Dwarf Lake Iris
(Iris lacustris)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
East Lansing Field Office
East Lansing, Michigan

5-YEAR REVIEW

Species reviewed: Dwarf lake iris
(Iris lacustris)

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5-YEAR REVIEW
Dwarf lake iris *(Iris lacustris)*

1.0 GENERAL INFORMATION

1.1 Reviewers

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1.2 Methodology used to complete the review

The U.S. Fish and Wildlife Service (Service) conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12) as required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 *et seq.*). The Service provided notice of this status review via the *Federal Register* (72 FR 56787) and requested new scientific or commercial data and information that may have a bearing on the classification of the dwarf lake iris (*Iris lacustris*) as a threatened species. The Service's 2006 Interim 5-Year Review Guidance does not require peer review if a 5-year review results in a recommendation to leave the status unchanged because there was no new information, or all new information has undergone prior peer review. For this reason, we have not conducted a peer review.

Biologists at the Service's East Lansing Field Office, in coordination with the cooperating field office and the Midwest Regional Office, conducted this review. We reviewed past and recent literature, public comments, the final listing rule (53 FR 37972), and species information and data that has become available since the 1988 listing.

1.3 Background

1.3.1 FR Notice citation announcing initiation of this review

72 FR 56787 (October 4, 2007)

1.3.2 Listing history

Original Listing

FR notice:	53 FR 37972
Date listed:	September 28, 1988
Entity listed:	Species
Classification:	Threatened

1.3.3 Associated rule makings

None

1.3.4 Review History

Dwarf lake iris was included in a cursory 5-year review of all species listed before January 1, 1991 (56 FR 56882). The 5-year review resulted in no change to dwarf lake iris' listing classification of threatened.

1.3.5 Species' Recovery Priority Number at start of review

8C, indicating a species with a moderate degree of threat, a high potential for recovery, and in conflict with construction or other development projects.

1.3.6 Recovery Plan or Outline

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?

No

2.2 Recovery Criteria

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

No

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history

Sunlight is one of the most critical factors in the growth and reproduction of dwarf lake iris (Van Kley and Wujek 1993). Dwarf lake iris experienced reduced shoot densities as well as fewer fruits and flowers at both the lowest and highest light levels, indicative of a nearly closed

canopy and completely open canopy respectively (Van Kley and Wujek 1993). Morgan and Wolf (2008) found floral ramet densities of 2.5 and 5.4 per plot in more shaded areas as opposed to 21.9 per plot in more open areas. Overall increases in the number of vegetative ramets are typically associated with abundant light conditions, while decreases are often the result of reduced light availability (Morgan and Wolf 2008).

Despite years of observations by several researchers, the pollen vector(s) remains to be identified. Larson (1998) reported halictid bees (*Augochlorella striata*) visiting dwarf lake iris flowers at Dorcas Bay, Bruce Peninsula, Ontario in late May 1996. Observations of floral visitation and grooming behaviors suggest halictid bees are potential pollinators.

Most observations of dwarf lake iris indicate flower production, fruit set, and seed production to be very low (Makholm 1986; Planisek 1983; Van Kley and Wujek 1993; Morgan and Wolf 2008). Morgan and Wolf (2008) also observed that a major contributor to immature fruit loss was infection by a *Botrytis* fungus. Overall, the low fruit set indicates limited pollination, corroborating the need for considerably more research addressing the pollination biology of dwarf lake iris (Morgan and Wolf 2008).

Dwarf lake iris seed capsules, on average, contain 20-22 small seeds (Planisek 1983). Each seed possesses a conspicuous elaiosome (food body) that may attract ants, and Planisek (1983) concluded that seeds were dispersed by ants. However, Morgan and Wolf (2008) never observed ants transporting seeds during 17 years of observation in Brown County, Wisconsin.

Field observations indicate that seeds must overwinter at least one year before germinating (Makholm 1986), but can remain viable for at least 15 years within a soil bank (Morgan and Wolf 2008). Laboratory studies produced a maximum of 88% germination after five cycles of 16-week periods of cold stratification (5° C) with an intervening eight-week period of warm temperatures (20° C day and 10° C night thermoperiod) (Morgan and Wolf 2008). Although this rate of germination appears to be relatively high, field trials in which fresh seeds were sown in greenhouse flats and placed outside for a period of nearly five years were not able to replicate this germination rate and resulted in only 6% of the seeds germinating (Morgan and Wolf 2008).

