

Lake Erie Watersnake
(Nerodia sipedon insularum)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service, Midwest Region
Ohio Ecological Services Field Office
Columbus, OH

5-YEAR REVIEW

Species reviewed: Lake Erie Watersnake (*Nerodia sipedon insularum*)

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5-YEAR REVIEW
Lake Erie Watersnake (*Nerodia sipedon insularum*)

1.0 GENERAL INFORMATION

1.1 Reviewers

Lead Regional Office:

Carlita Payne, Midwest Region, Fort Snelling, MN (612) 713-5339

Lead Field Office:

Megan Seymour, Ohio Ecological Services Field Office (614) 416-8993, ext.16

Cooperating Field Office(s): none

Cooperating Regional Office(s): none

1.2 Methodology used to complete the review:

This 5-year review was completed by Megan Seymour, Wildlife Biologist with the Ohio Ecological Services Field Office, and recovery coordinator for the Lake Erie Watersnake (*Nerodia sipedon insularum*). The Service requested new scientific or commercial data and information that may have a bearing on the species' classification of threatened status through a April 22, 2008, *Federal Register* notice (73 FR 21643) initiating the 5-year review. The primary data used to conduct this 5-year review include various annual reports from Dr. Richard King, Northern Illinois University (NIU), a recognized Lake Erie Watersnake expert, Principal Investigator for the annual Lake Erie Watersnake census, and generator of annual population estimates. Additional information was obtained from Kristin Stanford, a Ph.D. candidate under Dr. King. Ms. Stanford conducts research on various aspects of Lake Erie Watersnake biology and behavior, and conducts significant public outreach efforts among island residents and visitors on the U.S. western Lake Erie islands. Information on public opinion was derived primarily from formal surveys conducted by Wayne Wilkinson, NIU (Wilkinson 2008) and Andrea Olive (Olive 2008). Information on accidental human-induced mortality was obtained from research conducted by NIU and The Ohio State University. Contaminant research was conducted by Fernie *et al.* (2008). Research on the impacts of invasive species was primarily completed by faculty and students at NIU (Jones *et al.* 2009, King *et al.* 2008, King *et al.* 2006). The final listing rule (52 FR 21478) and the species recovery plan (USFWS 2003) were also relied upon to evaluate if and to what degree each of the recovery criteria identified in the Lake Erie Watersnake Recovery Plan (USFWS 2003) has been achieved, and follow-up actions that may be warranted, while assessing the

species status in this 5-year review. In the recovery plan (Service 2003a, p. G-19) we describe a revision to the common name from “Lake Erie water snake” to “Lake Erie Watersnake” per the peer-reviewed naming convention outlined in “Scientific and Standard English Names of Amphibians and Reptiles of North America North of Mexico, with Comments Regarding Confidence in Our Understanding” (most recent version Crother 2008). Subsequently, we refer to the subspecies as “Lake Erie Watersnake” in this and future documents.

In accordance with the 5-Year Review Guidance (USFWS and NMFS 2006), peer review will be conducted when the proposed rule to remove the species from the List of Endangered Species (50 CFR 17.11) is issued.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

73 FR 21643 (April 22, 2008)

1.3.2 Listing history

Original Listing

FR notice: 64 FR 47126

Date listed: August 30, 1999

Entity listed: Lake Erie Water Snakes (*Nerodia sipedon insularum*) on the Offshore Islands of Western Lake Erie

Classification: Threatened

1.3.3 Associated rulemakings: None

1.3.4 Review History: None.

1.3.5 Species’ Recovery Priority Number at start of 5-year review: 9C, indicating a moderate degree of threat, high recovery potential, and conflict with economic development for this subspecies.

1.3.6 Recovery Plan

Name of plan: Lake Erie Watersnake Recovery Plan (*Nerodia sipedon insularum*)

Date issued: September 25, 2003

Dates of previous revisions, if applicable: None

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? *Yes.*

2.1.2 Is the species under review listed as a DPS? *Yes.*

2.1.3 Was the DPS listed prior to 1996? *No.*

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards? *No.*

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy? *Yes.*

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy? *No.*

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? *Yes.*

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? *Yes.*

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? *Yes.*

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

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.

Dr. Richard King, Northern Illinois University (NIU) has lead intensive annual Lake Erie Watersnake censuses since 2001 and has data collected to generate annual population estimates as recommended in the Lake Erie Watersnake

Recovery Plan (USFWS 2003). King and Stanford (2009) report the results of these annual population estimates from the time period encompassing 2001 through 2008. These population estimates indicate that Criterion 1a has been fully achieved during the period of 2002-2008 (Table 1).

