-term persistence of the population.

PART II. RECOVERY

RECOVERY STRATEGY

Research indicates that the primary threat to the survival of the Lake Erie Watersnake is intentional and accidental human-induced mortality, with habitat loss, alteration, and degradation as a secondary threat. Censuses of the islands within the range of the snake indicate that the majority of the U.S. population is located on the four largest Lake Erie islands (Kelleys, South Bass, Middle Bass, and North Bass), with modest, satellite populations on each of five smaller islands. The USFWS believes that, if multiple subpopulations of the snake can be sustained, if the four largest Lake Erie Watersnake subpopulations can be stabilized at a size that has a reasonable expectation to persist over time, and if a total U.S. population size with a reasonable certainty of persisting over time can be established, recovery can be partly achieved. In order to achieve and maintain these stable subpopulations we must address the threats that resulted in declines from historic population numbers. If we can significantly decrease the threat of human persecution, and maintain enough essential summer and hibernation habitat to support these stable subpopulations in perpetuity, recovery of the Lake Erie Watersnake will be achieved.

The primary strategy for the recovery of the Lake Erie Watersnake in the U.S. is to achieve a total population size such that the snake has a reasonable certainty of persisting over time. This will be done by undertaking the following actions: sustaining multiple subpopulations of the snake on all currently inhabited islands, including a stable, persistent subpopulation of snakes on each of the four largest U.S. islands; significantly reducing deliberate and accidental human-induced mortality; and maintaining enough essential habitat to support these subpopulations in perpetuity. This strategy will be accomplished by working with government agencies to develop management plans for public lands on the islands, continuing a vigorous outreach campaign targeting residents and visitors to the islands, encouraging private land actions that benefit snake habitat, and conducting additional research to assess other potential threats to the continuing existence of the Lake Erie Watersnake population.

The recovery strategy relies heavily on the abatement of human-induced mortality, whether deliberate or accidental. To date, a vigorous outreach campaign on the islands has helped to inform residents and visitors about the snake's life history, behavior, and protected status. Awareness of the uniqueness of the Lake Erie Watersnake and its role in the island ecosystem is expected to reduce instances of deliberate mortality, and could potentially reduce accidental mortality by increasing awareness of the presence of the snake near typically high mortality areas such as roads. Furthermore, identification of areas with high incidences of roadkill and identification of methods to reduce roadkill will further address this threat.

The recovery strategy also relies in part on State, Federal, and private lands. Efforts to manage for snakes on these properties should focus on preservation and restoration of natural shoreline habitat, protection of hibernation sites, and incorporation of conservation measures into existing land management activities such as mowing. Because most of the land on the U.S. islands is held in private ownership, recovery is dependent on public interest in protecting the Lake Erie Watersnake. Sustaining shoreline and hibernation habitat in ways that will benefit the snake should be encouraged. State, Federal, and other conservation agencies will work with

private landowners who are interested in developing strategies to benefit the snake and its habitat. These plans can take the form of conservation easements (such as are currently offered by the ODNR and Lake Erie Islands Chapter of the Black Swamp Conservancy), Habitat Conservation Plans (HCP), Safe Harbor Agreements (SHA), or other similar documents. It is understood that many landowners will likely have other interests in addition to snake recovery, so such voluntary actions on public and private land that benefit recovery will maintain flexibility with respect to these needs.

This plan describes the minimum effort thought necessary to provide for the long-term survival of the Lake Erie Watersnake in its natural habitat. Many other measures will be used to enhance this effort, such as studies to identify additional threats, constraints, and limiting factors that could be resulting from changes in prey base, the introduction of invasive species, and the presence of contaminants. If, after these studies, data indicate adverse effects on the snake from these or other factors, corrective measures should be investigated and implemented, and the recovery plan updated to reflect this new information.

RECOVERY GOAL

The goal of this recovery plan is to remove the Lake Erie Watersnake from the Federal list of “Endangered and Threatened Wildlife” (50 CFR 17.11).

RECOVERY OBJECTIVE

Realization of this goal will occur by undertaking the following actions: achieving a total U.S. population size such that the snake has a reasonable certainty of persisting over time; perpetuating multiple, viable, persistent subpopulations of the Lake Erie Watersnake; achieving viable population goals for each of the four largest U.S. islands, Kelleys, South Bass, Middle Bass, and North Bass; sustaining enough essential summer and hibernation habitat in perpetuity to support viable persistent subpopulations; and reducing or eliminating the threat posed by intentional and accidental human-induced mortality. The Lake Erie Watersnake may be considered for delisting when the recovery criteria outlined below are met. It is estimated that full recovery of the species can be accomplished within 10 years, if fully funded. Numerical goals are based on the most recently available scientific information and are subject to revision as new information becomes available.

RECOVERY CRITERIA

Delisting Criteria

Criterion 1: Population Persistence

- a) Estimated population size reaches or exceeds 5,555 adult Lake Erie Watersnakes on the U.S. islands combined (Kelleys, South Bass, Middle Bass, North Bass, Rattlesnake, West Sister, Sugar, Green, Ballast, and Gibraltar) for a period of six or more consecutive years.

- b) Subpopulations on each of the 5 small U.S. islands capable of supporting Lake Erie Watersnakes year-round (Rattlesnake, Sugar, Green, Ballast, and Gibraltar) persist during the same six or more year period as Criterion 1a, and estimated population size reaches or exceeds the population size stated below for each of the four largest islands simultaneously during the same six or more year period as Criterion 1a:
1. Kelleys Island—minimum of 900 adults
 2. S. Bass Island—minimum of 850 adults
 3. M. Bass Island—minimum of 620 adults
 4. N. Bass Island—minimum of 410 adults

Criterion 2: Habitat Protection and Management

- a) Sufficient summer and hibernation habitat protected in perpetuity and sustained in a manner suitable for the continued persistence of the Lake Erie Watersnake. Individual parcels will collectively encompass a total of 7.4 km (4.6 mi) of shoreline, and 0.51 km² (126 ac) of inland habitat lying within 69 m (226 ft) of the shoreline on U.S. islands in Lake Erie. To be included under this criterion, each parcel will have a written agreement, which may be represented by a conservation easement (such as is currently offered by the ODNR and Lake Erie Islands Chapter of the Black Swamp Conservancy) or other habitat management plan that has been approved by the USFWS (such as the “Lake Erie Watersnake Habitat Management Planning” document for Middle Bass Island State Park). Individual parcels may be publicly or privately owned.
- b) Protected shoreline habitat and inland habitat within 69 m (226 ft) of the shoreline, as described in Criterion 2a, will be distributed among the four major islands as follows, with the remaining protected habitat occurring on any of the U.S. islands:
1. Kelleys Island—minimum 1.2 km (0.75 mi) shoreline, 0.083 km² (20.5 ac) inland
 2. S. Bass Island—minimum 1.1 km (0.70 mi) shoreline, 0.078 km² (19.3 ac) inland
 3. M. Bass Island—minimum 0.82 km (0.51 mi) shoreline, 0.057 km² (14.1 ac) inland
 4. N. Bass Island—minimum 0.54 km (0.34 mi) shoreline, 0.037 km² (9.1 ac) inland

The USFWS recommends that ideal parcels of protected habitat, as referred to in Criterion 2a, each encompass at least 440 m (0.27 mi) of shoreline and 3 ha (7.4 ac) of inland habitat lying within 69 m (226 ft) of shoreline. Ideal parcels may include large contiguous pieces of property, or smaller properties of multiple, non-adjacent landowners in close proximity to each other.

Table 3. Summary of protected habitat minimum goals for each island, total island measurements, and extent of public land. Public land identified in this table may qualify as protected habitat, once Lake Erie Watersnake management plans are prepared. Numbers for area and shoreline have been calculated using ODNR Geographic Information Systems (GIS) data sets. Currently, only 0.046 km² (11.4 ac) of inland habitat and 0.89 km (0.55 mi) of shoreline habitat meets the definition of “protected habitat” (Middle Bass Island State Park).

Island	Protected shoreline habitat minimum goal-km (mi)	Total island shoreline-km (mi)	Public land shoreline-km (mi)	Protected inland habitat minimum goal-km² (ac)	Total island area within 69 m of shore-km² (ac)	Public land area within 69 m of shore-km² (ac)
Kelleys	1.2 (0.75)	23.4 (14.5)	1.88 (1.2)	0.083 (20.5)	1.3 (322)	0.12 (31)
S. Bass	1.1 (0.70)	20.4 (12.7)	0.57 (0.35)	0.078 (19.3)	1.1 (273)	0.049 (12)
M. Bass	0.82 (0.51)	16.9 (10.5)	0.89 (0.55)	0.057 (14.1)	0.9 (222)	0.046 (11)
N. Bass	0.54 (0.34)	10.7 (6.7)	0.38 (0.24)	0.037 (9.1)	0.64 (157)	0.016 (4)

Criterion 3: Reduction of Human-induced Mortality

- a) Objective analysis of public attitude on the islands indicates that intentional human persecution is no longer a significant threat to the continued existence of the snake.
- b) Accidental human-induced mortality, such as occurs from roadkill and fishing, has been reduced to the maximum extent practicable, and no longer represents a significant threat to the population.

These criteria are designed to ensure that when delisted, the overall U.S. adult population size of the Lake Erie Watersnake exceeds 5,555 (Criterion 1a), Lake Erie Watersnake subpopulations persist on multiple islands (Criterion 1b), habitat sufficient to sustain an adult population size of 1,100 Lake Erie Watersnakes is protected in perpetuity (Criterion 2a), protected habitat exists on multiple islands (Criterion 2b), and the threats of intentional (Criterion 3a) and accidental (Criterion 3b) persecution have been adequately abated. Achievement of all the recovery criteria will address each of the listing factors identified when the snake was listed as a threatened species, including habitat destruction, inadequacy of existing regulatory mechanisms, and human-induced mortality.

Reclassification Criteria

The Lake Erie Watersnake will be reclassified from threatened to endangered if either or both of the following criteria are met:

1. Total U.S. adult population estimates show a cumulative decline of at least 20% over six or more consecutive years (Criteria EN C.1; IUCN 2001)

2. A significant increase in any of the threats already identified, or other threats which are newly identified

RATIONALE

Estimated population size and duration

Population size criteria described above are based on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List Categories and Criteria: Version 3.1 (IUCN 2001). According to that document, “population size is measured as numbers of mature individuals only” (IUCN 2001). Furthermore, estimates of the number of mature individuals are to be lowered to adjust for mature individuals that fail to reproduce, biased sex ratios, fluctuations in population size, and other characteristics of a population that reduce the number of individuals represented in subsequent generations (IUCN 2001). In essence, these adjustments serve to provide an estimate of the *effective population size*, N_e . *Effective population size* is the size of an ideal population (a population with 1:1 sex ratio, random mating, constant size over time, equal contribution of all adults to subsequent generations) having the same genetic characteristics as the real population of concern (Crandall and others 1999; Frankham 1995; Nunney and Elam 1994; Nunney 2000). Because the characteristics of real populations rarely match those of an ideal population, effective population size is typically smaller than census population size (N) – that is, the ratio N_e/N is typically less than 1 (Frankham 1995). In applying IUCN population size criteria to the Lake Erie Watersnake, a ratio of $N_e/N \approx 0.45$ was used as explained in the following paragraphs.

Method of measuring N

Census population size, N , may be measured by determining the total number of individuals, the number of adults, or the number of breeding adults in a population. It is the number of breeding adults that is most relevant to conservation (Frankham 1995; IUCN 2001). Methods used to estimate population size for Lake Erie Watersnakes have focused on number of adults (King 1986, 1998a, 2002a, 2002c). In the Lake Erie Watersnake, adult males and females occur in approximately equal numbers; of 3,419 adults captured in 1980 - 2002, 1,828 (53.4%) were male and 1,591 (46.6%) were female (RB King, unpublished data, 2003). Thus, adult sex ratio alone is not expected to reduce N_e/N below 1. However, it is unlikely that all adults succeed in reproducing. In Lake Erie Watersnakes, more than 70% of adult females reproduce in a given year (King 1986). Comparable data are not available for males but Prosser and others (2002) report that in northern watersnakes, fewer than 50% of adult males reproduce in a given year. Annual adult survivorship is not known for Lake Erie Watersnakes but is about 50% in northern watersnakes (Brown and Weatherhead 1999). Using these rates of annual reproduction (70% for females, 50% for males) and survival (50%), it is estimated that about 82% of adult females and 67% of adult males reproduce at least once in their lifetime. As a consequence, the number of breeding adult Lake Erie Watersnakes is calculated to be about 73% of the adult census population size ($N_e/N \approx 0.73$).

Variation in number of offspring

Effective population size is also influenced by variation in number of offspring by individuals within a population; N_e is greatest when individuals produce similar numbers of offspring. Ideally, information on variation in *lifetime* offspring production and survival is used in estimating this effect. However, when such data are lacking, data on variation in *annual* offspring production can be used. Observed litter sizes in Lake Erie Watersnakes (King 1986) and Northern Watersnakes (Prosser 1999) suggest that variation in offspring numbers among females should have little effect on N_e . Comparable data are not available for male Lake Erie Watersnakes but variation in number of offspring among male Northern Watersnakes (Prosser 1999; Prosser and others 2002) results in $N_e/N \approx 0.7$. Variation in offspring survival among litters (as might result from natural selection acting on differences in color pattern, (King 1993c)) could further reduce N_e/N .

Temporal variation in population size

If population size varies from generation to generation, N_e is more strongly affected by periods when population size is small. If such changes are extreme (e.g., 10 fold changes in population size from generation to generation), N_e/N may be less than 0.5 whereas if temporal variation is more moderate (2 fold changes in population size from generation to generation), N_e/N exceeds 0.89. Data on temporal variation in Lake Erie Watersnake population size are incomplete; population sizes apparently decreased during the 1980s and early 1990s but have apparently increased since then (King 2002c). However, with the possible exception of population declines leading to federal listing, available data suggest that 2 fold changes in Lake Erie Watersnake population size are more likely than 10 fold changes (King 2002c). Consequently, recent changes in population size (since 1980) probably result in $N_e/N \geq .89$.

Additional considerations regarding population size criteria

Because population subdivision can accelerate loss of genetic variation the IUCN (2001) includes additional population size criteria when gene flow among subpopulations is rare (1 individual or fewer per generation). Although the Lake Erie Watersnake is subdivided into a number of island populations, available data indicate that rates of gene flow exceed 1 individual per generation (King and Lawson 1995). Furthermore, significant gene flow occurs from mainland watersnake populations (King and Lawson 1995), thus maintaining greater genetic variation than if populations were more fully isolated.

Lake Erie Watersnakes occur on Canadian islands in Lake Erie (King and others 1997) and are listed as an endangered species in Ontario. These islands encompass about 41 km (25.5 mi) of shoreline (compared to approximately 81.2 km (50.53 mi) of shoreline on the U.S. islands) and thus provide significant potential Lake Erie Watersnake habitat. Canadian populations were not considered in establishing population size criterion for delisting in the U.S., but should the population size criteria for recovery in the U.S. be met, total population size (U. S. and Canadian islands combined) will be somewhat larger.

Ne/N and estimated population size for delisting the Lake Erie Watersnake

The information summarized above on how N_e/N of Lake Erie Watersnakes is influenced by method of measuring population size ($N_e/N \approx 0.73$), variation in number of offspring ($N_e/N \approx 0.7$), and temporal variation in population size ($N_e/N \geq 0.89$) can be combined into a single estimate: $N_e/N = 0.73 \times 0.7 \times 0.89 = 0.45$. According to IUCN criteria, a taxon should be listed as Endangered when effective population size is estimated to number fewer than 2500 mature individuals and decreasing in size (Criterion EN C; IUCN 2001). Because the Lake Erie Watersnake is an insular species, and because it naturally has a limited geographic distribution, total recovered U.S. population size will be lower than the population size of a more wide-ranging species. Although one requirement of the IUCN “Endangered” Criteria (which corresponds to the USFWS’s designation of “threatened”) indicates that an Endangered population has an effective population size of fewer than 2500 individuals, the USFWS believes that because of the restricted geographic range of the Lake Erie Watersnake, an effective population size of 2500 would constitute a viable, persistent population. Using $N_e/N = 0.45$, this corresponds to a census population size of 5,555 adults (Criterion 1a, above).