During 17 years of observation in Brown County, Wisconsin, Morgan and Wolf (2008) observed only one mass germination event. Over a two-year period, hundreds of seedlings appeared in two separate patches that had not been occupied by dwarf lake iris for at least four years. This supports

the previous suggestion that dwarf lake iris seeds can stay viable for long periods of time, remaining dormant until favorable conditions occur for germination. Within six years of the seedlings' initial appearance, however, one of the patches had vanished completely, and the other patch had experienced a 60% decline in the number of vegetative ramets. This may have been associated with the relatively closed overstory canopy, resulting in reduced light, a habitat characteristic that may have caused the extirpation of the previous parent colonies (Morgan and Wolf 2008).

Dwarf lake iris allocates a far lower percentage of resources to sexual than to vegetative reproduction. Dwarf lake iris produces a very low average annual floral to vegetative ramet ratio (Planisek, 1983; Makholm 1986; Van Kley and Wujek 1993), and tubers producing a single vegetative ramet are most common (Makholm 1986). This indicates that the overall expansion of colonies is relatively slow, with the notable exception being the single mass germination event observed by Morgan and Wolf (2008). Although the mass germination was an occurrence that took place only once in 17 years of observations, it suggests that given ideal conditions, dwarf lake iris can rapidly colonize an area devoid of ramets (Morgan and Wolf 2008).

2.3.1.2 Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends

The global population of dwarf lake iris is collectively restricted to Michigan, Wisconsin, and Ontario. Because the extent of biological "populations" is extremely difficult to determine, geographically distinct "occurrences," consisting of more or less contiguous colonies, are used to estimate the overall abundance (Michael Penskar, Michigan Natural Features Inventory, pers. comm. 1998). Since the species was listed as threatened in 1988, several additional occurrences have been located during field surveys in Michigan and Wisconsin, while numerous occurrences have been extirpated in Ontario. The 1988 listing rule indicated about 60 known occurrences in Michigan and 15 in Wisconsin.

Updated surveys conducted by the Michigan Natural Features Inventory (MNFI) show a total of 84 extant occurrences throughout ten counties (Alpena, Charlevoix, Cheboygan, Chippewa, Delta, Emmet, Mackinac, Menominee, Presque Isle, and Schoolcraft) in Michigan (MNFI 2007). Similarly, the Wisconsin Department of Natural Resources (WDNR) currently reports a total of 41 known extant occurrences in Wisconsin located within Door and Brown counties (Craig Anderson, WDNR, in litt. 2005). The Ontario Natural Heritage Information Center previously identified a total of 43 sites where dwarf lake iris had been reported. Field

visits made in 2003 to 32 accessible sites found only 16 of these occurrences to be extant; however, several of the occurrences not visited during these surveys are thought to persist (COSEWIC 2004). Two potentially new sites were also located. Presently, the total number of known extant occurrences of dwarf lake iris is 143, with colonies ranging from less than one acre to greater than 500 acres in size.

Due to a lack of consistent systematic surveys of dwarf lake iris in the past, trends are difficult to determine. COSEWIC (2004) defined the overall population in Ontario as unknown but probably stable. In Michigan and Wisconsin, where dwarf lake iris is abundant, populations can persist for long periods of time (Makholm 1986). Since its listing, the total number of dwarf lake iris occurrences has increased slightly. Overall, the total population of dwarf lake iris appears relatively stable; however systematic monitoring is required to confirm this.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.)

Orick (1992) completed a genetic comparison among nine Michigan populations of dwarf lake iris, studying variations both among and within populations. In addition, inland populations, assumed to represent founder or relict populations on earlier post-glacial beach ridges, were compared with shoreline populations located on more recent beach ridges on or near the present shorelines.

Orick (1992) found the level of genetic variation in these nine populations of dwarf lake iris lower than that of widely distributed plant taxa with sexual mating systems. This is consistent with other findings that narrowly distributed species have less diverse genomes than widely distributed taxa (Ledig and Conkle 1983; Prentice 1984).

Hamrick *et al*. (1979) reported a mean heterozygosity of 14.1% in wide-ranging species compared to 8.6% for rare and endemic plant taxa. Loveless and Hamrick (1988) estimate the total mean heterozygosity for Pitcher's thistle (*Cirsium pitcheri*), also a Great Lakes endemic, at only 2.4%. In contrast, Orick (1992) estimated the mean heterozygosity of dwarf lake iris at just 1.7%.