Table 1. Total estimated U.S. Adult Lake Erie Watersnake population size, 2001-2008. Estimates that exceed island-specific and overall population size goals specified in the Lake Erie Watersnake Recovery Plan (Service 2003) are shown in bold. Modified from King and Stanford 2009 Table 11.

Year	Kelleys	South Bass	Middle Bass	North Bass	Small Islands	All U.S. Islands
2001	2160	1510	1020	170	830	5690
2002	2240	1410	1300	610	830	6390
2003	2610	1500	1960	290	830	7190
2004	2650	1620	1470	450	1270	7460
2005	2410	1630	2230	660	930	7860
2006	2360	2900	3720	1440	1410	11830
2007	2290	2160	2060	1060	1010	8580
2008	2810	1890	1840	500	1560	8600
Recovery Goal	900	850	620	410	Not applicable	5555

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

Populations of Lake Erie Watersnakes have been confirmed on the following small U.S. islands from the period of 2002-2008: Rattlesnake, Sugar, Green, Ballast, and Gibraltar (King 2008, R. King, pers. com. 16 July 2008). As required above, populations of Lake Erie Watersnakes have persisted on the small islands during the same six year period as Criterion 1a, and though not specifically required in the Recovery Plan, population estimates for the small islands as a group are presented in Table 1 above.

As identified in Table 1 above, estimated population sizes for each of the four largest U.S. islands have also exceeded their population size criteria for the same consecutive six year period as Criterion 1a, with only one exception—North Bass Island in 2003 (King 2008). King (2008) describes the circumstances surrounding the 2003 North Bass Island population estimate:

North Bass Island was surveyed just once in 2003 and weather conditions were poor (partly cloudy and cool) during this survey. As a result, capture rates, especially at the NE,E,SE Shore site, were low. It is noteworthy that estimates for both 2002 (n = 610) and 2004 (n = 440) well exceed the estimate for 2003. Furthermore, given that watersnakes require 3 – 4 years to reach adulthood, it is unlikely that these year-to-year differences in estimated population size (from 610 to 270 to 440) reflect true variation in population numbers. Instead, the low estimate for 2003 appears to reflect inadequate sampling in that year.

Based on the information above, it is reasonable to conclude that North Bass Island has indeed met the population size criterion for seven consecutive years, as have the other three largest U.S. islands. Therefore, Criterion 1b has been fully achieved.

To address the long-term persistence of the recovered population of Lake Erie Watersnakes, The Service and many partners have worked collaboratively to protect enough habitat across the U.S. range of the subspecies to support approximately 50% of the Lake Erie Watersnake recovery population in perpetuity. This is described fully under criterion 2 below.

By achieving (and substantially exceeding) Criterion 1, vulnerability of Lake Erie Watersnake to extinction from small population size is abated. As detailed in the Lake Erie Watersnake Recovery Plan (USFWS 2003), achieving the population goal of 5,555 adult watersnakes for six or more consecutive years “would constitute a viable persistent population.” Additionally, the persistence of multiple island subpopulations will help to insulate the overall population against declines due to stochastic events such as catastrophic weather events. Therefore, threats to Lake Erie Watersnake due to small population size have been addressed (Factor D. The inadequacy of existing regulatory mechanisms and Factor E. Other natural or manmade factors affecting its continued existence, see also Criterion 3 below).

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 Ohio Department of Natural Resources (ODNR) and Lake Erie Islands Chapter of the Black Swamp Conservancy (LEIC-BSC)) 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.**

By working collaboratively with partners, primarily ODNR, LEIC-BSC, Western Reserve Land Conservancy (WRLC), Cleveland Museum of Natural History (CMNH) and the Put-in-Bay Township Park District, we have ensured the permanent protection of 11.27 miles of shoreline habitat and 313.88 acres of inland habitat within 69 m of shore (Table 2). This is more than double the goal laid out in the Recovery Plan. Each of these properties is protected by a conservation easement, long-term management plan, or Environmental Covenant. Copies of these documents are on file in the Ohio Ecological Services Field Office, and are available upon request. Criterion 2a has been fully achieved.