Time frame

The requirement that Lake Erie Watersnake population size reaches or exceeds 5,555 adults *for six or more consecutive years* is intended to ensure that there is sufficient time for recruitment of new adults within the recovery period. Lake Erie Watersnakes can reach sexual maturity in 2 – 3 years, therefore the recovery period provides enough time for at least two generations of snakes to mature (King 1986). Because quantitative population monitoring has taken place since 1980 (King 2002c), data on population trends will be available for a much longer period than the six years required to meet this criterion.

Estimated population size per island and persistence of multiple subpopulations

Population size criteria for the four largest U.S. islands are intended to ensure the persistence of multiple subpopulations of Lake Erie Watersnakes. These size criteria require that 50% (2,780) of the total adult population size required for delisting be distributed among the four largest islands in proportion to the amount of shoreline habitat they provide (23.4 km (14.5 mi) on Kelleys Island, 20.4 km (12.7 mi) on South Bass Island, 16.9 km (10.5 mi) on Middle Bass Island, 10.7 km (6.7 mi) on North Bass Island). The remaining 2,775 adult snakes required to meet Recovery Criterion 1a might be found on any of these four islands or on the smaller U.S. islands in Lake Erie.

The criterion addressing persistence of all currently existing subpopulations is intended to ensure that multiple subpopulations of the Lake Erie Watersnake exist throughout the historic range of the snake. The presence of multiple population centers helps to protect against stochastic events, such as storms and severe winters. If entire subpopulations are lost from catastrophic weather events, the presence of other subpopulations provides the opportunity for individuals to recolonize the disturbed areas. The chance that the species will persist over time increases with the presence of additional subpopulations.

Extent of protected habitat

Criterion 2a is intended to ensure that sufficient habitat exists to protect approximately one-fifth of the Lake Erie Watersnake delisting population goal of 5,555 adult snakes. The goal for protecting a total of 7.4 km of shoreline habitat and 0.51 km² of inland habitat within 69 m of shore accounts for approximately 10% of the total shoreline of the four largest islands and 13% of the total inland habitat within 69 m of shore of the four largest U.S. islands. Currently, only 0.046 km² (11.4 ac) of inland habitat and 0.89 km (0.55 mi) of shoreline habitat meets the definition of “protected habitat” (this includes Middle Bass Island State Park property, protected by the Lake Erie Watersnake Habitat Management Planning document). This comprises only a small percentage of the goal for protected habitat. Despite the lack of currently protected habitat, population estimates for the snake have been increasing since implementation of a public education and outreach campaign and since listing the snake as a federally threatened species, and current population estimates are very close to achieving the delisting population goal. Additionally, we know that hibernation sites can support more than one snake, therefore protection of the specified habitat amounts will likely protect hibernacula for more than the estimated 1/5 of the “recovered” snake population. Furthermore, habitat loss, alteration, and degradation is now thought to be less of a threat than at the time of listing because snakes can tolerate human presence and activities, provided that development is done in manner that is compatible with the needs of the snake (Appendix D) and intentional human-induced mortality is not a factor. In addition, certain other protective laws are in place on some of the islands, and although unrelated to the snake, these laws do provide a certain degree of protection for snake habitat. For example, Kelleys Island has a zoning law that prevents construction of buildings within 125 ft. (38 m) of the shoreline. This law will result in the protection of hibernation sites within 38 m of the shore. Other islands have similar restrictions. Finally, the USFWS expects that protection of the specified amount of habitat would be acceptable to the public and is reasonably achievable. Due to the above factors, it is estimated that the protection of enough habitat to permanently support one-fifth of the recovery population goal is sufficient to maintain a viable population on the U.S. islands.

The observed median density of Lake Erie Watersnakes at 23 sites in 2000 – 2002 was 162 adults per km of shoreline (range = 49 – 1347 adults/km (King 2002c)). Thus, 7.4 km (4.6 mi) of shoreline is anticipated to provide sufficient habitat to support 1,100 adult Lake Erie Watersnakes, approximately one-fifth of the total U.S. recovery population goal. The requirement that 0.51 km² (126 ac) (approximately 2% of total U.S. island area) of adjacent appropriately managed inland habitat be protected is intended to ensure that onshore basking sites, retreats, and hibernation sites are also protected. Radio telemetry data indicate that 75% of adult Lake Erie Watersnakes hibernate within 69 m (226 ft) of shore (King 2003). Combining this with the 7.4 km (4.6 mi) of shoreline necessary to support a population of 1,100 adults gives an area of 0.51 km² (7.4 km X 0.069 km). The USFWS expects that the remaining four-fifths of the Lake Erie Watersnake population will persist on the other 90% of unprotected U.S. island shoreline and 98% of unprotected U.S. island inland areas.

Composition of protected habitat

Criterion 2b is intended to ensure that individual parcels of protected habitat each encompass at least 440 m (1443 ft) of shoreline, and 3 ha (7.4 ac) of inland habitat lying within 69 m (226 ft) of shoreline, and that protected habitat exists on multiple islands. Radio telemetry data indicate that summer activity areas of 75% of adult Lake Erie Watersnakes includes 440 m (1443 ft) of shoreline or less (King 2003). Combining this with the distance inland within which 75% of adult watersnake hibernation sites occur gives an area of 3 ha [(440 m X 69 m)/10,000 m²/ha]. These parcels may be composed of either public or private land. USFWS recognizes the need for flexibility in the design of protected habitat units, therefore these units may include large contiguous pieces of property or smaller properties of multiple, non-adjacent landowners in close proximity to each other.

Reduction of human-induced mortality

Criterion 3a is intended to ensure that the Lake Erie Watersnake will no longer be threatened by intentional human persecution, the main factor that lead to the listing of the snake. The threat of human persecution will be measured objectively by surveying the attitudes of island residents over a period of time, and by comparing the results of the surveys over time. To date, the USFWS has relied heavily on outreach efforts to abate this threat. If objective surveys indicate that these outreach efforts are not reducing human persecution, the USFWS will modify our approach, as necessary, to ensure that the threat of human persecution is addressed appropriately.

Criterion 3b is intended to ensure that accidental human-induced mortality, such as occurs from roadkill, has been reduced to the maximum extent practicable, and no longer represents a significant threat to the population.

Reclassification Criteria

This criterion is intended to ensure that if the total U.S. adult Lake Erie Watersnake population shows cumulative declines of at least 20% over six or more consecutive years (Criteria EN C.1; IUCN 2001), and/or if previously known or newly identified threats increase, endangered status will be assigned to the snake.

Table 4. Summary of Listing Factors, Threats and Recommended Recovery Actions

Listing Factor	Threat	Recovery Objective	Recovery Criteria	Task Numbers
A,D	Hibernation habitat loss/degradation	Persistence of population over time; Habitat protection and management	1, 2	1.1-1.3 Population persistence 2.1-2.8 Habitat protection and management 4.1, 4.4 Identify threats, constraints, and limiting factors 5.1-5.3 Review and track recovery progress
A,D	Summer habitat loss/degradation	Persistence of population over time; Habitat protection and management	1, 2	1.1-1.3 Population persistence 2.1-2.8 Habitat protection and management 4.1- 4.3 Identify threats, constraints, and limiting factors 5.1-5.3 Review and track recovery progress
E	Intentional human-induced mortality	Persistence of population over time; Reduce human-induced mortality	1, 3	1.1-1.3 Population persistence 3.1-3.3 Reduction of human-induced mortality 5.1-5.3 Review and track recovery progress
E	Accidental human-induced mortality	Persistence of population over time; Reduce human-induced mortality	1, 3	1.1-1.3 Population persistence 3.1-3.2 Reduction of human-induced mortality 4.5 Identify threats, constraints, and limiting factors 5.1-5.3 Review and track recovery progress

Listing Factors:

- A. The Present or Threatened Destruction, Modification, or Curtailment Of Its Habitat or Range
- B. Overutilization for Commercial, Recreational, Scientific, Educational Purposes (not applicable to this species; see Part 1, “Introduction”)
- C. Disease or Predation (not applicable to this species; see Part 1, “Introduction”)
- D. The Inadequacy of Existing Regulatory Mechanisms
- E. Other Natural or Manmade Factors Affecting Its Continued Existence

Recovery Criteria:

1. Population Persistence--Estimated population size reaches or exceeds 5,555 adult Lake Erie Watersnakes on the U.S. islands combined for a period of six or more consecutive years; subpopulations persist on each of the currently occupied islands; and the four largest islands support adult population sizes as specified: Kelleys-900, S. Bass-850, M. Bass-620, N. Bass-410.
2. Habitat Protection and Management--A total of 7.4 km of shoreline and 0.51 km² of inland habitat protected in perpetuity and sustained in a manner suitable for the continued persistence of the Lake Erie Watersnake on the U.S. islands. Each individual parcel must be protected by a management plan approved by the USFWS. Protected habitat will be distributed among the islands as follows: Kelleys-1.2 km shoreline, 0.083 km² inland; S. Bass-1.1 km shoreline, 0.078 km² inland; M. Bass-0.82 km shoreline; 0.057 km² inland; N. Bass-0.540 km shoreline, 0.037 km² inland, with the remainder of habitat located on any of the U.S. islands.
3. Reduction of Human-induced Mortality--Objective analysis of public attitude on the islands indicates that intentional human persecution is no longer a significant threat, and accidental human-induced mortality has been reduced to the maximum extent practicable such that neither of these pose a threat to the continued existence of the snake.

STEPDOWN RECOVERY OUTLINE

1. Population persistence
 - 1.1. Develop a standard monitoring protocol for Lake Erie Watersnake censuses
 - 1.2. Annually census each of the four largest Lake Erie Watersnake subpopulations in the U.S.
 - 1.2.1. Kelleys Island
 - 1.2.2. South Bass Island
 - 1.2.3. Middle Bass Island
 - 1.2.4. North Bass Island
 - 1.3. Census small island subpopulations every two years
2. Habitat protection and management
 - 2.1. Review, revise, and redistribute existing guidelines to reflect most recent scientific data
 - 2.1.1. USFWS Lake Erie Watersnake Management Guidelines for Construction, Development, and Land Management Activities
 - 2.1.2. ODNR's Lake Erie Watersnake Habitat Management Planning Document
 - 2.1.3. Coastal Guidance Sheet No. 9
 - 2.2. Develop standard Lake Erie Watersnake habitat maintenance guidelines for protected habitat (as mentioned in Recovery Criterion 2a) that can be tailored to individual parcels of public and private land
 - 2.3. Implement habitat maintenance guidelines for protected habitat (as mentioned in Recovery Criterion 2a) via management plans developed in conjunction with State and Federal landowners on the U.S. islands
 - 2.3.1. Ohio Department of Natural Resources
 - 2.3.2. National Park Service
 - 2.3.3. U.S. Fish and Wildlife Service
 - 2.4. Implement habitat maintenance guidelines for protected habitat (as mentioned in Recovery Criterion 2a) via voluntary management plans in conjunction with private landowners on the U.S. islands
 - 2.5. Protect habitat through land acquisition

- 2.6. Protect the Lake Erie Watersnake and its habitat during review of Federal, State, and private activities
 - 2.6.1. Section 7 Federal responsibilities
 - 2.6.2. Section 10(a)(1)(A) scientific permits
 - 2.6.3. Section 10(a)(1)(B) incidental take permits
- 2.7. Develop a system to evaluate, prioritize, and select potential protected habitat
- 2.8. Notify landowners of hibernacula on their property and options to protect it
3. Reduction of human-induced mortality
 - 3.1. Public outreach efforts to address intentional human-induced mortality
 - 3.1.1. Distribution of “Watersnakes welcome here” signs to island residents
 - 3.1.2. Publication and distribution of the biannual Lake Erie Watersnake Newsletter, “LEWS News”
 - 3.1.3. Presentations on the Lake Erie Watersnake at public events
 - 3.1.4. Post educational displays in high-density snake areas on public lands
 - 3.1.5. Address resident’s concerns about snakes on their property
 - 3.1.6. Facilitate media coverage of pertinent Lake Erie Watersnake issues
 - 3.2. Evaluate the effectiveness of the public outreach efforts in reducing intentional human-induced mortality, and modify approach as necessary
 - 3.3. Address roadkill mortality
4. Identification of additional threats, constraints, and limiting factors
 - 4.1. Estimating annual survivorship and demographic perturbation analysis
 - 4.2. Identification of foraging habitat, behavior, and prey base
 - 4.3. Impact of invasive species and contaminants
 - 4.4. Identification and characterization of high quality hibernation locations
 - 4.5. Identification of areas with frequent incidences of roadkill
5. Review and track recovery progress
 - 5.1. Meet regularly with State and Canadian partners and Lake Erie Watersnake researchers to evaluate progress of recovery and identify additional recovery needs
 - 5.2. Revise plan as appropriate at five-year intervals, if resources allow
 - 5.3. Develop a post-delisting monitoring plan

RECOVERY NARRATIVE

1. Population persistence

To facilitate recovery of the Lake Erie Watersnake, subpopulations should be monitored to determine the trends of the population, to ensure persistence of multiple subpopulations over time, and to determine when subpopulation and total U.S. population goals have been achieved (Recovery Criterion 1).

1.1. Develop a standard monitoring protocol for Lake Erie Watersnake censuses

Development of a standard monitoring protocol will ensure a consistent approach to monitoring individual subpopulations over time. The protocol will ensure that surveys are comparable among years, the same information is collected each year, and the same information is collected at each site.

1.2. Annually census each of the four largest Lake Erie Watersnake subpopulations in the U.S.

Recovery of the Lake Erie Watersnake can be partially achieved if multiple, stable, persistent subpopulations can persist, and if subpopulation and total U.S. population goals are achieved. Annual censuses of each of the four main subpopulations will allow the USFWS to identify when these subpopulations have achieved their population goal for six or more consecutive years.

1.2.1. Kelleys Island

Kelleys Island currently has the largest subpopulation of adult Lake Erie Watersnakes of all of the U.S. islands. Annual censusing of this subpopulation will allow the USFWS to track changes in population status and determine when the effective population size of 900 adult snakes has been achieved for six or more consecutive years.

1.2.2. South Bass Island

South Bass Island also supports a large subpopulation of adult Lake Erie Watersnakes. Annual censusing of this subpopulation will allow the USFWS to track changes in population status and determine when the effective population size of 850 adult snakes has been achieved for six or more consecutive years.

1.2.3. Middle Bass Island

Middle Bass Island currently supports the second largest subpopulation of Lake Erie Watersnakes of all of the U.S. islands. Annual censusing of this subpopulation will allow the USFWS to track changes in population status

and determine when a population size of 620 adult snakes has been achieved for six or more consecutive years.

1.2.4. North Bass Island

North Bass Island currently supports the smallest subpopulation of Lake Erie Watersnakes among the four largest U.S. islands. Annual censusing of this subpopulation will allow the USFWS to track changes in population status and determine when the population size of 410 adult snakes has been achieved for six or more consecutive years.

1.3. Census small island subpopulations every two years

Recovery of the Lake Erie Watersnake can be partially achieved if multiple, stable, persistent subpopulations can persist, and if subpopulation and total U.S. population goals are achieved. Total U.S. population size includes the snakes on the small U.S. islands. Censuses of the small islands will be completed every two years and will help to identify when total U.S. population goals have been achieved for six or more consecutive years. Furthermore, recovery is dependent on the persistence of multiple subpopulations, including those on the smaller islands. Occasional monitoring will confirm the continued presence of these subpopulations.