Table 2: Lake Erie Watersnake protected habitat

Island	Property	Land within 69 m of shore		Length of shoreline		Ownership
		(ac)	(km ²)	(mi)	(km)	
Kelleys	Kelleys Island State Park; North Pond State Nature Preserve; Kelleys Island Alvar	36.90	0.149	1.09	1.74	ODNR
	Long Point Preserve	21.40	0.087	0.36	0.57	CMNH
	Schollenberger Easement	0.14	0.001	0.02	0.03	LEIC-BSC
<i>subtotal</i>		58.44	0.237	1.47	2.34	

South Bass	South Bass Island State Park; Oak Point State Park	12.90	0.052	0.50	0.80	ODNR
	Scheef East Point Nature Preserve	6.4	0.026	0.32	0.52	WRLC
<i>subtotal</i>		19.30	0.078	0.82	1.32	
Middle Bass	Middle Bass Island State Park; Kuehnle Wildlife Area	48.70	0.197	1.71	2.74	ODNR
	Petersen Woods	1.55	0.006	0.02	0.03	LEIC-BSC
	Lawrence Evans	0.75	0.003			LEIC-BSC
<i>subtotal</i>		51.00	0.206	1.73	2.77	
North Bass	North Bass Island State Park; Fox's Marsh Wildlife Area	168.80	0.683	6.19	9.90	ODNR
	<i>subtotal</i>		168.8	0.683	6.19	9.90
Green	Green Island Wildlife Area	16.34	0.066	1.06	1.70	ODNR
TOTAL		313.88	1.270	11.27	18.03	

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**

By working collaboratively with partners, primarily ODNR, LEIC-BSC, WRLC, CMNH, and the Put-in-Bay Township Park District, protected habitat for the watersnake is in place and the total distribution meets or exceeds the recovery criteria for each of the four major islands (Table 2). Criterion 2b has been fully achieved.

By achieving Criterion 2, threats to Lake Erie Watersnake from habitat loss, alteration, and degradation are sufficiently addressed, such that availability of high quality habitat now and into the future is no longer a limiting factor for the watersnake. The Federal Register listing described various status designations of

the Lake Erie Watersnake in both the U.S. and Canada, but concluded that “regulatory mechanisms are inadequate because of the small number of water snakes in preserves and the vulnerability from lack of regulatory protection outside of preserves” (64 FR 47126, August 30, 1999). Because sufficient habitat has been permanently protected to support nearly 50% of the population goal of 5,555 adult Lake Erie Watersnakes (more than twice that required in the Recovery Plan) the USFWS does not believe that removal of regulatory protection for the remainder of occupied habitat via a delisting proposal would substantially increase the vulnerability of the watersnake to extinction. Therefore, threats to Lake Erie Watersnake due to habitat loss have been addressed (Factor A. The present or threatened destruction, modification, or curtailment of its habitat or range and Factor D. The inadequacy of existing regulatory mechanisms).

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.

The most significant and well-documented factor in the decline of Lake Erie Watersnake is persecution by humans (64 FR 47126-47134; August 30, 1999). Therefore the recovery strategy for the watersnake focused heavily on public outreach and education, in an attempt to change the perception and behavior of island residents and visitors toward the watersnake. Information on public opinion was derived primarily from formal surveys conducted by Wayne Wilkinson, NIU (Wilkinson 2008) and Andrea Olive (Olive 2008).

The 2008 Public Opinion Survey (Wilkinson 2008) of 754 randomly selected island residents within the range of Lake Erie Watersnake resulted in 355 responses from residents of 5 U.S. islands, 1 response from a Canadian island resident, and 2 responses from non-island residents. Nineteen questions were asked to gauge the general knowledge, perceptions, and threat of human persecution among island residents. Respondents were also given the opportunity to provide written comments. Several of the survey questions were identical to survey questions asked of island residents in a 1999 public opinion survey, and answers were compared to determine changes over time.

Responses from the 2008 survey (Wilkinson 2008) indicated that 99% of respondents were aware that Lake Erie Watersnake occurs on the island, and that 94% of respondents were aware that it is a protected animal. Knowledge of Lake Erie Watersnake also increased in 83.5% of respondents since listing in 1999. Respondents cite a large variety of methods by which they have become more familiar with the snake, including the USFWS and ODNR’s biannual newsletter, the Island Snake Lady (funded by ODNR and USFWS), and various media sources. Generally, these data indicate that the USFWS outreach and education

campaign is reaching the vast majority of island residents, and helping to increase their access to information about the watersnake.

Additionally, Wilkinson (2008) reports that 66% of respondents indicated that their attitude toward the watersnake is generally positive or neutral, while 34% indicate that their attitude is generally negative. While it is apparent that not all residents feel positively toward the snake, it is very notable that only 4.3% of respondents indicated they had knowingly killed a watersnake since the time of listing, and only 14.4% of respondents said they would knowingly kill a watersnake if it was no longer protected by State or Federal laws (Wilkinson 2008). The USFWS interprets these responses to indicate that, while the watersnake will still face some human persecution, the vast majority of islanders would not resort to lethal means if they encountered watersnakes on their property.

Similarly, Andrea Olive, a Ph.D. candidate at Purdue University, randomly selected and interviewed 43 individual property owners from Middle Bass Island in 2007 regarding the Endangered Species Act and Lake Erie Watersnake. Of those interviewed, 8% admitted to already killing a snake and 18% admitted they might kill a snake while it is listed (Olive 2008).

Olive (2008) found that, in general, landowners believe that the Endangered Species Act is “legitimate” and that landowners are willing to comply with it. However she also specifically notes with respect to Lake Erie Watersnake, landowners perceptions are beginning to change because of the large number of snakes that they regularly encounter.

Indeed, Wilkinson’s 2008 public opinion survey reflected a similar view, in that 31% of respondents stated their attitude toward Lake Erie Watersnake has become more negative since listing, 30% indicated their attitude has become more positive, and 39% indicated their attitude towards Lake Erie Watersnake has not changed. While this survey did not attribute reasons to the change in attitude, 69 out of 168 (41%) of the optional comments on Wilkinson’s (2008) survey response form indicated the belief that there are now too many snakes, that the snakes are becoming nuisances due to their numbers and their habits of clustering along the shoreline, or that the snakes should no longer be protected.

Further supporting the concept that watersnake numbers have significantly rebounded and are becoming a nuisance to island residents, four of the five public comments received during the 5-year review public comment period were from island residents. The comments indicated that watersnakes were very abundant and did not need to be protected anymore.

It is apparent that public opinion of the Lake Erie Watersnake varies widely between those who are supportive of it, those that do not care about it one way or another, and those that dislike and sometime fear the snake. Opinion surveys

(Olive 2008, Wilkinson 2008) seem to indicate that most people do not now and will not in the future kill Lake Erie Watersnakes, however many people indicate that the sheer number of snakes along the shoreline has become a nuisance, and this may contribute to more negative feelings towards the snake. Continued outreach regarding the Lake Erie Watersnake's role in the island ecosystem is important, and outreach will continue through various partners' post-delisting actions. Based on the above information, Criterion 3a has been fully achieved.

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.

Several sources of accidental human-induced mortality have been examined to determine to what degree they may be contributing to overall mortality of Lake Erie Watersnakes.

A survey of registered boaters in the Lake Erie island region was completed by Kristin Stanford when she was a Masters Student at NIU in 2004 (Stanford 2004). The survey sought to determine the number of members of the Lake Erie Island boating/fishing community who had ever had a direct encounter with a watersnake on a boat or on a fishing hook, and to characterize the responses from these encounters. The results of this survey are presented below, and all data is taken from Stanford (2004):

Of 1,437 surveys mailed out, 468 were completed and returned. An additional 21 surveys were completed voluntarily by individuals who attended various outreach events that occurred in the vicinity of the islands, for a total of 489 survey responses. Of the responders, 118 (24%) reported encountering a watersnake (participants were not asked to differentiate between Lake Erie Watersnakes or other species) on their boat one or more times throughout their boating experience in Lake Erie, and of these encounters, 86.9% occurred while the boat was docked. Of the 118 encounters, not one resulted in a boater or angler killing a snake. As only approximately 24% of Lake Erie island region boaters have ever encountered a watersnake on their boat at any time in their boating experiences, it is apparent that watersnake encounters are relatively infrequent among the boating community in general. Further, these data confirm that encounters between boaters and watersnakes typically do not result in mortality. Only 13 of the 489 respondents (2.6%) indicated that they have ever caught a watersnake (participants were not asked to differentiate between Lake Erie Watersnakes or other species) by hook-and-line while fishing from boat or shore, though no information was provided regarding snake mortality during these incidents. As captures of watersnakes via hook-and-line fishing incidents are exceedingly rare (13 reported incidences among 468 respondents throughout their boating experiences in the region), even if every capture had resulted in mortality, this level of mortality is not significant enough to cause population-level impacts.

Therefore, we conclude that accidental human-induced mortality from boating or fishing encounters is not a significant threat to the population.

To address the effect roadkill mortality may have on Lake Erie Watersnake populations, a survey of roadkill mortality was conducted on the four large U.S. islands between 26 June and 15 July 2005 by an Ohio State University undergraduate student, under the advisement of Kristin Stanford and Rich King, NIU (Reider 2005). A total of 71 roadkilled snakes were found, of which 45 were Lake Erie Watersnakes (Reider 2005). Ninety-nine percent of all snake mortality was distributed fairly equally across the three most populated islands: Kelleys, Middle Bass, and South Bass (Reider 2005). Only one dead snake (not a Lake Erie Watersnake) was found on North Bass Island, which has very few human inhabitants (Reider 2005). Dr. King's 2007 Annual Report (King 2007) states:

Of 71 dead snakes found, 45 were [Lake Erie] watersnakes. Among the [Lake Erie] watersnakes, 38 were neonates, 5 were juveniles, and 2 were adults. These results suggest that adult [Lake Erie] watersnake roadkill mortality is relatively low (Brown and Weatherhead 1999). Available data on watersnake mortality suggest that survivorship of neonates is low. Thus, roadkill mortality of this age-class likely has little impact on watersnake population trends.