2. Habitat protection and management

Sustaining and protecting summer and hibernation Lake Erie Watersnake habitat will ensure the availability of the habitat for the snake, and address the threat posed by habitat loss and degradation. These efforts will be a positive first step towards stabilizing and increasing the snake population on all of the islands and will contribute towards achieving Recovery Criterion 2.

2.1. Review, revise, and redistribute existing guidelines to reflect most recent scientific data

Several documents exist that provide recommendations on managing land and designing projects to benefit the Lake Erie Watersnake. As new information becomes available from recent and ongoing studies on the snake, from scientific observation, and from feedback from local residents, this information will be incorporated into these guidelines to ensure that habitat management reflects the most current data available.

2.1.1. USFWS Lake Erie Watersnake Management Guidelines for Construction, Development, and Land Management Activities

The USFWS provides these guidelines to island residents and local government agencies to minimize development-related impacts on the

snake and to enhance snake habitat. These guidelines provide recommendations that can be easily implemented on a number of island projects to limit otherwise significant impacts to the Lake Erie Watersnake. These guidelines should be reviewed and revised every two years to incorporate any new information gained from recent watersnake studies, scientific observation, and feedback from local residents. After updating these guidelines, the USFWS will distribute them to local government agencies on the islands, publish them in LEWS News, and provide them to island residents, as needed.

2.1.2. ODNR's Lake Erie Watersnake Habitat Management Planning Document

This is a management document created by ODNR and approved by the USFWS. This plan addresses how to manage habitat to protect the snake on Middle Bass Island State Park, and how to improve existing habitat to further benefit the snake. These guidelines will be reviewed every two years and revised as needed to incorporate any new information gained from recent watersnake studies. Where appropriate, these guidelines can be adapted for other ODNR island properties.

2.1.3. Coastal Guidance Sheet No. 9

This is a guidance document created by ODNR, with input from OEPA and USFWS, that was prepared to assist island landowners who plan to install shoreline erosion control structures or docks on the U.S. islands. These guidelines provide recommendations that can be easily implemented to enhance Lake Erie Watersnake shoreline habitat when designing shoreline projects. After updating these guidelines every two years, ODNR and USFWS will distribute them to local government agencies on the islands, publish them in LEWS News, and provide them to island residents, as needed.

2.2. Develop standard Lake Erie Watersnake habitat restoration and maintenance guidelines for protected habitat (as mentioned in Recovery Criterion 2a) that can be tailored to individual parcels of public and private land

Creation of standard habitat restoration and maintenance guidelines that can be tailored to individual parcels of land will encourage timely and uniform management of protected habitat. This action will facilitate the achievement of Recovery Criterion 2, which addresses the threat posed by habitat loss and degradation.

2.3. Implement habitat restoration and maintenance guidelines for protected habitat (as mentioned in Recovery Criterion 2a) via management plans developed in conjunction with State and Federal landowners on the U.S. islands

Management of public lands to promote Lake Erie Watersnake recovery is a key component of the recovery strategy. The USFWS, in conjunction with State and Federal partners, will develop management plans for protecting Lake Erie Watersnake habitat on public lands on the U.S. islands, utilizing the habitat restoration and maintenance guidelines (Recovery Outline item 2.2).

Furthermore, the USFWS will attempt to streamline incorporation of concerns for the snake into current management plans. These plans will be tailored to the individual land parcel, and will be written with the designated uses of the area in mind. One example of such a document is the Lake Erie Watersnake Habitat Management Planning Document, used by ODNR to manage habitat on Middle Bass Island State Park. Implementation of such management plans can ultimately lead to Lake Erie Watersnake habitat being protected and managed in perpetuity, and will contribute towards achieving Recovery Criteria 2.

2.3.1. Ohio Department of Natural Resources

Where appropriate, Lake Erie Watersnake management plans (e.g., Appendix B) will be created and administered by the ODNR for portions of public land within 69 m of the island shoreline. These plans will be tailored to the individual land parcel, and will be written with the primary designated uses of the area in mind. These plans will incorporate the habitat restoration and maintenance guidelines (Recovery Outline item 2.2), and may cover such areas as Kelleys Island State Park, Green Island, South Bass Island State Park, Honey Point Wildlife Area on North Bass Island, Kuehnle Wildlife Area on Middle Bass Island, and North Pond on Kelleys Island. The ODNR habitat management plan for Middle Bass State Park has already been completed (Appendix B). For islands with multiple ODNR land management responsibilities, the plan would encompass all ODNR properties and be a combined effort by all divisions. Implementation of such management plans can ultimately lead to Lake Erie Watersnake habitat being protected and managed in perpetuity, and will contribute towards achieving Recovery Criteria 2.

2.3.2. National Park Service

A Lake Erie Watersnake management plan for land owned and administered by the National Park Service on South Bass Island, Perry's Victory Monument, will be developed. This plan will incorporate the habitat restoration and maintenance guidelines (Recovery Outline item 2.2), and will be written with the designated use of the area in mind. Implementation of this management plan can ultimately lead to Lake Erie

Watersnake habitat being protected and managed in perpetuity, and will contribute towards achieving Recovery Criteria 2a.

2.3.3. U.S. Fish and Wildlife Service

A Lake Erie Watersnake management plan for West Sister Island, owned and administered by the USFWS, will be considered. Lake Erie Watersnakes have been extirpated from West Sister Island, although there is potential that recolonization may occur. If it is determined that Lake Erie Watersnakes have recolonized the island, a management plan incorporating the habitat restoration and maintenance guidelines (Recovery Outline item 2.2), will be developed to ensure that snake habitat will be protected in perpetuity. Implementation of this management plan can ultimately lead to Lake Erie Watersnake habitat being protected and managed in perpetuity, and will contribute towards achieving Recovery Criteria 2a. In the meantime, the USFWS will consider snake habitat needs when planning management actions on West Sister Island.

2.4. Implement habitat restoration and maintenance guidelines for protected habitat (as mentioned in Recovery Criterion 2a) via voluntary management plans in conjunction with private landowners on the U.S. islands

Because most of the land on the U.S. islands is held in private ownership, recovery is dependent on public interest in protecting the Lake Erie Watersnake. Restoring and/or sustaining shoreline and hibernation habitat in ways that will benefit the snake should be encouraged. State, Federal, and other conservation agencies will work with private landowners who are interested in developing strategies to benefit the snake and its habitat. These plans will utilize the habitat restoration and maintenance guidelines (Recovery Outline item 2.2) and can take the form of conservation easements, management plans, or other similar documents. It is understood that many landowners will likely have other interests in addition to snake recovery, so such voluntary actions on private land that benefit recovery will maintain flexibility with respect to these needs.

2.5. Protect habitat through land acquisition

Currently, the USFWS does not know of significant parcels of property that are necessary to acquire for Lake Erie Watersnake recovery. If significant property owned by a willing seller is identified, the purchase and management of land by state, federal, or conservation agencies would benefit snake recovery. An example of this is the proposed purchase of a large parcel of North Bass Island by ODNR. These lands could be purchased using Federal grants, such as the Section 6 Recovery Land Acquisition grant, or by using other state or private funds.

The Ottawa National Wildlife Refuge Complex (Refuge), managed by the USFWS, and located along the northwestern shore of Lake Erie, recently had its purchase boundary expanded by Public Law 108-23 (H.R. Bill 289). The expansion bill allows the Refuge to purchase land and water located between the eastern boundary of Maumee Bay State Park and the eastern boundary of the Darby Unit of the Refuge, including the Bass Island archipelago, from willing sellers only. Additionally, the bill allows the Refuge to accept donated land, to exchange land, or to accept land transferred from other agencies within the expansion boundaries. If the USFWS identified significant snake habitat on island property that was available for purchase, the Refuge could purchase this property, and manage it to benefit the snake, thereby helping to achieve snake recovery.

2.6. Protect the Lake Erie Watersnake and its habitat during review of Federal, State and private activities

Federal, state, and private activities that may affect the habitat or result in the taking of Lake Erie Watersnakes should be reviewed to the extent possible under Federal and State law. Appropriate measures should be taken to protect the snake and its habitat from adverse impacts from the proposed activities.

2.6.1. Section 7 Federal responsibilities

Under section 7(a)(1) of the ESA, Federal agencies are directed to utilize their programs to conserve threatened and endangered species. Section 7(a)(2) requires Federal agencies to consult with the USFWS to insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of listed species, nor destroy or adversely modify critical habitat (no critical habitat has been designated for the Lake Erie Watersnake). Federal programs and consultations with the USFWS should strive to implement recovery goals for the Lake Erie Watersnake to the maximum extent possible. Consultations are expected to continue with Federal agencies whose projects occur within the range of the Lake Erie Watersnake. Refer to PART 1 CONSERVATION MEASURES, Federal Regulatory Protection, Section 7 Consultation for an overview of consultation activities.

2.6.2. Section 10(a)(1)(A) scientific permits

Enhancement of survival permits under section 10(a)(1)(A) of the ESA are issued by the USFWS to researchers for scientific purposes or to private individuals who wish to enhance the propagation or survival of the listed species through a Safe Harbor Agreement (SHA). Research permits should be well thought out, designed to minimize harm to the species, and reviewed by appropriate experts to ensure meaningful results. A SHA is a voluntary arrangement between the USFWS and a landowner to promote

voluntary habitat management for listed species on non-Federal land, while giving assurances to the landowner that no additional future regulatory restrictions will be imposed as a result of habitat management. Any non-federal landowner may request the development of an SHA if they want to help conserve a listed species on their property. The listed species must receive a “net conservation benefit” from the Agreement’s management actions in order to be approved by the USFWS. To date, the USFWS has not completed any SHAs for the Lake Erie Watersnake. If a landowner was interested in completing an SHA, the USFWS would work with the landowner to determine the feasibility of the SHA, and to develop it. Furthermore, if multiple landowners were interested in completing an SHA, the USFWS could work with ODNR to develop a programmatic SHA which could apply to all islands within the range of the snake. The USFWS anticipates that several section 10(a)(1)(A) permits will be issued in the near future to address still unanswered research needs, and management and recovery questions.

2.6.3. Section 10(a)(1)(B) incidental take permits

Section 10(a)(1)(B) permits of the ESA provides for the issuance of “incidental take” permits for the take of federally-listed animals such as the Lake Erie Watersnake for actions not authorized, funded or carried out by Federal agencies; namely, most state, county, municipal, and privately owned lands. Applicants for an incidental take permit must develop a Habitat Conservation Plan. The USFWS has issued one incidental take permit, in response to an HCP, which will conserve the Lake Erie Watersnake and its habitat on 15 acres of the Long Point peninsula of Kelleys Island while still allowing private development to occur.

2.7. Develop a system to evaluate, prioritize, and select potential protected habitat

This system will allow the USFWS to evaluate potential protected habitat and to select the most valuable parcels for protection. This system will focus on such issues as how to identify suitable hibernation sites, how to assess the value of the habitat for snakes, how to prioritize amongst several parcels of habitat if faced with multiple selections, how to protect significant hibernation locations that fall outside of the 69 m boundary, and if/how to protect areas where no hibernation data is available. This action will aid in achieving Recovery Criterion 2.

2.8. Notify landowners of hibernacula on their property and options to protect it

Notify landowners of hibernacula on their property and options to protect it when notification will be beneficial in protecting the hibernacula and snakes that use it. Each time a new hibernaculum is identified, the USFWS will notify the landowner, in writing, of the finding and of potential options to protect the site if

doing so aids in recovery of the snake. This will contribute towards achieving Recovery Criterion 2.

3. Reduction of human-induced mortality

Human-induced mortality has been identified as the main threat to the continued existence of the Lake Erie Watersnake. By addressing this threat with multiple methods, the USFWS expects to reduce both intentional and accidental human-induced mortality, achieving Recovery Criterion 3.

3.1. Public outreach efforts to address intentional human-induced mortality

By increasing awareness among individuals that regularly come in contact with the snake, the USFWS hopes to address some of the misconceptions about the snake, make the public aware of the snake's protected status, and encourage conservation of the snake and its habitat. It is anticipated that as people come to understand the snake better, they will be less inclined to kill or harass the animals, resulting in less take and better stewardship, and overall, contributing to recovery of the species. As other opportunities arise, additional public outreach activities will be implemented.

3.1.1. Distribution of "Watersnakes welcome here" signs to island residents

These signs are distributed free-of-charge to any island resident that requests them from the USFWS. The signs provide a highly visible means of making the public, especially visitors to the islands, aware that the snake exists and is a protected species, and are a way for island residents to show their support for the Lake Erie Watersnake. Distribution of these signs is expected to continue for as long as island residents request the signs.

3.1.2. Publication and distribution of the biannual Lake Erie Watersnake Newsletter, "LEWS News"

This newsletter is regularly distributed to island residents, government agencies, and the State Parks on the islands. It addresses many issues related to the Lake Erie Watersnake, including the ongoing research project, recommendations on designing projects and managing land to benefit the snake, the biology and life history of the snake, and photos of the snake. By increasing awareness among individuals that regularly come in contact with the snake, the USFWS hopes to address some of the misconceptions about the snake, make the public aware of the snake's protected status, and encourage conservation of the snake and its habitat. As people develop an increased understanding of the snake and its needs, they will be less inclined to kill or harass the animals, resulting in less take and better stewardship, and overall, contributing to recovery of the

species. Publication of LEWS News will continue, with increasing distribution, as long as it is considered to be a valuable tool for public outreach.

3.1.3. Presentations on the Lake Erie Watersnake at public events

Prior to, and after listing the Lake Erie Watersnake as a threatened species, the USFWS, ODNR, and researchers have participated in festivals, workshops, and presentations on many occasions. These outreach opportunities expose the public to information about the snake, and to people who can answer questions about the snake. It is reasonable to expect that as people gain a better understanding of the snake, they will be less likely to harm or harass it, further contributing to recovery of the snake. The USFWS anticipates that these agencies and individuals will continue to participate in these activities, as the opportunities arise.

3.1.4. Post educational displays in high-density snake areas on public lands

The USFWS will work with ODNR and the National Park Service to identify high-density snake areas on public lands. The agencies will then determine if potential exists to post educational signage and/or displays in these areas. This outreach effort will target visitors to the islands, who may not know about the snake. The USFWS anticipates that this action will make the public aware of the snake's protected status, and encourage conservation of the snake and its habitat. It is anticipated that as people come to understand the snake better, they will be less inclined to kill or harass the animals, resulting in less take and better stewardship, and overall, contributing to recovery of the species.

3.1.5. Address resident's concerns about snakes on their property

Representatives from USFWS and ODNR and researchers will develop outreach materials, meet with interested landowners, and facilitate the formation of outreach network volunteers. Continued interactions between residents and agency representatives facilitate interest in the snake's protection and better land management. Furthermore, personal meetings help residents understand that the agencies are interested in helping them deal with important snake-related issues, and are willing to discuss different approaches to snake conservation. The USFWS anticipates that agency representatives will travel to the islands to meet with residents several times each year.

3.1.6. Facilitate media coverage of pertinent Lake Erie Watersnake issues

News releases will continue to be distributed when newsworthy and timely. USFWS and ODNR staff and researchers will continue to grant interviews and provide information to media outlets when requested.

3.2. Evaluate the effectiveness of public outreach efforts in reducing intentional human-induced mortality, and modify approach as necessary

The USFWS anticipates that as people come to understand the snake better, they will be less inclined to kill or harass the animals, resulting in less take and better stewardship, and overall, contributing to recovery of the species. Using surveys of public opinion, the USFWS will objectively evaluate the success of this outreach campaign in reducing intentional killing of snakes, and will modify our approach, as necessary, to ensure that the threat of human persecution is addressed appropriately.