While this study was limited by only one season of mortality surveys, and further mortality surveys would likely provide a more thorough understanding of levels of roadkill mortality, it does provide evidence that adult Lake Erie Watersnakes are not subject to high levels of roadkill mortality. Further, the adult Lake Erie Watersnake population continues to grow, despite presumably continuous rates of roadkill mortality since before the time of listing. Therefore, the Service concludes that accidental human-induced mortality due to roadkill events is not a significant threat to the Lake Erie Watersnake population.

The Lake Erie Watersnake Recovery Plan (USFWS 2003) recommends additional studies be conducted to document the impact that invasive species including the round goby (*Neogobius melanostomus*) may have on the watersnake. Dr. Richard King and a number of his students at NIU have studied various aspects of goby/watersnake interactions and documented significant interaction between the two. King *et al.* (2006) found that since the time when gobies first appeared in the Great Lakes in the early 1990's, Lake Erie Watersnake diets have shifted from a diet of native fishes and amphibians to a diet composed of >90% round gobies. This dietary shift corresponds to increased watersnake growth rates, increased body size, and increase in fecundity, with female watersnakes producing on average 25% more offspring post-invasion (King *et al.* 2008, King *et al.* 2006). King *et al.* (2008) suggest that, "resource availability may have contributed to population declines in Lake Erie Watersnakes during the mid- to late-1900s... While habitat loss and human-caused mortality are likely contributors to past watersnake population declines, the possibility exists that a reduction in

benthic fish biomass, resulting in reduced watersnake fecundity, was also a factor. Unfortunately, quantitative data on long-term temporal trends in benthic fish biomass are lacking.” If King *et al.* (2008) are correct and that limited foraging opportunities were a cause of the watersnake’s population declines, the overabundance of the round goby within the island region of western Lake Erie will likely provide a significant prey source into the foreseeable future, negating any threats from limited prey availability.

The Lake Erie Watersnake Recovery Plan (USFWS 2003) recommends additional studies be conducted to document the impact that contaminants may have on the watersnake. In particular, this research became a high priority when the watersnake’s diet switched from native fish and amphibians to almost exclusively round goby, which prey extensively on zebra mussels (*Dreissena polymorpha*) and quagga mussels (*Dreissena bugensis*). Potential biomagnification of contaminants through this change in the food web was thought to be a possible threat to the watersnake. Previous research had documented polychlorinated biphenyls (PCBs) in Lake Erie Watersnakes in fairly high levels (90 micrograms per gram ($\mu\text{g/g}$) [Rouse and Bishop 2002], 167 $\mu\text{g/g}$ [Bishop and Rouse 2000]), but did not document problems with embryonic survivorship. Recent research compared the levels of contaminants in Lake Erie Watersnakes pre- and post-goby invasion (Ferne *et al.* 2008). Ferne *et al.* (2008) found “a marginal increase in hexachlorobenzene levels, and a significant decline in dieldrin, oxychlorodane, and heptachlor epoxide,” and concluded that, “sum PCBs and p,p’-DDE remained stable in the watersnakes after the invasion of round goby... suggesting that although the dietary switch to round gobies meant consumption of a more contaminated diet, their diet remained at the same trophic position.” Ferne *et al.* (2008) did recommend additional studies to determine if these contaminants affect reproductive and physiological parameters in Lake Erie Watersnakes. However, as Bishop and Rouse (2006) did not correlate high levels of PCBs with embryonic mortality or number of embryos produced by female watersnakes, no additional research on contaminants is deemed necessary at this time.

Recent research confirms that contaminant levels due to the dietary switch from native fish and amphibians to round goby has not resulted in significant increases in contaminants in Lake Erie Watersnakes (Ferne *et al.* 2008). Additionally, while relatively high levels of PCBs were detected in watersnakes in the past, these levels did not correspond with embryonic survivorship. Lake Erie Watersnake population numbers continue to increase despite relatively stable exposure to contaminants over the past 18 years of study (King and Stanford 2009), and therefore, the Service concludes that contaminants do not pose a significant threat to survival of the Lake Erie Watersnake.

As described above, persecution by humans has been minimized and no longer poses a significant threat to the Lake Erie Watersnake. Additionally, based on several surveys of sources of accidental human-induced mortality, it does not

appear that accidental mortality due to boating, fishing, or roadkill events pose a substantial threat to the adult Lake Erie Watersnake populations. Published research on the impacts of invasive species and contaminants on the Lake Erie Watersnake do not indicate a significant threat to the subspecies. We assert that Criterion 3 has been achieved, and therefore threats to the Lake Erie Watersnake due to persecution by humans have been addressed (Factor E. Other natural or manmade factors affecting its continued existence).

At the time of listing, all of the five listing factors were addressed, and it was determined that Factor B. Overutilization for commercial, recreational, scientific, or educational purposes, and Factor C. Disease or predation, did not pose a significant threat to Lake Erie Watersnake populations. These factors are not threats to the Lake Erie Watersnake.

2.3 Updated Information and Current Species Status – This section not applicable since the recovery criteria have been met.

2.4 Synthesis

The Lake Erie Watersnake is a federally threatened, island-dwelling subspecies with a very narrow range, encompassing the offshore islands of the western Lake Erie basin in Ohio and Ontario.

Lake Erie Watersnake summer habitat is composed of rocky shorelines with limestone or dolomite shelves, ledges, or boulders for sunning and shelter. Shelter occurs in the form of loose rocks, piled rocks, or shelves and ledges with cracks, crevices, and nearby vegetation. Rip-rap erosion control, armor stone, and docks incorporating a stone crib structure often serve as summer habitat for the snake. Since the time of listing, substantial research on Lake Erie Watersnake habitat use and foraging behavior has been completed. Lake Erie Watersnakes typically forage for fish and amphibians in Lake Erie, and recent research indicates that more than ninety percent of their current diet is composed of the nonnative, invasive fish round goby (King *et al.* 2006). Jones *et al.* (2009) report that the mean foraging distance from shore was 85 m (279 ft), and the average water depth of the foraging locations was 3.32 m (10.9 ft). During the summer, 75 percent of Lake Erie Watersnakes are found within 13 m (42.7 ft) of the water's edge (King 2003). King (2003) identified that 75 percent of Lake Erie Watersnakes used 437 m (1433 ft) of shoreline or less as a home range. In the winter, Lake Erie Watersnakes hibernate below the frost level, in cracks or crevices in the bedrock, interstitial spaces of rocky substrates, tree roots, building foundations, and other similar natural and human-made structures. Seventy-five percent of Lake Erie Watersnakes hibernate within 69 m (226 ft) of the water's edge (King 2003). Individual snakes often demonstrate site fidelity, returning to the same shoreline area and the same or nearby hibernacula in successive years (King 2003).

The Lake Erie Watersnake Recovery Plan (USFWS 2003) remains current and addresses appropriately all the known threats to the subspecies. Since the time of listing, nine years of focused effort by State and Federal wildlife agencies, Universities, and non-government partners has resulted in significant population and habitat protection and improvements for Lake Erie Watersnake. Intensive annual census activities and mark-recapture population estimates indicate that Lake Erie Watersnake populations have grown steadily since the time of listing and have far exceeded the recovery criterion of 5,555 adult animals, with a 2008 population estimate of 8,600 adult Lake Erie Watersnakes (King and Stanford 2009). Further, King and Stanford (2009) documented realized population growth of approximately 6 percent per year for the years 2001-2008, with 95 percent confidence limits of 2-10 percent, providing strong evidence of population growth across multiple sites.

Additionally, land protection and management efforts by ODNR and other partners have resulted in the protection of 11.27 miles of shoreline habitat and 313.88 acres of suitable habitat within 69m of the shoreline across the U.S. Lake Erie islands being permanently protected and managed to benefit Lake Erie Watersnake, exceeding the recovery criterion (USFWS 2003). Finally, extensive outreach efforts are reaching the desired audiences, and most island residents are aware of the snake and its protected status (Wilkinson 2008). While public perception of and attitudes toward the snake are mixed, several public opinion surveys (Olive 2008, Wilkinson 2008) indicated that the vast majority of island residents would not resort to killing snakes they encountered on their property, even if the snake was no longer listed.

A few additional notable changes in the species status since listing and issuance of the recovery plan warrant discussion here.

Range Expansion

Since the time of listing, Lake Erie Watersnakes have naturally recolonized Green Island, a small island close to South Bass Island, and a viable population of adult watersnakes has persisted there for six years after an absence of 10 or more years (King and Stanford 2009; King 2002). This natural recolonization demonstrates the importance of maintaining multiple subpopulations of the Lake Erie Watersnake on as many islands as possible, to provide source populations for recolonization, should a stochastic event occur that eliminates all or a significant portion of the population on another island.