3.3. Address roadkill mortality

The USFWS will work with ODNR, the National Park Service, interested residents, and local governments, as appropriate, to identify and implement mechanisms to reduce roadkill of snakes. Such mechanisms might include reduction in speed limits, display of signage, or installation of tunnels or culverts in areas with frequent incidences of roadkill. ODNR has agreed to similar conservation measures on Middle Bass Island State Park, and a private development, Middle Bass Dock Company, has also agreed to these measures. This will contribute towards achieving Recovery Criterion 3b.

4. Identification of additional threats, constraints, and limiting factors

Research is important to the recovery of the Lake Erie Watersnake because it allows the USFWS to tailor the recovery process to the biology of the snake, and to identify additional biological constraints, limiting factors, and threats to the snake and its habitat, and identify recovery actions to address these threats. It is anticipated that research activities could potentially be undertaken or funded by USFWS, ODNR, various universities, and private organizations. These research needs are based on identified data gaps in our current knowledge of the Lake Erie Watersnake, that when filled, would significantly contribute towards recovery of the species. This recovery plan will be updated at regular intervals to incorporate the results of research as it becomes available. For a list of additional research topics that are not essential for recovery, see Appendix F.

4.1. Estimating annual survivorship and demographic perturbation analysis

Data on annual survivorship and reproduction will be used to predict future population trends. This information will be useful in evaluating the effectiveness of Criteria 1a and b in achieving recovery and identifying critical life stages for protection.

4.2. Identification of foraging habitat, behavior, and prey base

Learning more about the foraging patterns of the Lake Erie Watersnake will allow the USFWS to better protect, enhance, and restore important foraging habitat. It will allow the USFWS to juxtapose protected habitat (Recovery Criterion 2) and foraging habitat. It will also allow the USFWS to better identify development projects that could have an adverse affect on the snake and its habitat. Finally, learning about current foraging patterns will provide insight into the shifting prey base of the snake and lead to research opportunities related to how the current infestation of invasive species in Lake Erie is affecting the Lake Erie Watersnake population.

4.3. Impact of invasive species and contaminants

Lake Erie has been inundated by invasive species, including the round goby (*Neogobius melanostomus*). Recent observations indicate that the Lake Erie Watersnake may be consuming round gobies at high rates, which may result in increased contaminant loading in individual snakes. The USFWS is unsure if this probable shift in prey base constitutes a threat to the continued existence of the snake. This research is recommended to determine the degree of threat, if any, posed by invasive species and contaminants.

4.4. Identification and characterization of high quality hibernation locations

Identification and characterization of high quality hibernation sites will facilitate actions to protect and enhance these areas to ensure the long-term persistence of the Lake Erie Watersnake. Because snakes are vulnerable to disturbances during the hibernation season, protecting them during this time is critical. Priority will be given to hibernation locations that support multiple snakes in close proximity.

4.5. Identification of areas with frequent incidences of roadkill

Identification of areas with frequent roadkill will allow the agencies to work to reduce mortality at these locations, as proposed in Recovery Outline item number 3.3.

5. Review and track recovery progress

5.1. Meet regularly with State and Canadian partners and Lake Erie Watersnake researchers to evaluate progress of recovery and identify additional recovery needs

The USFWS, ODNR, Canadian Wildlife Service (CWS), Ontario Ministry of Natural Resources (OMNR), and Lake Erie Watersnake researchers have been successfully partnering since before the snake was listed. This effort is expected to continue until the snake is delisted. Semi-annual meetings will be arranged to assess recovery progress. Furthermore, these meetings will facilitate discussion of recent research, and will be used to determine additional recovery needs stemming from information gained through this research.

5.2. Revise plan as appropriate at five-year intervals, if resources allow

The Lake Erie Watersnake Recovery Plan cannot address every future development and contingency. As such, it will likely need to be revised and updated at regular intervals to better reflect current conditions, and incorporate new research findings.

5.3. Develop a post-delisting monitoring plan

Once a species is removed from the list of threatened and endangered species, the ESA Section 4(g)(1) requires the USFWS to monitor the status of the species for a minimum of 5 years. A plan shall be developed to describe how the status of the Lake Erie Watersnake will be monitored once the snake has been delisted.

PART III. IMPLEMENTATION

The Implementation schedule that follows lists the actions and estimated costs for the recovery program for the Lake Erie Watersnake. It is a guide for meeting the recovery goals outlined in this plan. Parties with authority, responsibility, or expressed interest to implement a specific recovery action are identified in the Implementation Schedule. When more than one party has been identified the proposed lead party is indicated by an asterisk (*). The listing of a party in the Implementation Schedule does not require, nor imply a requirement, that the identified party has agreed to implement the action(s) or to secure funding for implementing the action(s). However, parties willing to participate may benefit by being able to show in their own budgets that their funding request is for a recovery action identified in an approved recovery plan and is therefore considered a necessary action for the overall coordinated effort to recover the Lake Erie Watersnake. Also, section 7(a)(1) of the ESA directs all federal agencies to utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of threatened and endangered species.

The Implementation schedule lists and ranks recovery tasks, provides task descriptions and duration, identifies responsible agencies, and provides estimated costs. This schedule will be reviewed periodically until the recovery objectives are met, and priorities and tasks will be subject to revision. Tasks are presented in order of task priority number.

KEY TO IMPLEMENTATION SCHEDULE

Column 1: Task Priority

- Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
- Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.
- Priority 3: All other actions necessary to meet the recovery objectives.

Column 2: Task Number

The number from the STEPDOWN RECOVERY OUTLINE (refer to PART II).

Column 3: Task Description

A short description of the recovery task, which coincides with the STEPDOWN RECOVERY OUTLINE (refer to PART II).

Column 4: Task Duration

The number of years that it is expected to take before the task is completed. A pound sign (#) indicates that the task is currently ongoing. A plus (+) indicates that the task will be continuous throughout the recovery period. Tasks may be both ongoing and continuous.

Column 5: Participants

This lists the agencies, organizations, and participants that are expected to be involved in completing these tasks, but other partners may be included as they are identified. If a lead organization exists for a task, the lead organization is indicated by an asterisk (*). A key to the acronyms is provided here.

CONS-consultants

CWS-Canadian Wildlife Service

LEIC-BSC-Lake Erie Islands Chapter of the Black Swamp Conservancy

LG-local governments

NPO-non-profit organizations

NPS-National Park Service

OFA-other Federal agencies

ODNR-Ohio Department of Natural Resources

OMNR-Ontario Ministry of Natural Resources

PLO-private landowners

UNIV- Universities

USFWS-U.S. Fish and Wildlife Service

Columns 6-10: Cost Estimates for FY's 1-5

The estimated cost for carrying out the task during the next five fiscal years (FY). Estimated costs are listed in thousands of dollars.

TBD-to be determined. Cost estimates are not available.

Column 11: Comments

Explanatory comments and additional information.

Table 5. Implementation table for the Lake Erie Watersnake recovery plan.

TASK PRIORITY	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS.)	PARTICIPANTS	COST ESTIMATES (in \$1000)					COMMENTS
					FY1	FY2	FY3	FY4	FY5	
2	2.1.1.	Review, revise, redistribute USFWS Lake Erie Watersnake Management Guidelines for Construction, Development and Land Management Activities	+	USFWS*, ODNR, UNIV, LG	0.5	0	0.5	0	0.5	Review and revise at 2-year intervals
2	2.1.2.	Review and revise ODNR's existing Lake Erie Watersnake Habitat Management Planning Document	+	ODNR*, USFWS	0.25	0	0.25	0	0.25	Review and revise at 2-year intervals
2	2.1.3.	Review, revise, redistribute Coastal Guidance Sheet No. 9	+	ODNR*, LG, OFA, USFWS	0.25	0	0.25	0	0.25	Review and revise at 2-year intervals
2	2.2.	Develop standard habitat restoration and maintenance guidelines for protected habitat	1	USFWS*, ODNR, UNIV	3	0	0	0	0	
2	2.3.1.	Develop and implement habitat management plans for all ODNR island properties	+	ODNR*, USFWS	2.5	3.5	1	1	1	Years 1 and 2-develop plans; years 2-5 implement
2	2.3.2.	Implement habitat restoration and maintenance guidelines via management plans for protected habitat on NPS property	+	NPS*, USFWS	5	1	1	1	1	Year 1-develop plans; years 2-5 implement

TASK PRIORITY	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS.)	PARTICIPANTS	COST ESTIMATES (in \$1000)					COMMENTS
					FY1	FY2	FY3	FY4	FY5	
2	2.4.	Implement habitat restoration and maintenance guidelines via voluntary management plans for protected habitat on private land (ex, conservation easement)	+	USFWS*, PLO, ODNR, LEIC-BSC, NPO	50	50	50	50	50	Costs of easements, travel, coordination, drafting agreements
2	2.6.1.	Consult with Federal agencies under section 7(a)(1) of the ESA	# +	USFWS*, OFA	0	0	0	0	0	
2	2.7.	Develop a system to evaluate, prioritize, and select potential protected habitat	1	USFWS*, ODNR, UNIV	2	0	0	0	0	
2	3.1.4.	Post educational displays on public lands	3	ODNR*, USFWS, NPS	0	10	10	10	0	Cost of printing and designing displays
2	3.1.5.	Address residents' concerns about snakes on their property	# +	USFWS*, ODNR, UNIV, CONS	15	15	15	15	15	Cost of staff time, travel
2	3.2.	Evaluate effectiveness of public outreach in reducing intentional mortality	+	USFWS*, CONS	10	0	10	0	10	Every two years
2	3.3.	Address roadkill mortality	2	USFWS*, ODNR, UNIV, LG, NPS	0	3	3	TBD	TBD	Years 2-3-Cost of travel and coordination; Years 4-5-implementation
2	4.1.	Research survivorship and demographic perturbation analysis	# 2	UNIV*, CONS	3	3	0	0	0	Study began in 2003, will continue for 2 more years

TASK PRIORITY	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS.)	PARTICIPANTS	COST ESTIMATES (in \$1000)					COMMENTS
					FY1	FY2	FY3	FY4	FY5	
2	4.4.	Identify high quality hibernation locations	2	UNIV*, CONS	0	5	5	0	0	
2	4.5.	Research areas of frequent roadkill	2	UNIV*, CONS	1	1	0	0	0	
3	1.1.	Develop standard monitoring protocol for censuses	1	UNIV*, USFWS, ODNR	5	0	0	0	0	Year 1-develop protocol; Years 2-5 modify as necessary
3	1.2.1.	Annually census Kelleys Island subpopulation	# +	UNIV*, USFWS, CONS	15	15	15	15	15	
3	1.2.2.	Annually census South Bass Island subpopulation	# +	UNIV*, USFWS, CONS	15	15	15	15	15	
3	1.2.3.	Annually census Middle Bass Island subpopulation	# +	UNIV*, USFWS, CONS	10	10	10	10	10	
3	1.2.4.	Annually census North Bass Island subpopulation	# +	UNIV*, USFWS, CONS	10	10	10	10	10	
3	1.3.	Census small subpopulations every 2 years	# +	UNIV*, USFWS, CONS,	0	20	0	20	0	
3	2.3.3.	Implement habitat restoration and maintenance guidelines via management plans for protected habitat on USFWS property if snakes recolonize island	3+	USFWS*	0	0	5	1	1	Year 3-develop plans; years 4-5 implement

TASK PRIORITY	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS.)	PARTICIPANTS	COST ESTIMATES (in \$1000)					COMMENTS
					FY1	FY2	FY3	FY4	FY5	
3	2.5.	Protect habitat through land acquisition	+	USFWS, ODNR, NPO, OFA	TBD	TBD	TBD	TBD	TBD	Land purchases are unlikely. Cost will be adjusted as priority needs are identified.
3	2.6.2.	Review and comment on Section 10(a)(1)(A) permits under the ESA	#+	USFWS*, ODNR	0	0	0	0	0	
3	2.6.3.	Review and comment on Section 10(a)(1)(B) permits under the ESA	# +	USFWS*	20	20	20	20	20	Cost of staff time, travel, coordination
3	2.8.	Notify landowners of hibernacula on their property and options to protect it	+	USFWS*, UNIV, ODNR	.5	.5	.5	.5	.5	Cost of staff time
3	3.1.1.	Continue to print and distribute Lake Erie Watersnake signs	# +	USFWS*, ODNR	0	0	2	0	0	Additional printing need projected for FY3
3	3.1.2.	Write, publish and distribute LEWS News	# +	USFWS*, ODNR, UNIV	4.5	4.5	4.5	4.5	4.5	Cost of mailing, printing, designing
3	3.1.3.	Participate in presentations about the snake at public events	# +	USFWS*, ODNR, UNIV, CONS, LEIC-BSC, NPO	5	5	5	5	5	Cost of staff time, travel, materials
3	3.1.6.	Facilitate media coverage of pertinent Lake Erie Watersnake issues	# +	USFWS*, ODNR, UNIV	0	0	0	0	0	
3	4.2.	Research foraging behavior and prey	3	UNIV*, CONS	19	19	19	0	0	

TASK PRIORITY	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YRS.)	PARTICIPANTS	COST ESTIMATES (in \$1000)					COMMENTS
					FY1	FY2	FY3	FY4	FY5	
3	4.3.	Research impact of invasive species and contaminants	3	UNIV*, CONS	1	1	1	0	0	In conjunction with foraging research
3	5.1.	Meet with partners and researchers to evaluate recovery progress and identify additional needs	#+	USFWS*, ODNR, UNIV, OMNR, CONS, CWS	0	2	0	2	0	Meet every 2 years
3	5.2.	Revise plan as appropriate at 5-year intervals	+	USFWS*, ODNR, UNIV	0	0	0	0	5	
3	5.3.	Develop a post-delisting monitoring plan	1	USFWS*, ODNR, UNIV	0	0	0	2	0	

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APPENDIX A

Glossary

Demographic perturbation analysis- a study to determine how population growth rate responds to changes in survival, growth, development, and reproduction rates

Demographic variation- individual variation in birth and death rates that causes a population size to fluctuate randomly up or down

Effective population size- the size of an ideal population (a population with 1:1 sex ratio, random mating, constant size over time, equal contribution of all adults to subsequent generations) having the same genetic characteristics as the real population of concern (Crandall and others 1999; Frankham 1995; Nunney and Elam 1994; Nunney 2000)

Endangered- the classification provided to an animal or plant in danger of extinction within the foreseeable future throughout all or a significant portion of its range (USFWS 2003)

Essential habitat- habitats needed to fulfill such species needs as breeding, foraging, migrating, and reproducing (USFWS/NMFS 2002).

Extirpated species- a species no longer surviving in regions that were once part of their range (USFWS 2003)

Genetic drift- process of pure chance by which gene frequencies can change with no external stimuli

Habitat- the location where a particular taxon of plant or animal lives and its surroundings (both living and nonliving) and includes the presence of a group of particular environmental conditions surrounding an organism including air, water, soil, mineral elements, moisture, temperature, and topography (USFWS 2003)

Inbreeding depression- negative effects caused by breeding with close relatives

Insular- dwelling or situated on an island (Merriam-Webster 2000)

Protected habitat- specifically identified parcels of shoreline and hibernation habitat that are managed to benefit the Lake Erie Watersnake. Protected habitat will utilize the habitat maintenance guidelines (Recovery Outline item 2.2) and can take the form of voluntary conservation easements on private property, management plans for public property, or other similar documents.