Lake Erie Watersnakes are known from West Sister Island based on specimens collected there in 1938 and 1939 but were not collected during repeated searches in the 1980s and 1990s (King *et al.* 2006a). While it is not known why Lake Erie Watersnakes disappeared from West Sister Island, it is the most isolated of the U.S. islands, located approximately 13.7 km (8.5 mi) from the mainland and approximately 20.9 km (13.0 mi) from the nearest island. Three intensive snake surveys since the time of listing have documented two adult female watersnakes on West Sister Island, one in 2002 and one in 2008, though it is unclear if these individuals were members of a permanent resident population, or transient individuals

that swam or drifted to the island (King and Stanford 2009). King and Stanford (2009) indicate that “Lake Erie Watersnakes remain exceedingly rare or absent from West Sister Island.”

Resilience of Lake Erie Watersnakes to Habitat Modification

The Lake Erie Watersnake has demonstrated resilience and behavioral plasticity to both ecological and human-induced changes in its environment in the recent past. As described above, the Lake Erie Watersnake has made a nearly complete dietary shift since the invasion of the round goby in the early 2000’s indicating flexibility in prey selection (King *et al.* 2006b). We have learned that crib docks and armored shorelines provide valuable Lake Erie Watersnake summer habitat and that the Lake Erie Watersnake can persist in stable numbers in human-dominated island landscapes, so long as rocky or vegetated shorelines are present. Further, we have documented multiple situations where Lake Erie Watersnakes have been able to identify and successfully use new hibernation sites when historical hibernation sites are destroyed or unavailable, thus indicating that the Lake Erie Watersnake is more resilient to hibernation habitat modification than was previously known. The Lake Erie Watersnake has also demonstrated its ability to naturally re-colonize historic habitat after an absence of many years. Thus, despite any remaining threats, we believe the Lake Erie Watersnake has sufficient resiliency to persist within the foreseeable future.

Climate Change

Global climate change due to trapping of greenhouse gases, particularly carbon dioxide, within the atmosphere is widely predicted by scientists all over the world (IPCC 2007). Within the Great Lakes region and Ohio specifically, climate change is expected to bring increased temperatures, increased but altered distribution patterns of precipitation, and greater intensity of extreme weather events including drought, storms, floods, and heat waves (Karl *et al.* 2003; Kling *et al.* 2003). Winters will be of shorter duration and warmer temperatures and snow melt will occur earlier (Kling *et al.* 2003). These projected changes in seasonal temperature patterns may cause Lake Erie Watersnakes to hibernate for shorter periods of time, to seek cover more frequently during the active season to escape extreme weather events, and to forage more frequently than they do now to compensate for an extended active season. It is unlikely that these potential behavioral changes brought on by warmer temperatures would constitute a threat to the population.

Warmer temperatures and decreased ice cover across the Great Lakes region predicted by multiple models could result in warmer water temperatures and water levels between 0.3-0.6 m (1-2 ft) below current levels in Lake Erie (Karl *et al.* 2009; Kling *et al.* 2003). Decreases in Lake Erie water levels, which define the boundaries of the western Lake Erie islands, can lead to increases in the area of the island exposed, expansion or loss of coastal wetland habitat (depending on elevation and topography), changes in extent and/or composition of island shoreline habitat, and changes in erosion and accretion patterns. Over all, lower water levels will likely create additional linear footage of island shorelines within the western Lake Erie basin, potentially expanding Lake Erie Watersnake summer terrestrial habitat areas.

Portions of former foraging habitat may become dry, requiring watersnakes to seek out additional foraging territories. Water depth decreases of 0.3-0.6 m (1-2 ft) are unlikely to disturb large portions of Lake Erie Watersnake foraging habitat. As noted previously, Lake Erie Watersnakes' diets are composed primarily of round goby, which are plentiful in the warm waters of the western Lake Erie island region, and would likely remain plentiful despite potential effects from climate change. It is unlikely that lower water levels would significantly change Lake Erie Watersnake behavior, or represent a threat to the population.

Climate change projections for Lake Erie indicate that increases in water temperature during the summer may result in lower dissolved oxygen, and prolonged stratification of lake water, resulting in an increase in the potential for dead-zones to occur or expand across time and space (Karl *et al.* 2009; Kling *et al.* 2003). However, the western Lake Erie basin is generally shallow, with an average depth of 7.4 m (24 ft), and stratification is rare here, and brief when it does occur (USEPA and Environment Canada 2008), and therefore we do not anticipate a threat to the population from this projected change. However, low dissolved oxygen could also result in more easily mobilized mercury and other contaminants that exist in Lake Erie sediments, and introduction of increased contaminant loads into the food chain (Karl *et al.* 2009). As discussed above, contaminants have been detected in Lake Erie Watersnakes in relatively high levels, but have not been documented to cause adverse effects. It is possible that additional contaminant loads could result in physiological or reproductive impacts to Lake Erie Watersnakes, but at what level this contamination would have to be is unknown.