Shoreline- the water's edge to 13 m (42.7 ft) inland

Snout-vent length (SVL)- a standard measurement of body length for reptiles. The measurement is from the tip of the nose (snout) to the anus (vent), and excludes the tail

Subpopulation- an identifiable fraction or subdivision of a population (Merriam-Webster 2000)

Survivorship- the probability of surviving to a specific age; the number or proportion of survivors, as of an age group (Merriam-Webster 2000)

Take- from Section 3(18) of the Federal Endangered Species Act: "The term 'take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." (USFWS 2003)

Threatened- the classification provided to an animal or plant likely to become endangered within the foreseeable future throughout all or a significant portion of its range (USFWS 2003)

APPENDIX B

**Lake Erie Water Snake Habitat Management Plan,
Middle Bass Island State Park**

The Lake Erie water snake habitat management plan specifies:

Measures ODNR will undertake to monitor, avoid and minimize adverse impacts to snake habitat and the procedures to deal with unforeseen circumstances. This management plan is consistent with the USFWS Lake Erie Water Snake Draft Recovery Plan, May 2003.

- ODNR will, to the maximum extent practicable, minimize impacts to Lake Erie water snake habitat; and

It is not likely that ODNR will injure or disrupt the normal behavior patterns of Lake Erie water snakes, providing the guidelines presented in this plan are observed and implemented.

The US Fish and Wildlife Service (Service) serves as the federal agency responsible for protecting the Lake Erie water snake. The Service conducts several types of consultations on Federal agency activities for listed species or designated critical habitats.

- **Early consultations** are held before an application is actually filed with a Federal agency to determine at an early planning stage what effect a proposed action may have on a species or critical habitat and what modifications may be needed to remove or minimize those effects. ODNR will initiate early consultations with the Service when appropriate.

Additional information regarding Lake Erie water snake habitat and biology can be found at: <http://endangered.fws.gov/>

Contact the US Fish and Wildlife Service at 614/469-6923 or Division of Wildlife at 614/265-6329. The Service's address is: 6950 Americana Parkway, Suite H, Reynoldsburg, Ohio 43068-4127.



**Middle Bass Island
State Park**



Winter Hibernation Habitat Guidelines

Lake Erie water snakes...

- Begin entering hibernation in September and October and emerge by the end of May.
- Hibernates above water level on both the island shoreline and island interior with 75% hibernating within 226 feet (69 m) of the shoreline.
- Are unable to move and are vulnerable to any disturbance of their hibernation sites.

Suitable winter hibernation sites include cracks and crevices in base rock, rock piles, animal burrows, certain tree components (e.g., downed trees, standing trees with base cavities, or exposed root masses), or human-made structures (e.g., walls, erosion barriers, or foundations made of rock or concrete, docks, drainage tiles, building pads, piled debris on the ground, etc.). Any excavation activity, removal of suitable tree roots or hollow tree bases, destruction of human-made structures (walls, etc.) or disturbance of other suitable hibernation habitat sites may cause take of Lake Erie water snakes.

Guideline 1:

Where suitable winter hibernation habitat exists, no excavation activity should occur from 15 October through April 15.

- Activities to be avoided include, but are not limited to, digging holes, removing suitable tree roots or hollow tree bases, and destroying suitable human-made structures (walls, etc.).
- If such activities must occur during the winter months, Parks should contact the US Fish and Wildlife Service early to seek technical assistance in exploring alternatives to avoid taking Lake Erie water snakes.

When the air temperature is less than 60 degrees Fahrenheit, the water snakes are sluggish and experience difficulty in moving away from excavation equipment. Hibernating snakes cannot move at all during low winter temperatures.

Guideline 2:

Where suitable winter hibernation habitat exists, excavation of any kind activities from 16 April through 14 October should occur only when air temperature is greater than 60 degrees Fahrenheit. The excavation site should be actively monitored for Lake Erie water snakes.

Guideline 3:

Monitoring should be conducted before and during construction by an individual trained to identify Lake Erie water snakes.

Guideline 4:

If water snakes are encountered during excavation, operations should cease immediately and the monitoring individual should contact the US Fish and Wildlife Service at 614-469-6923 extensions 12, 15, 16, or 22).

In locations that do not contain suitable hibernation habitat (e.g., locations composed purely of topsoil covered by short grasses and forbs), ground disturbance activities during cold months (i.e., 15 October through April 15) are not likely to cause take of Lake Erie water snakes.

Summer Habitat and Shoreline Vegetation Interface Guidelines

During warm months (i.e., from June through September), Lake Erie water snakes are found most often within 43 feet (13m) of the Lake Erie island shoreline, ponds, wetlands or streams. Cliffs with crevices, rocky shorelines, and rock-filled structures such as docks, breakwater rocks, and shoreline erosion barriers provide important shelter, breeding and foraging habitat for Lake Erie water snakes. The water snakes forage for small fish and amphibians near these locations and use spaces among rocks in the structures and along the shoreline for rest, reproduction and protection from predators. The shoreline/vegetation interface adjacent to the island shoreline and interior island ponds, wetlands, and streams is vital to both the summer and winter survival of Lake Erie water snakes. Any kind of excavation or removal of shrubs, standing or downed trees, root masses, animal burrows, piled rock, cliffs and bedrock within 43 feet (13m) of the shoreline, ponds, wetlands, or streams should occur only after conducting monitoring for snakes during the warm months (i. e., from June through September).

Guideline 5:

Monitoring should be conducted before and during construction by someone trained to identify Lake Erie water snakes. The site will be walked daily prior to any earthmoving activity to ensure no snakes are within the work area. If the snakes are encountered in the work area, their locations will be marked on a topographic map, and they will be moved outside the work limits. Information on snake locations should be sent to the US Fish and Wildlife Service in Reynoldsburg, Ohio.

Guideline 6:

Construction activities from June through September should occur when the air temperature is above 60 degrees Fahrenheit.

Guideline 7:

Any holes or trenches that are dug should be filled in as soon as possible to prevent water snakes from inadvertently falling into them and becoming trapped. Holes or trenches should be inspected for Lake Erie water snakes before being filled.

Guideline 8:

Mowing that involves removal of woody vegetation and tall grasses (e.g., bush-hog mowing) should be conducted when the air temperature is above 60 degrees Fahrenheit during warmer months (e.g., from June through September). Additionally, these activities may occur at any time from November through March when the air temperature is less than 60 degrees Fahrenheit.

Mowing in locations that do not contain suitable hibernation habitat (e.g., locations composed purely of topsoil covered by short grasses) is not likely to cause a take of Lake Erie water snakes. This includes mowing that is conducted regularly, such as the weekly mowing of lawns. Because this activity is not likely to cause a take of Lake Erie water snakes, it may be conducted year around, as necessary. Mower operators should always be watchful to avoid incidentally injuring or killing snakes.

APPENDIX C

Coastal Guidance Sheet No. 9

Shore Structures and the Lake Erie Water Snake



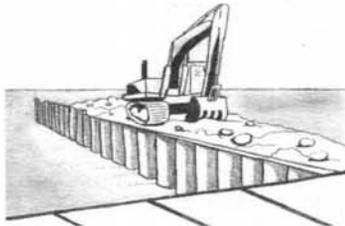
Ohio Department of Natural Resources
Ohio Environmental Protection Agency
U.S. Fish and Wildlife Service



Although you may not know it, the Lake Erie water snake, commonly referred to as the LEWS, may inhabit your shoreline property. Known scientifically as *Nerodia sipedon insularum*, the LEWS is a native creature of the western Lake Erie islands; namely, North, Middle, and South Bass, Sugar, Kelleys, Rattlesnake, Gibraltar, Starve, Ballast, Lost Ballast, and Gull Islands. Because the shore of these islands is the snakes' only natural habitat in the world, shore structures can be and have been extremely detrimental to their population. In an effort to preserve the lives of these unique reptiles now and in the future, Lake Erie water snakes are protected by the Endangered Species Act. The species is listed Federally as *threatened* and as *endangered* by the State of Ohio. Under this Act it is unlawful to kill, harm, or collect these snakes. Despite this, survival of the species may depend on the not losing its habitat to shore structures.

Natural Habitat

Lake Erie water snakes make their homes in different places throughout the year; during the summer they may make their homes along the shore or even in a shore structure. The snakes generally inhabit areas with large stones, exposed bedrock with cracks or crevices, and dense bushy vegetation. In the fall the snakes enter into hibernation and choose areas that will protect them from the harsh winter weather. The snakes emerge from hibernation in late April, and once temperatures rise, return to the Lake to forage.



Shore Structures

The warm spring and summer weather brings with it ideal conditions for property owners to make improvements. Along Lake Erie this may mean constructing docks, bulkheads, or other shore structures. Unfortunately, the construction of shore structures often has adverse effects on the LEWS' habitat. Both construction activities and the presence of solid wall structures can be detrimental to the LEWS.

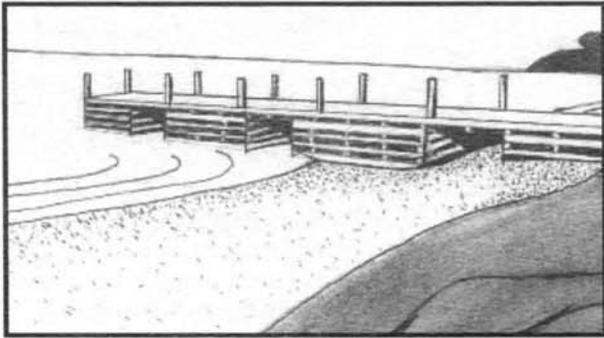
During construction, consider the following techniques:

- 🔑 If you choose to make improvements in the summertime, complete the project in a timely fashion. This will minimize the duration of stress for the LEWS.
- 🔑 When you have completed the project, restore the shore to its original state. This will allow the LEWS to return to its natural habitat.

~Over~

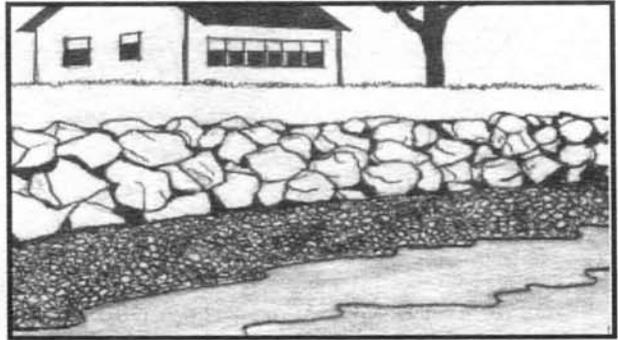
If you plan to construct a new shore structure, consider the following LEWS-friendly options:

Crib Docks or Bulkheads



Wood or steel cribs filled with large stones provide excellent habitat for water snakes.

Stone Revetments or Dikes



The cracks and crevices of these structures make for safe and cozy homes for the LEWS.

To increase LEWS' habitat when repairing existing structures, keep these ideas in mind:

- Allow natural vegetation and brush to grow along the shore.
- Leave some areas of your property undisturbed.
- Place stone behind or in front of existing concrete or steel vertical walls.

The Ohio Department of Natural Resources (ODNR), the Ohio Environmental Protection Agency (Ohio EPA), and the US Fish and Wildlife Service (USFWS) are available to assist you with improving your property and preserving the LEWS population. ODNR can visit your site and offer technical suggestions on construction as well as issue permits for building. USFWS and Ohio EPA can better inform you of Federal and State regulations regarding the LEWS and ways to preserve their habitat. These two agencies can also help you obtain permits to build, if they are necessary. To help keep the Lake Erie water snake alive and well along the island's shore please contact these agencies before embarking on construction.

Ohio Department of Natural Resources
Coastal Services Center
1630 Sycamore Line
Sandusky, Ohio 44870
Toll Free (888) 644-6267
<http://www.dnr.state.oh.us/water>

US Fish and Wildlife Service
Division of Ecological Services
6950 American Parkway, Suite H
Reynoldsburg, Ohio 43068-4127
(614) 469-6923
http://midwest.fws.gov/Endangered/lists/e_th_pr.html
<http://midwest.fws.gov/Reynoldsburg>

Ohio Environmental Protection Agency
Division of Surface Water
401/ Wetlands Unit
122 South Front Street
P.O. Box 1049
Columbus, Ohio 43216-1049
(614) 644-2001
<http://www.epa.state.oh.us/dsw/>

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APPENDIX D

U.S. Fish and Wildlife Service Lake Erie Watersnake Management Guidelines for Construction, Development, and Land Management Activities May 2, 2003

The Lake Erie Watersnake is a federally listed threatened species that occurs on the islands in the western basin of Lake Erie. When an agency or individual is involved in Lake Erie island development activities, the U.S. Fish and Wildlife Service (Service) encourages the use of caution to avoid take of Lake Erie Watersnakes. "Take" is defined as to pursue, harm, harass, hunt, wound, kill, trap, capture, collect, or to attempt to engage in any of these activities. "Harm" is further defined as any action that injures or disrupts the normal behavior patterns of the snake. Section 9(a)(1)(B) of the Endangered Species Act states that "it is unlawful for any person subject to the jurisdiction of the United States to take any such species within the United States or the territorial sea of the United States." The Service recommends that anyone planning a development project on the Lake Erie islands should contact us early in the planning stages for project design assistance.

The Service has developed the following guidelines to assist in avoiding take of Lake Erie Watersnakes. These season-based guidelines utilize the most current scientific information available and present a general overview of watersnake habitat. The guidelines may change as new information becomes available. Although implementation of these guidelines does not remove legal liability associated with take of a federally threatened species, the Service believes that if you follow these guidelines, you are not likely to incidentally take Lake Erie Watersnakes. Furthermore, these guidelines discuss the area of habitat used by 90% of the Lake Erie Watersnake population, however all Lake Erie Watersnakes are protected from take, no matter where they occur.

Winter Hibernation Habitat Guidelines

Lake Erie Watersnakes enter hibernation in September and October, and emerge in April and May. The watersnakes hibernate in suitable sites located above water level on both the island shoreline and island interior. Research indicates that 90% of Lake Erie Watersnakes hibernate within 528 feet (161 m) of the shoreline. Suitable winter hibernation sites include the following locations: cracks and crevices in bedrock; rock piles; animal burrows; tree root masses and cavities; and human-made structures such as rock walls, erosion barriers, foundations, drainage tiles, building pads, and piled debris on the ground surface. During hibernation, Lake Erie Watersnakes are unable to move and are vulnerable to any disturbance of their hibernation sites. Any excavation activity, removal of suitable tree roots, destruction of human-made structures (walls, etc.) or disturbance of other suitable hibernation habitat sites may cause take of Lake Erie Watersnakes.

At island sites where suitable winter hibernation habitat exists, excavation activity should not occur during the hibernation season. Activities to be avoided include, but are not limited to,

digging foundations, burying utility lines, removing suitable tree roots or hollow tree bases, and destroying suitable human-made structures (walls, foundations, etc.). If such activities must occur during the winter months, excavators should contact us early to seek our technical assistance in exploring methods to avoid take of Lake Erie Watersnakes. Contacting us early allows us to review a proposed project, discuss options, address species needs, and find solutions while avoiding project delays. If take is unavoidable, early planning also will help to ensure compliance with Sections 7 and 10 of the Endangered Species Act, while avoiding project delays.

In order to avoid taking Lake Erie Watersnakes, excavation of any kind in potential suitable winter hibernation habitat within 528 ft (161 m) of shore should be avoided between October 15 and April 15. Hibernating snakes cannot move at all during low winter temperatures, and are sensitive to disturbance. Excavation activities occurring between April 16 and May 31, or between September 15 and October 14 should only be conducted when air temperatures are above 60 degrees Fahrenheit. When the air temperature is less than 60 degrees Fahrenheit, the watersnakes are sluggish and experience difficulty in moving away from excavation equipment. The construction site should be actively monitored for snakes before and during construction by an individual that can identify a Lake Erie Watersnake. If Lake Erie Watersnakes are encountered during excavation, operations should cease immediately and the monitoring individual should contact us promptly at our Reynoldsburg, Ohio, Field Office (614-469-6923 extensions 12, 15, 16, or 22). Exercising these precautions will help avoid injuring or killing hibernating Lake Erie Watersnakes.