Warmer lake waters are anticipated to result in coldwater habitat being eliminated or shifting north in some areas, potentially changing the fish communities in these areas (Karl *et al.* 2009; Kling *et al.* 2003). However, the western basin of Lake Erie is composed of warmwater habitat already (USEPA and Environment Canada 2008) and is too shallow to support coldwater habitat, therefore we do not anticipate shifts in fish species composition within the western Lake Erie basin due to climate change, and therefore no threat to the Lake Erie Watersnake is anticipated.

At this time, we do not have sufficient information to document that climate change poses a significant threat to the continued existence of the Lake Erie Watersnake.

Canadian status

The range of the Lake Erie Watersnake includes all islands in the western Lake Erie basin, including islands in Ohio and Canada. Lake Erie Watersnakes are listed as an endangered species in Canada, and are afforded legal protection. While some limited amount of intra-island movement by Lake Erie Watersnakes has been documented, most Lake Erie Watersnakes demonstrate site fidelity, returning to the same or nearby summer shoreline areas and winter hibernation sites each year. King (1987) estimates that less than 3% of Lake Erie Watersnakes move among islands or among sites on a given island each year. Therefore, Lake Erie Watersnakes that occur on the U.S.

islands are unlikely to be threatened by activities, events, or individuals occurring on the Canadian islands.

Previously recognized threats of habitat destruction, little or no legal protection, and human persecution no longer affect the existence of the watersnake. Current available information shows that the populations are persisting and a substantial amount of habitat is now secured and managed. Recovery of Lake Erie Watersnake has been achieved (USFWS 2003). Based on this 5-year review, Lake Erie Watersnake does not meet the definition of an endangered or threatened species, and therefore delisting the species due to recovery is recommended.

3.0 RESULTS

3.1 Recommended Classification:

Downlist to Threatened

Uplist to Endangered

Delist (*Indicate reasons for delisting per 50 CFR 424.11*):

Extinction

Recovery

Original data for classification in error

No change is needed

3.2 New Recovery Priority Number: 15.

Brief Rationale: Recovery criteria met; threats removed, abundant habitat secured, protected and managed; populations persisting.

3.3 Listing and Reclassification Priority Number

Delisting Priority Number: 2

Brief Rationale: The Delisting Priority Number is “2,” indicating that the management impact from delisting this subspecies is high, and that this is not a petitioned action. The Service currently spends a significant amount of staff time and resources consulting on Section 7 activities that may affect the Lake Erie Watersnake, and implementing ongoing recovery actions for the snake. As the Lake Erie Watersnake is currently meeting all the recovery criteria, we believe these resources could be directed to species more deserving of conservation efforts. Delisting is not a petitioned action, however it should be noted that in a recent settlement agreement regarding critical habitat for Lake Erie Watersnake, the Service agreed that if we did not propose delisting the Lake Erie Watersnake during fiscal year 2009, we would reevaluate the need to designate critical habitat for this subspecies. The process for designating critical habitat would create a large management burden for a subspecies that may not warrant such effort due to recovery.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

All of the Recovery Criteria in the Lake Erie Watersnake Recovery Plan (USFWS 2003) have been met, and the majority of the recovery actions in the Plan have also been completed. At this time, Lake Erie Watersnake shows substantial recovery, and we recommend initiation of the delisting process during Fiscal Year 2009, which will include development of a proposed rule and post-delisting monitoring plan.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW

Lake Erie Watersnake (*Nerodia sipedon insularum*)

Current Classification: Threatened

Recommendation resulting from the 5-Year Review

- Downlist to Threatened
 Uplist to Endangered
 Delist
 No change is needed

Appropriate Recovery Priority Number: 15

Appropriate Listing/Reclassification Priority Number: 2

Review Conducted By: Megan Seymour, Wildlife Biologist

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Ohio Ecological Services Field Office, Fish and Wildlife Service

Approve Angela T. Boyer Date 8/31/2009
Acting for Mary M. Knapp, Ph.D., Supervisor

REGIONAL OFFICE APPROVAL:

Lead Assistant Regional Director, Ecological Services, Midwest Region, Fish and Wildlife Service

Approve Lynn M Lewis Date 8/31/09