In locations that do not contain suitable hibernation habitat (e.g., locations composed purely of topsoil covered by short grasses and forbs with no cracks or crevices present), ground disturbing activities during the hibernation period (i.e., after October 15 and before April 15) are not likely to cause take of Lake Erie Watersnakes. Anyone uncertain about whether or not a site contains suitable winter hibernation habitat should contact our Reynoldsburg office.

Summer Habitat Guidelines

During warm months (i.e., from June through September), 90% of Lake Erie Watersnakes are found within 69 feet (21 m) of the Lake Erie island shoreline, and within the same distance of ponds, inlets, bays, and marinas within the interior of the islands. Cliffs with crevices, rocky shorelines, and rock-filled structures such as docks, breakwater rocks, and shoreline erosion barriers provide important shelter, breeding and foraging habitat for Lake Erie Watersnakes. The watersnakes forage for small fish and amphibians near these locations and use spaces among rocks in the structures and along the shoreline for rest, reproduction, and protection from predators.

The shoreline/vegetation interface on the islands, as well as interior island ponds, inlets, bays, and marinas are vital to both the summer and winter survival of Lake Erie Watersnakes. Any kind of excavation or removal of shrubs, standing or downed trees, root masses, animal burrows, piled rock, cliffs, or bedrock within 69 feet (21 m) of the shoreline, ponds, inlets, bays, and

marinas may cause take of the Lake Erie Watersnake. For this reason, if you plan to conduct such activities, you should contact the Service early to seek technical assistance in exploring alternatives that avoid take. Contacting us early allows us to review a proposed project, discuss options, address species needs, and find solutions while avoiding project delays. If take is unavoidable, early planning also will help to ensure compliance with Sections 7 and 10 of the Endangered Species Act, while avoiding project delays.

Summary of habitat management practices, timing, and location where applicable.

Time	Location	Recommendation
Oct 15- April 15	Within 528 feet (161 m) of shore	No Excavation.
April 16- May 31	Within 528 feet (161 m) of shore	Excavation only when temperature above 60° F. Mow at dusk, on high setting.
June 1- Sept 14	Within 69 feet (21 m) of shore	Coordinate all construction and excavation projects along shoreline with Service.
Sept 15- Oct 14	Within 528 feet (161 m) of shore	Excavation only when temperature above 60° F. Mow at dusk, on high setting.

The Service encourages preservation or construction of structures with designs beneficial to watersnakes (e.g., certain rock walls, rock-filled crib docks, and rock erosion barriers, etc.) because such structures may provide shelter for the snake. When building or replacing a dock, the Service recommends that you refer to the Ohio Department of Natural Resources (ODNR) Coastal Guidance Sheet No. 9. This can be obtained by contacting ODNR at 419-626-7980, or online at <http://www.dnr.state.oh.us/water/coastal/pubs/cmguide9.pdf>. When conducting such activities, you should also contact us early for technical assistance in exploring alternatives or pursuing necessary compliance with Sections 7 and 10 of the Endangered Species Act. Furthermore, any project that will impact the shoreline or waters of Lake Erie (including marinas, wetlands, and natural ponds), for example the installation of a new dock or shoreline erosion protection structure, must be coordinated with the U.S. Army Corps of Engineers (Corps) to ensure compliance with the Clean Water Act. The Buffalo District of the Corps can be contacted at (716) 879-4330.

In addition to contacting us early in the project planning process, construction projects during warm months (i.e., from June through September) in suitable summer habitat should be actively monitored for Lake Erie Watersnakes. The monitoring should be conducted before and during construction by a person that can identify a Lake Erie Watersnake. If watersnakes are encountered within the project area during construction, operations should cease and the monitoring person should contact us immediately in our Reynoldsburg, Ohio, office (614-469-6923 extensions 12, 15, 16, or 22). Finally, any holes or trenches that are dug should be filled in as soon as possible to prevent watersnakes from inadvertently falling into them and becoming trapped. Holes or trenches should be inspected for Lake Erie Watersnakes before being filled.

Land Management Guidelines

Tree Removal

Tree root masses may provide suitable hibernation habitat for the Lake Erie Watersnake. If you are planning on removing trees on your property, the Service recommends that only the above-ground portion of the tree be removed. The root mass should be left underground, so as not to disturb hibernation locations. Within 69 feet (21 m) of shore, heavy machinery should be limited to paved roads, ramps, etc. so as not to harm watersnakes that may have retreated under rocks, logs, and other material.

Mowing

Shoreline vegetation is an important component of Lake Erie Watersnake summer habitat. Vegetation provides resting, basking, cover, and mating locations for the snake, while it also provides habitat for native birds, fish, amphibians, and mammals, helps to stabilize banks and prevent erosion, and helps to promote improved water quality. Landowners are encouraged to avoid mowing within 69 feet (21 m) of the shoreline to protect these important habitat and water quality features. During late April and May as Lake Erie Watersnakes are emerging from hibernation, and during late September and early October as Lake Erie Watersnakes are entering into hibernation, lawn mowing within 69 feet (21 m) of the shore should be completed at dusk, when the snakes will have taken cover for the night. Mowing during these time frames should utilize a high setting, and the area to be mowed should be actively monitored for Lake Erie Watersnakes.

Questions

Three people are available in the Service's Reynoldsburg, Ohio office to answer any questions you may have about the Lake Erie Watersnake. You may contact our office Monday through Friday, 8am-4pm by dialing 614-469-6923. For questions about U.S. Army Corps of Engineers permits, contact wildlife biologist Megan Seymour (ext.16). For questions about Lake Erie Watersnake biology or about the Endangered Species Act, contact endangered species biologist Angela Boyer (ext. 22). All questions may also be directed to the office's Supervisor, Dr. Mary Knapp (ext. 12).

APPENDIX E

Summary of U.S. islands

Kelleys Island

Kelleys Island supports the largest U.S. subpopulation of Lake Erie Watersnakes. The largest of the U.S. islands at approximately 11.7 km² (2,888 ac), Kelleys is the only island located in Erie County, and is slightly south and east of most of the other U.S. islands (Core 1948). Kelleys Island is moderately populated during the summer. It supports many summer homes and cottages, but only a few families inhabit the island year-round. Tourism on Kelleys is moderate in comparison to South Bass Island, but does play a key role in the economy of the island. Kelleys Island State Park, North Pond Nature Preserve, and the Kelleys Island Alvar, all owned by ODNR, comprise the public land on the island, which totals 2.74 km² (677.1 ac) (Figure 2). Additionally, the Cleveland Museum of Natural History owns a several-acre parcel of undeveloped land that provides snake habitat. The 18.6 km (11.6 mi) of shoreline on Kelleys Island currently supports approximately 1,942 adult Lake Erie Watersnakes (King 2002c).

South Bass Island

South Bass Island, also called Put-in-Bay, is the second largest U.S. island, measuring approximately 6.75 km² (1,664 ac), and providing 17.5 km (10.9 mi) of shoreline habitat (Core 1948). Located at the southern end of the Bass Island chain in Ottawa County, South Bass supports a large tourism and vacation economy during the summer months. A heavily developed bay and downtown complex support numerous visitors during the summer, facilitated by several large ferries that bring visitors to the island. Most of the remainder of the island is in private ownership, with many cottages and homes throughout the island. Public land on South Bass Island is comprised of ODNR's South Bass Island State Park, and the National Park Service's Perry's Victory Monument (Figure 3). South Bass Island supports an estimated 1,145 adult Lake Erie Watersnakes (King 2002c).

Middle Bass Island

Middle Bass Island, located in the center of the Bass Islands chain in Ottawa County, is a relatively quiet, residential island supporting mostly single-family seasonal homes. The island measures approximately 3.01 km² (742 ac) in size and includes 12.7 km (7.9 mi) of shoreline (Core 1948). The ODNR recently purchased a 0.50 km² (123 ac) parcel of land on the south portion of the island, and is currently developing Middle Bass Island State Park, which will feature a large public marina, and possibly camping, hiking, and swimming opportunities in the future. In addition to this land, the ODNR, Division of Wildlife owns and manages Kuehnle Wildlife Area, a 8.9 ha (22 ac) wetland in the center of the island (Figure 4). The Lake Erie Watersnake population on Middle Bass Island is estimated to be 1,387 adult snakes (King 2002c).

North Bass Island

North Bass Island is located on the north end of the Bass Island chain, in Ottawa County, Ohio (Figure 5). Almost 90% of North Bass Island's 3.04 km² (748 ac) is currently owned by Meier's Wine Cellars, and most of that land is vineyard, with a significant amount of coastal wetland along the lake. The remainder of the island is composed of twelve homes, an airstrip, church, and cemetery. Recently, the ODNR has been offered the option to purchase the portion of the island owned by Meier's Wine Cellars, and will likely do so in the near future. The 8.4 km (5.2 mi) of shoreline on North Bass Island supports approximately 583 adult Lake Erie Watersnakes (King 2002c).

Gibraltar Island

Gibraltar Island is located in the bay of South Bass Island, and is owned by The Ohio State University, and operated as a biological research station named Stone Laboratory. This small 0.024 km² (6 ac) island is developed with several large historic buildings associated with the University (Core 1948). The estimated Lake Erie Watersnake population on Gibraltar as of 1998 is 44 adult snakes (King 2002c). The current total population estimate does not include the 1998 population estimate for Gibraltar because we believe the Gibraltar estimate to be less accurate than the 1999-2002 population estimates.

Rattlesnake Island

Rattlesnake Island is located approximately 1.6 km (1 mi) west of Middle Bass Island, and is approximately 0.24 km² (60 ac) (Core 1948). Some say the island gets its name from its shape, elongated with two islets at the tail end, while others believe it is so named because of all the rattlesnakes that inhabited the island prior to development (Core 1948). This island is privately owned and operated as a club. It contains a few residences, small golf course, airstrip, marina, and several clubhouse buildings. The estimated Lake Erie Watersnake population as of 1998 is 20 adult snakes (King 2002c). The current total population estimate does not include the 1998 population estimate for Rattlesnake because we believe the Rattlesnake estimate to be less accurate than the 1999-2002 population estimates.

Sugar Island

Sugar Island is approximately 0.40 km (0.25 mi) northwest of Middle Bass Island. It also is small, approximately 0.16 km² (40 ac), and is privately owned (Core 1948). Several cottages are currently found on the island. The current estimate for adult Lake Erie Watersnakes on Sugar Island is 314 (King 2002c).

Green Island

Green Island lies about 1.6 km (1 mi) west of South Bass Island, and is owned and managed by the ODNR, Division of Wildlife as a wildlife preserve. The island is approximately

0.068 km² (17 ac) in size, and is composed mainly of dense, young forest. There is a U.S. Coast Guard operated lighthouse on the island, and the remains of an old stone lighthouse, but these are the only human-made structures still present on the island. An alvar community exists along parts of the shore of Green Island, which provides suitable summer habitat for the Lake Erie Watersnake. Lake Erie Watersnakes were extirpated from Green Island for unknown reasons, sometime between the late 1940's and the 1980's (King and others 1997), however surveys during 2002 found that the snakes had recolonized the island (King 2002c). Currently, the population is estimated to be 102 adult snakes (King 2002c).

Ballast Island

Ballast Island is privately owned and composed mainly of scattered forested areas and several cottages. This tiny island is approximately 0.049 km² (12 ac), and has a small islet off the shore called Lost Ballast Island (Core 1948). Estimates of Lake Erie Watersnake population on Ballast Island from 1998 total 44 adult snakes (King 2002c). The current total population estimate does not include the 1998 population estimate for Ballast because we believe the Ballast estimate to be less accurate than the 1999-2002 population estimates.

Other islands

West Sister Island is the most western island within the range of the Lake Erie Watersnake, located about 27.3 km (17 mi) west of the Bass Islands. This island is owned by the USFWS and managed as part of Ottawa National Wildlife Refuge. This 0.28 km² (70 ac) island is densely vegetated and inhabited by a number of colonial nesting water birds. Historic records indicate that the island was inhabited by Lake Erie Watersnakes, but the snakes were extirpated sometime between 1940 and 1980 (King and others 1997). During a 2002 survey of the island, one adult female watersnake was found (King 2002c). However, the color pattern of this snake suggests it may be an immigrant from mainland Northern Watersnake populations. Thus, the status of the Lake Erie Watersnake on this island remains uncertain.

Starve Island is actually an islet located near the south shore of South Bass Island. Due to the small size of the island and the impact on the island from weather events, it is unlikely that this islet could support a year-round population of Lake Erie Watersnakes, although snakes from other islands may use it for basking habitat or may rest here between foraging attempts during the summer.

Gull Island is also an islet located north of Kelleys Island and south of Middle Island (Canada). Due to the small size of the island and the impact on the island from weather events, it is unlikely that this islet could support a year-round population of Lake Erie Watersnakes, although snakes from other islands may use it for basking habitat or may rest here between foraging attempts during the summer.

Mouse Island is a tiny, privately owned island located less than 0.40 km (0.25 mi) from the Catawba peninsula on the Ohio mainland. The status of Lake Erie Watersnakes on Mouse

Island is unknown (King and others 1997) and federal protection does not extend to this location due to its proximity to the mainland.

Johnson Island is located within Sandusky Bay, very near the mainland and is connected to the mainland by a short bridge. Federal protection is not extended to watersnakes on Johnson Island due to the likelihood that these snakes represent intergrades between Northern Watersnakes and Lake Erie Watersnakes.

APPENDIX F

Additional Research Needs

These research needs are based on identified data gaps in our current knowledge of the Lake Erie Watersnake, that when filled, may contribute somewhat towards recovery of the species.

Effects of disease on the snake population

The USFWS has no evidence to indicate that disease is adversely affecting the Lake Erie Watersnake population, however further research is needed to document which, if any, diseases could be causing mortality in the population.

Effect of habitat fragmentation on the snake population

Construction of docks, breakwaters, or seawalls within the range of the shoreline used by the Lake Erie Watersnake can result in fragmentation of the snake's habitat. Since these snakes are mobile and can readily swim around structures, habitat fragmentation along the shoreline may not be as significant of a threat as habitat loss, but further studies to quantify the impact of fragmentation on Lake Erie Watersnakes are recommended.

Significance of mortality from fishing and boating

Snakes are known to use boats as basking and resting spots and may occasionally become entangled in fishing gear or inadvertently caught on fishing hooks. This form of take may represent a potential threat to the species, although this threat has yet to be quantified. Although it is unlikely that this represents a significant threat to the population, further studies to quantify the impact of this form of mortality on the Lake Erie Watersnake population are recommended.

APPENDIX G

Summary of Comments on Draft Recovery Plan and U.S. Fish and Wildlife Service Responses

On June 19, 2003 the U.S. Fish and Wildlife Service (Service) released the Draft Recovery Plan for the Lake Erie Watersnake for a 60-day review and comment period ending on August 18, 2003. Availability of the plan was announced in the *Federal Register* (FR 68 36828), via a news release to media contacts throughout Ohio, and via a public meeting on Kelleys Island on June 18, 2003.

In accordance with Service policy, requests for peer review of the draft plan were sent to experts outside the Service. In particular, these experts were asked to comment on (1) issues and assumptions relating to the biological and ecological information of the plan, (2) scientific data relating to the tasks in the proposed recovery program, and (3) the determination of the proposed recovery criteria, including population size and extent of protected habitat. Peer reviews were received from the following individuals:

Ms. Deb Jacobs, Ontario Ministry of Natural Resources, Chatham, Ontario, Canada
Dr. Bruce A. Kingsbury, Indiana-Purdue University, Fort Wayne, IN
Mr. Doug Wynn, Westerville High School North, Westerville, OH

During the comment period, 90 copies of the Draft Recovery Plan were distributed to affected government agencies, organizations, and interested individuals.

Thirty-three comment letters were received during the official comment period. Affiliations of the originators of these comment letters are tabulated below:

Peer reviewers	3 letters
Federal agencies	1 letters
State Governments	1 letter
Environmental/Conservation organizations	3 letters
Individuals/Private citizens	25 letters

Each letter contained one or more comments, with some letters raising similar issues. Most letters commented on the cost of the recovery plan, and the current abundance of Lake Erie Watersnakes on the islands. Several letters stated that the snakes are a nuisance to people using the Lake. One commenter stated that the plan was well thought out, and another supported all the provisions of the Draft Recovery Plan's general tasks. Two additional letters supported snake conservation in general. One letter supported the proposed delisting population goal and habitat protection goal. Many comments from both peer reviewers and commenters recommended rewording to clarify the meaning of specific sentences. All comments received were considered and noted. Significant comments that were not incorporated or that require further clarification are addressed below.

The letters received from the independent peer reviewers, as well as other comment letters on the Draft Recovery Plan are on file at the U.S. Fish and Wildlife Service, Reynoldsburg, Ohio Field Office, 6950 Americana Parkway, Suite H, Reynoldsburg, Ohio, 43068.

- Comment: One reviewer stated that the appearance of the name “Lake Erie Watersnake” should follow the naming system outlined in: “Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding,” produced by the Committee on Standard English and Scientific Names in 2000, and officially recognized and adopted by The Society for the Study of Amphibians and Reptiles, American Society of Ichthyologists and Herpetologists, and the Herpetologists’ League.

Response: The Final Recovery Plan has been altered to reflect the standard naming protocol. The Draft Plan used, “Lake Erie water snake,” and the Final Plan now uses, “Lake Erie Watersnake.”

- Comment: Two reviewers stated that the description of the Lake Erie Watersnake as “aggressive” does not correctly describe the snake’s disposition, and suggested that this term be omitted

Response: This term has been omitted from the document.

- Comment: One reviewer asked for inclusion of the rationale for not listing the Lake Erie Watersnake as a threatened species on the mainland and nearshore islands.

Response: This rationale has been included under the Population Status and Distribution Section.

- Comment: One reviewer asked for clarification of the longitude and latitude coordinates provided under the “Distribution” section.

Response: Clarification has been provided in the text of the specified section.

- Comment: One reviewer noted that Figure 1 has no scale.

Response: A scale has been added to this figure.

- Comment: One reviewer asked that additional information regarding hibernacula fidelity in the “Movement Patterns” section be included, or that the text of this section refer the reader to the section where fidelity is discussed in depth.

Response: Further information and references have been provided in the text of the specified section.

- Comment: One reviewer asked for clarification of the numbering system in the “Critical Habitat” section.

Response: The numbering in this section is taken from the Endangered Species Act of 1973, as amended.

- Comment: One reviewer asked for more detailed information on the percent of the total snake population that occupies public land, and land owned by non-government organizations.

Response: Current data is not sufficient to give a definitive answer to this question; however, population estimates are available for portions of public property as follows: Kelleys Island State Park boat ramp area-89 adult snakes; Middle Bass Island State Park-147 adult snakes; South Bass Island State Park-527 adult snakes; Green Island-102 adult snakes; Gibraltar Island-44 adult snakes. Total estimated number of adult snakes on these properties combined is 909, which is 16.6% of the total estimated adult population (King 2002c).

- Comment: One reviewer asked for an example of when a Section 10(a)(1)(B) permit would be issued.

Response: Section 10(a)(1)(B) permits are issued to non-Federal parties when there is the possibility that take may occur in the course of an otherwise lawful activity; this type of permit is also called a Habitat Conservation Plan.

- Comment: One reviewer suggested that feedback from local residents would be useful in revising the Service’s Management Guidelines for Construction, Development, and Land Management Activities, and Habitat Management Plans for other properties.

Response: This recommendation has been included in recovery tasks 2.1.1.

- Comment: One reviewer asked if “Watersnake welcome here” signs had been posted on the ferry boats.

Response: The Service contacted the various ferry operators servicing the islands in 2001, and distributed Lake Erie Watersnake signs to several of the companies. Signs were posted at ferry docks on Kelleys and South Bass Island in 2001. The Middle Bass Dock Company has agreed to post signs on their dock, which is currently being rehabilitated. No signs have been posted on the boats themselves, to our knowledge. The Service will provide additional signs at the ferry company’s request.

- Comment: One reviewer asked whether any necessary revisions to the standard monitoring protocol (Recovery task 1.1) would occur during the single year of development or in subsequent years.

Response: The basic monitoring protocol will be developed during the first year, with any necessary revisions completed during successive years. The Implementation Schedule has been modified to reflect this comment.

- Comment: One reviewer asked if there was a suitable plant species that is pleasing to local residents and would provide shelter for the snake that could be recommended for planting.

Response: Under the “Essential Summer Habitat” section, shoreline vegetation is discussed. In terms of providing snake habitat, the exact type of vegetation does not appear to be important, but its use depends on vegetation density and proximity to the shoreline and basking areas. Dense shrubs, brush, and vines such as grape (*Vitis* spp.), Virginia creeper (*Parthenocissus quinquefolia*), and red cedar (*Juniperus virginiana*) are native plants that provide good sources of cover when located in proximity to the shoreline. Cultivated plants that provide similar habitat may also be suitable.

- Comment: One reviewer asked if artificial hibernacula could be put in place when disturbances, such as excavation, are planned, and another reviewer asked if additional habitat, such as ponds, could be constructed onshore. One reviewer asked if destruction of a hibernaculum would constitute a “take?”

Response: Construction of artificial hibernacula or other artificial habitat such as ponds or wetlands may be a suitable means of creating habitat in areas that do not currently provide suitable habitat. Furthermore, creation of summer habitat through the construction of “snake-friendly” docks and shoreline structures has provided significant basking and resting areas for snakes on many of the islands. These types of activities could be undertaken by individuals seeking to create or enhance snake habitat on their properties. In most cases, disturbance of existing hibernation habitat is likely to cause take of Lake Erie Watersnakes, therefore for this type of activity, the landowner would need to consult with the Service. The Service has recommended creation of artificial hibernacula as a measure to offset the loss of natural hibernation areas, such as was proposed in the Long Point Homeowner’s Association, LLC’s Habitat Conservation Plan for the Lake Erie Watersnake. We will continue to recommend creation of artificial habitat as appropriate when consulted, and will encourage habitat creation and enhancement as appropriate.

- Comment: One reviewer noted that the definition of “effective population size” in Appendix A was incorrect.

Response: The definition has been corrected.

- Comment: One reviewer had suggestions regarding the mowing guidelines specified in Appendices B and D. Suggested recommendations include the following: (1) mowing and brush-hogging out of season (Nov. 1-May 1) when possible because snakes are underground and out of the way at this time; (2) providing a recommended height for mowing in areas that are only mowed occasionally, potentially 8 inches; (3) areas that are regularly and continuously mowed to low heights (for example, lawns) should be kept low all season to discourage snake use and thus reduce take during mowing.

Response: Since these documents (Appendices B and D) were just revised and distributed to the public this year, the Service will incorporate the recommended changes into “Lake Erie Watersnake Management Guidelines for Construction, Development, and Land Management Activities” when this guidance document is revised again, likely during fiscal year 2004. The Service will recommend the above modifications to ODNR when their “Lake Erie Watersnake Habitat Management Planning Document” is revised again, as well.

- Comment: One reviewer suggested that Appendix D, “Winter Hibernation Habitat Guidelines” be reworded to remove redundancy and improve flow.

Response: Since this document was just revised and distributed to the public this year, the Service will incorporate the recommended changes into “Lake Erie Watersnake Management Guidelines for Construction, Development, and Land Management Activities” when this guidance document is revised again, likely during fiscal year 2004.

- Comment: One reviewer suggested using the term “roadkill” instead of “vehicle collision” to describe this threat.

Response: The term “roadkill” has been used to describe this threat throughout the document.

- Comment: One reviewer asked if, once delisted from the Federal list of threatened species, is there any other designation that would apply to the snake, and if there is a designation, is there any protection afforded to it. Furthermore, the reviewer asked what the State of Ohio’s criteria is for downlisting, and if fulfilling the recovery criteria in this plan would have influence on the state designation of “endangered.”

Response: Once delisted, the Service is required to monitor the snake population for a minimum of five years to ensure that recovery has been achieved. There is no official federal designation or protection given to the species at this point, except that it is being monitored. Developing the post-delisting monitoring plan has been added to the plan as Task 5.3. Regarding the state “endangered” listing, at the time that the Service proposes to delist the snake, ODNR Division of Wildlife would evaluate the biological status of the species and determine if it was consistent with the rationale for downlisting or

delisting at the state level. If it was consistent, a parallel downlisting or delisting would occur.

- Comment: One reviewer asked for clarification regarding whether or not habitat restoration was part of the Recovery Strategy, as it was mentioned in one section, and never again throughout the document.

Response: Habitat restoration is part of the Recovery Strategy, and this has been clarified throughout the “Stepdown outline,” “Recovery Narrative,” and “Recovery Strategy” sections. The Service believes that shoreline habitat restoration (such as planting native vegetation and leaving it unmowed) will benefit the Lake Erie Watersnake by restoring natural habitat. The Service’s proposed “Standard Lake Erie Watersnake habitat restoration and maintenance guidelines for protected habitat” (Recovery Task 2.2), will be expanded to include measures to restore habitat.

- Comment: Does the targeted amount of land for protected habitat already exist? What part of those “protected area” targets are already achieved via the State and Federal owned lands?

Response: Protected habitat, as defined in the plan, is habitat that is protected in perpetuity and managed in a manner suitable for the continued persistence of the Lake Erie Watersnake. To be included, the land must have a written agreement that has been approved by the USFWS. Our recovery criteria for protected habitat is 7.4 km of shoreline habitat and 0.51 km² of inland habitat within 69 m of shore. Currently, the only public or private land that meets this requirement is Middle Bass Island State Park, which provides 0.89 km of shoreline habitat and 0.046 km² of inland habitat. Table 3 has been added to the document to provide data on public property that could *potentially* count towards protected habitat. These properties collectively could contribute up to 50% of the total protected shoreline habitat and 45% of the total protected inland habitat.

- Comment: The plan calls for an adult population size of 5,555 adults. Based on the information in Appendix E, this target has already been achieved (total is 5,581 snakes). For how many years has this target been achieved already out of the 6 consecutive years needed to fulfill recovery criterion 1?

Response: Appendix E provides summaries of each island and the estimated Lake Erie Watersnake population. This same information is summarized in Table 1 of the document. Population estimates for the U.S. islands surveyed during the 1999-2002 field seasons (Kelleys, the Bass Islands, Green, Sugar, and West Sister) total approximately 5,473 adult snakes. Population estimates for the remaining islands (Rattlesnake, Ballast, and Gibraltar) are calculated from the 1996-1998 field seasons. Due to the limited number of sampling sites, limited access to these privately owned islands, and limited survey events, we believe these estimates to be less accurate than the 1999-2002 population estimates, and these numbers are not included in the 2002 population estimate,

which is 5,473 adult snakes, just under the recovery population goal. Future survey events on Rattlesnake, Ballast, and Gibraltar Islands will result in more accurate population estimates, which will be included in the total population estimate.

- Comment: Page 26 refers to “threats that are currently depressing the size of the subpopulations.” It would seem that this “currently depressed” population the plan speaks of is already slightly higher than your target population, and that the plan does not actually prescribe any improvement to the current numbers. This seems to be a contradiction. If the Service deems current population numbers sufficient, it could be made more evident in the document overall that the current population is NOT a population in trouble, just a population that needs effort to be maintained at its current level.

Response: The current estimated population is 5,473 adult snakes, while the recovery objective is 5,555 snakes, thus current population numbers are not sufficient. The “Recovery Strategy” and “Population Status and Distribution” sections have been revised to clarify the current status of the population. At the time of listing, the adult population size was considered to be depressed. In the four years since listing, the adult population estimate has more than doubled, due to increases in the snake population and improved census data. Additionally, the snake has recolonized Green Island, from which it had been extirpated, since the time of listing. These two events indicate that since the time of listing, recovery has been ongoing. We are currently approaching our target population number, and believe this population goal is sufficient to ensure the continued existence of the Lake Erie Watersnake.

- Comment: A possible addition to Criteria 1 could be to give some consideration to maintaining populations on the smaller islands which are not smaller than the current populations. This would guard against further local extirpations and increase chances of a quick repopulation in the face of catastrophic events, such as weather.

Response: At this time, we believe that ensuring these small subpopulations persist is sufficient for recovery without achieving a specific population goal. Instead, we have included as part of Criterion 1 that these small satellite populations must persist throughout the duration of the recovery period (6 or more consecutive years where total population goal is achieved as are goals for four large islands).

- Comment: Will the areas for protection agreements be targeted to areas with known hibernacula and to shoreline areas with high census numbers?

Response: The Service will attempt to achieve protected habitat in a variety of locations. Preference will be given to areas that support large numbers of snakes, and hibernation locations that support multiple snakes in close proximity to each other. One research need specified in the plan is to identify and characterize high quality hibernation locations that support multiple snakes, in order to protect these areas (Task 4.4). The location of protected habitat will largely depend on the location of willing landowners,

and so actual location of protected habitat related to snake concentration areas will depend on availability. The Service will not protect just the known hibernacula, as we only have data on about 50 snakes, and protecting only these snakes would not necessarily benefit the snake population as a whole.

- Comment: Increased rationale/criteria for the selection or prioritization of protected habitat area targets could make this a more effective recovery action. Suggested items to address include the following: protection of known hibernacula that fall beyond the 69 m limit; and potentially protecting areas where no information on hibernacula is available and leaving known hibernation sites to the protection of the ESA.

Response: The Service has added Task 2.7 to the Recovery Plan, which will lead us to develop a system for evaluating potential protected habitat and selecting the most valuable parcels for protection. The recommended items above will be included in the development of this system.

- Comment: Are landowners notified of hibernation sites on their property, once the site has been identified?

Response: In the past, landowner notification may or may not have occurred, once a hibernation site was identified on their property. In the future, the landowner will be notified if notification will benefit the protection of the snake or its hibernacula, as described in task 2.8. In cases where a landowner is notified, potential habitat protection options will also be provided.

- Comment: Is there a contingency plan if the targeted amounts of land can not be protected by voluntary agreements alone?

Response: At this time, no such plan has been developed. We believe through education and working with public and private landowners that the targeted amount of land can be protected through voluntary agreements, management plans, and other means.

- Comment: Recovery tasks 2.1.1-2.1.3. Are these documents legally binding? Will these still be implemented/effective after the species is delisted? Is there any enforcement for non-compliance with these documents?

Response: The documents referred to in Recovery tasks 2.1.1-2.1.3 are not legally binding. They are merely recommendations that, if followed, should avoid take of Lake Erie Watersnakes while implementing certain activities. Item 2.1.1, USFWS Lake Erie Watersnake Management Guidelines for Construction, Development, and Land Management Activities, is a guidance document for landowners who are planning activities on their properties, and provides time frame and suggestions for planning such activities. Once the snake is delisted, these guidelines will still be effective in conserving the species, but would not be required to be implemented. It is anticipated that the long-

term effects of these recommendations are increases in the amount of artificial habitat, better land stewardship of snake habitat, and increased awareness of the needs of the snake. Item 2.1.2, ODNR's Lake Erie Watersnake Habitat Management Planning document, is a management strategy for protecting snake habitat on Middle Bass Island State Park. As the snake is also a state-listed species, and a unique, island-endemic species, we anticipate that the State will continue to implement this management plan after the snake is delisted. Item 2.1.3, Coastal Guidance Sheet No. 9, is also a guidance document that suggests preferred dock and shoreline erosion control structures which may provide artificial snake habitat. We anticipate that structures such as those recommended in this document will continue to be recommended by the State and Federal regulatory agencies after the snake has been delisted because these structures provide benefits to fish habitat and coastal processes more so than other structures used for similar purposes. The only enforcement that could result from non-compliance with any of the above referenced documents would have to occur as a result of take of snakes.

- Comment: Would there be consequences to landowners for renegeing on their agreements in the future. If landowner renegeed would other protected areas need to be obtained at that time to fulfill Criterion 2b?

Response: The Service expects that Federal and State landowners on the islands have a long-term interest in snake conservation, and therefore would not renege on their management agreements. The voluntary conservation easement program implemented by ODNR, Division of Wildlife and the Lake Erie Islands Chapter of the Black Swamp Conservancy establishes a perpetual easement with financial incentives. As a perpetual agreement, the landowners are legally bound by the terms of the easement and cannot violate these terms. ODNR would likely be responsible for enforcing the conditions of the easement. If, for some reason, a landowner would withdraw their property from the "protected habitat" designation and the snake was still listed, additional habitat would be required to fulfill Criterion 2b.

- Comment: Are the suggested amounts of protected habitat considered minimums? If you can get more, will you take more?

Response: The suggested amounts of protected habitat are minimums. We will accept more if the opportunity arises.

- Comment: Once the species is delisted, there will be no more legislative clout to protect remaining hibernacula and habitat, and the protected areas will be all there is to fall back on. I am not convinced that 2% is enough protected habitat. What is there to prevent the remaining habitat from getting nickel-and-dimed away by development in the future?

Response: In the "Rationale-Extent of protected habitat" section, we have clarified our rationale for only protecting 2% of total island area. Specifically we have identified that the goal for protecting a total of 7.4 km of shoreline habitat and 0.51 km² of inland

habitat within 69 m of shore accounts for approximately 10% of the total shoreline of the four largest islands and 13% of the total inland habitat within 69 m of shore of the four largest U.S. islands. Currently, only 0.046 km² (11.4 ac) of inland habitat and 0.89 km (0.55 mi) of shoreline habitat meets the definition of “protected habitat” (Middle Bass Island State Park). This comprises only a small percentage of the goal for protected habitat. Despite the lack of currently protected habitat, population estimates for the snake have been increasing since implementation of a public education and outreach campaign and since listing the snake as a federally threatened species, and current population estimates are very close to achieving the delisting population goal. Furthermore, habitat loss, alteration, and degradation is now thought to be less of a threat than at the time of listing because snakes can tolerate human presence and activities, provided that development is done in manner that is compatible with the needs of the snake (Appendix D) and intentional human-induced mortality is not a factor. In addition, certain other protective laws are in place on some of the islands, and although unrelated to the snake, these laws do provide a certain degree of protection for snake habitat. For example, Kelleys Island has a zoning law that prevents construction of buildings within 125 ft. of the shoreline. Other islands have similar restrictions. Furthermore, we know that hibernation sites can support more than one snake, therefore protection of the specified habitat amounts will likely protect hibernacula for more than the estimated 1/5 of the “recovered” snake population.

- Comment: If all snakes congregate in protected areas, these concentrated areas are much more susceptible to stochastic events.

Response: It is true that a greater number of snakes could be impacted by a single stochastic event if snakes are congregated or clumped, as opposed to evenly distributed. To address this, the Service proposes to distribute protected habitat proportionately among the four largest islands, and to establish multiple protected areas on each island. Furthermore, we do not expect the snakes to congregate in these areas. As is evidenced by research and observations, snakes can and do tolerate human presence and can co-exist despite some habitat modifications (such as construction of docks, shoreline erosion control structures, etc.), provided human persecution is not a factor. Snakes are known to use human-made structures for both summer and hibernation habitat. It is apparent that both natural and artificial habitat will be responsible for supporting snake populations into the future, not just the protected habitat. The discussion of habitat needs of the snake, as well as their tolerance of humans and some forms of development has been expanded in the text of the document in the “Essential summer habitat” and “Threats” sections.

- Comment: One reviewer had concerns with using 69 m (75% of snakes hibernate within 69 m of shoreline) as a limit for protected habitat. It is understood why it would be beneficial to capture the most hibernacula possible, focusing protection on the areas where hibernacula are most dense, and not spreading protection too far inland where the density of hibernacula is lower than in the first 69m, but this leaves 25% of total hibernation sites out of the realm of possible protection. This also does not allow for a

buffer zone outside of this 69m strip. Construction could push right up to this line and could impact a hibernacula located near the boundary of this area. The 75% figure should be higher, around 90%. This would be consistent with the Management Guidelines in Appendix D.

Response: Our rationale for selecting the 69 m distance/75% hibernacula boundary was as stated above, to focus our limited resources on protecting the area where hibernacula are most dense, and not moving farther inland where additional land protection would not encompass many more hibernacula. As stated above, location of protected habitat will depend heavily on the presence of willing landowners. If a significant hibernaculum was identified outside of the 69 m boundary, and the land was owned by a landowner that wanted to protect it, the Service would work with that landowner to achieve habitat protection. The boundary of 69 m is not absolute, but is used as a guide to focus habitat protection in the areas most often used by snakes.

- Comment: What percentage of the islands is comprised of lands within 69 m of the shoreline?

Response: The four largest islands total 22.75 km² in area. Land within 69 m of shore on these same islands totals 3.94 km², or 17% of total island area. The goal for habitat protection is 0.51 km², which is about 13% of the total habitat within 69 m of shore on the four largest islands, and is approximately 2.2% of the total area of these islands.

- Comment: One reviewer suggested that West Sister Island be managed now to increase the chance of recolonization. It seems that this island should constitute recovery habitat, which should not be hard since the island is already in public ownership.

Response: West Sister Island is Ohio's only Federally designated wilderness area. The island is heavily forested and inhabited by colonial nesting waterbirds. The island is managed with a more-or-less "hands-off" approach. Due to the wilderness designation, no motorized or mechanized equipment is permitted on the island (including cars, aircraft, chainsaws, or other battery-powered tools), therefore active management on the island is kept to a minimum. The only management currently undertaken is hand-clearing of several small plots (less than 1 ac) to benefit colonial nesting waterbird rookeries. The 2003 estimate for colonial nesting waterbird populations on the island is 4,774 nesting pairs of birds. This represents a significant predation threat for snakes, especially small, immature snakes. This island has not been inhabited by humans for a number of years, and the snakes may have disappeared from this island due to natural factors, such as predation, weather events, and because the island is so far from other Lake Erie Watersnake population sources (approximately 27.3 km (17 mi) from the next closest island and about the same distance from the mainland). Nonetheless, Recovery task 2.3.3 has been revised to state that the Service will consider snake habitat needs when planning management actions on West Sister Island.

- Comment: One reviewer asked for clarification of the cost of easements—namely why such a large sum of money is required for voluntary easements.

Response: Although the easements are voluntary, the cost of the survey, appraisal, legal recording, title search, site visits, staff time spent coordinating with the landowner and writing up the necessary documentation, and other direct and indirect costs figure into the total cost of the easement. Furthermore, the estimate provides for funding as many easements as possible with little to no cost to the landowner, due to the likelihood of working with multiple landowners and parcels of land.

Other Major Substantive Comments and Service Responses

1. Comment: Two local newspapers published articles about the Draft Plan with titles which referred to the estimated cost of recovery (\$956,000). Nineteen commenters, most in response to the newspaper articles, objected to the expenditure of close to \$1 million for recovery of the Lake Erie Watersnake. Several of the commenters suggested that the money could be better spent on schools, erosion control on Lake Erie, or balancing the [Ohio] state budget. One commenter requested further explanation and clarification of the purpose of the money.

Response: The ESA requires that for almost all species listed as threatened or endangered, a recovery plan be developed and implemented, such that the species can recover to a point where it ultimately does not need the protection of the ESA. The recovery plan is required to identify an estimated cost for the complete recovery of the species (including all recovery actions, not just increasing the number of snakes); however, this estimate does not necessarily result in funding at this level. Federal and State agencies will use general funds appropriated for recovery of listed species on a yearly basis to fund recovery tasks. Other interested parties, such as universities, non-profit organizations, or grant organizations, may also fund specific recovery tasks such as research and monitoring. Furthermore, the estimated cost of recovery has been modified in the final plan to reflect changes in the estimated costs of several of the recovery tasks.

2. Comment: Ten commenters stated that there are enough or too many snakes already.

Response: The snake population has increased in the last several years, probably due to a number of factors, both natural and human-induced. Recent censuses of the snake population indicate that the population is very close to the delisting population goal of 5,555 snakes. The delisting population goal was established by examining the total habitat available for the snake, and by using mathematical equations to determine how many snakes are necessary to ensure that the population will persist into the future. We expect that the population will not continue to grow as it has in recent years, but will begin to level out naturally. Additionally, the Service agrees that in some areas snakes are very concentrated, while other areas are very sparsely populated, which may lead to

the perception that the snakes are overabundant. The Service is happy to talk with landowners about snakes on their property and can make recommendations on dealing with snake-related concerns.

3. Comment: Six comments focused on the snakes being a nuisance to people using Lake Erie for recreation, including concerns that snakes may bite people. Two comments suggested that the number and the disposition of these snakes hurts Lake Erie tourism.

Response: Like any wild animal, snakes can be considered nuisances when human-snake encounters happen. Because the snakes are visible basking on the shoreline, docks or boats, and swimming in the water where many people go for recreation, this comment is commonly received by the Service. A goal of the Service is to help people understand that snakes and human beings can safely co-exist and share the shoreline and the lake. Although the snakes are often visible, they typically flee as humans approach, and are no more dangerous to swim with than fish. While many people are afraid of snakes, we must realize that these specific snakes are harmless and generally seek to avoid humans as much as we want to avoid them. Like any wild animal, in general, if humans do not try to handle a snake, it will not try to bite. The Service is happy to talk with landowners about snakes on their property and can make recommendations on dealing with snake-related concerns.

4. Comment: One commenter noted that the snakes seem to prefer marinas as habitat over state and federally managed wetland areas on the islands.

Response: Some marinas and other human-made habitat such as docks, breakwaters, and erosion control structures provide excellent summer habitat for Lake Erie Watersnakes. These areas typically provide basking habitat in close proximity to the Lake, and the Lake in turn provides foraging habitat and escape from predators. Specific wetlands may or may not provide suitable habitat for snakes; suitable habitat is dependent on many factors, including availability of prey, presence of predators, such as the great blue heron, and presence of suitable basking and escape cover. Research suggests that wetlands may be more important habitat during the early spring, when the snakes are just emerging from hibernation and Lake Erie's waters are very cold. This information has been added under the "Habitat Requirements" section.

5. Comment: One commenter stated that private citizens should be responsible for protection of the snake, and that government agencies should not be involved.

Response: The Lake Erie Watersnake was added to the federal list of *Endangered and Threatened Wildlife* as a threatened species in August 1999 because of significant population declines due to habitat loss and human persecution. Since the time of listing, the snake has been protected by the ESA which prohibits take (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct) of snakes. This protection will be extended to the snake until the Service

determines that the snake population has recovered, or reached a point where the protection of the Act is no longer necessary to ensure long-term survival of the population.

6. Comment: One comment stated that the shoreline rules and regulations in place for the snake are too restrictive.

Response: There are currently no specific rules or regulations in place for island shorelines that are the result of the Lake Erie Watersnake. The Service has prepared Management Guidelines for Construction, Development, and Land Management Activities (Appendix D), which recommend seasonal and temperature-specific windows within which to complete certain activities while avoiding adverse effects on snakes. These guidelines are recommendations and do not have any legal standing. Under the ESA, if a landowner wished to develop property that the snake inhabited, they would be responsible for consulting with the Service to ensure that the project would not adversely affect the snake. The Service tries to be flexible and will consider many different options during the consultation process to ensure that the landowner's and snake's needs are both met. Consultation is a legal requirement that applies to all listed species throughout their range.

7. Comment: More research needs to be done to better understand the effects of contaminants on snakes.

Response: The Service agrees that there is not enough information to understand the relationship between the Lake Erie Watersnake and contaminants such as PCBs. The Service recommends that this relationship be further studied to determine what, if any, impacts contaminants are having on the Lake Erie Watersnake.

8. Comment: One commenter suggested that the Service, in conjunction with the Ohio Department of Natural Resources (ODNR), develop an umbrella Safe Harbor Agreement (SHA) that would be applicable to any interested individual on any of the islands. The commenter suggested that this would complement other initiatives on the islands by providing a tool for landowners interested in conservation but not interested in other available programs. ODNR also commented that the Service should include SHAs as a viable means of conserving the snake on lands where the property owner isn't interested in developing an HCP or conservation easement. Furthermore, they suggested that the Service provide a modest financial incentive for property owners establishing a SHA.

Response: A SHA is a voluntary arrangement between the Service and a landowner to promote voluntary habitat management for listed species on non-Federal land, while giving assurances to the landowner that no additional future regulatory restrictions will be imposed as a result of habitat management. Any non-federal landowner may request the development of an SHA if they want to help conserve a listed species on their property. The listed species must receive a "net conservation benefit" from the SHA management

actions in order to be approved by the Service. To date, the Service has not completed any SHAs for the Lake Erie Watersnake. If a landowner was interested in completing an SHA, the Service would work with the landowner to determine the feasibility of the SHA, and to develop it. SHAs are voluntary agreements with which there are typically no financial incentives; the incentive is regulatory relief. The Service will contact ODNR to investigate interest in the possibility of an umbrella SHA.

9. Comment: One commenter suggested that it is a natural process that the snake population has decreased.

Response: In general, animal populations do fluctuate from year to year due to natural events such as disease, predation, food and shelter availability, and weather events. At the time of listing the Lake Erie Watersnake, it was determined that the population was experiencing population declines mainly due to habitat loss and human persecution. These population declines were over and above the characteristic yearly fluctuations, and significant enough that the species could become endangered in the foreseeable future. As a result, the snake was listed as a federally threatened species.

10. Comment: ODNR requested several modifications to the plan, including the following: incorporation of information regarding the Coastal Zone Management Act of 1972 under the “Federal Regulatory Protection” section; a change in the time frame for developing management plans for ODNR properties from one year to two years in the “Implementation Schedule”; further clarification of the “protected habitat” definition in Appendix A; inclusion of a revised version of Appendix B; further explanation of the easement program for protected habitat; and recommendations for continued and increased education and outreach programs by the Service.

Response: The Service has incorporated the suggested changes and additional information provided by ODNR into the plan.

11. Comment: ODNR stated that Criterion 3 seems very subjective, and that an objective measure should be developed to measure change in public attitude and reduction in human induced mortality. ODNR is willing to work with the Service to help develop the criteria.

Response: The Service intends to use a survey or other objective method to measure changes in public attitude and human-induced mortality. The Service will work with ODNR and other groups or consultants, as appropriate, to develop this measure.

12. Comment: One commenter urged the Service to recommend designating critical habitat for the Lake Erie Watersnake as a task in the Recovery Plan, or to ensure that the Service “has satisfied the requirements for invoking a “not prudent” determination and substantiated [our] decision to leave the designation of critical habitat out of the Recovery Plan’s recommended actions.” They stated, “Critical habitat designation for

the Lake Erie Watersnake would provide important protections for its habitat not otherwise provided by law. Without critical habitat, the Lake Erie Watersnake has a much lower chance of persisting and recovering.”

Response: At the time of listing, the Service determined that designation of critical habitat for the snake was not prudent for the following reasons: (1) the species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species; and (2) such designation of critical habitat would not be beneficial to the species (50 CFR Part 17). The Service stands by its initial determination of “not prudent” for critical habitat designation, however further clarification and discussion has been provided in the Plan, under the “Critical Habitat” section.