On average, inland dwarf lake iris sites displayed higher polymorphism indices, a greater proportion of polymorphic loci, and slightly more alleles per locus than shoreline sites (Orick 1992). Based on these data, Orick hypothesized that inland populations represent relicts containing more diverse genomes.

Orick (1992) also found that about 70% of the diversity occurred within dwarf lake iris populations and attributed this to the limited gene flow due to low levels of sexual reproduction, limited seed dispersal capabilities, and the clonal habit of dwarf lake iris. The dwarf lake iris individuals from Bois Blanc Island, Michigan (the only island population in the study) had the lowest diversity of any Orick studied and were monomorphic at all loci. This lack of diversity in the island population could be due to founder effects if individuals from the Lake Huron shoreline populations, which did not exhibit polymorphism at one loci, colonized the island. Isolation and genetic drift could also have exacerbated the genetic homogeneity of the island population (Orick 1992).

Simonich (1992) and Simonich and Morgan (1994) used enzyme electrophoresis to determine the extent of genetic variation within and among nine Wisconsin populations. Simonich and Morgan (1994) examined ten enzymes, coded by 22 genetic loci, and found that all nine dwarf lake iris populations were monomorphic at the 22 loci. No heterozygosity was detected, and all nine populations were therefore genetically identical with respect to isozymes. Simonich and Morgan (1994) indicate that the genetic uniformity in Wisconsin populations suggests a severe population bottleneck during the last glaciation 16,000 years ago. Since then, the species' almost exclusive reliance on vegetative reproduction has likely led to continued monomorphism.

2.3.1.4 Taxonomic classification or changes in nomenclature

There have been no changes in taxonomic classification or nomenclature.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g., corrections to the historical range, change in distribution of the species within its historic range, etc.)

Dwarf lake iris is endemic to the modern and ancient shorelines of northern Lakes Huron and Michigan, where it ranges from northeastern Wisconsin to the Bruce Peninsula of Ontario, following the northern calcareous arc of Silurian and Devonian bedrock. Historical records indicate that it once occurred as far south as Milwaukee, Wisconsin (Anderson, in litt. 2005) and possibly along the Detroit River (near Sandwich) in Ontario (COSEWIC 2004). Due to the rapid development of the Great Lakes shoreline, many of the historical occurrences have been destroyed, and the current distribution of dwarf lake iris is substantially more fragmented than it was historically (Penskar, pers. comm. 1998). Moreover, the scattered distribution of dwarf lake iris colonies is further exacerbated by the plants poor dispersal ability (Makholm 1986).

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem)

Dwarf lake iris typically occurs in shallow soil over moist calcareous sands, gravel and beach rubble, and limestone crevices (Voss 1972; Crispin 1981) and is most often associated with coniferous forest dominated by northern white-cedar (*Thuja occidentalis*) and balsam fir (*Abies balsamea*) (Van Kley 1989). Except for six anomalous inland locations, most dwarf lake iris occurrences lie along or very near the northern shores of lakes Huron and Michigan. In some areas, such as Thompson's Harbor in Michigan, extensive dwarf lake iris colonies stretch along the immediate Lake Huron shoreline and also extend inland for up to several miles throughout a parallel series of former shoreline ridges, representing stages of post-glacial Lake Nipissing.

Dwarf lake iris can tolerate nearly full shade to open sun, but optimal vegetative growth and sexual reproduction are clearly light-dependent. Field observations have indicated that the most prolific flowering populations are those that receive a minimum threshold of direct sunlight for at least a portion of the day; however, plants in full sun tend to reproduce only vegetatively under such conditions and usually require a partly shaded or sheltered forest edge for optimal sexual reproduction (Crispin 1981; Makholm 1986; Van Kley 1989).

Leaf litter is also an important habitat factor in the life cycle of dwarf lake iris. The presence or absence of leaf litter and its depth and type strongly influence vegetative growth, sexual reproduction, seed germination, and seedling establishment (Makholm 1986; Van Kley 1989). Thick litter restricts seedling establishment either by preventing the developing roots from reaching mineral soil or by preventing the developing shoot from reaching light (Makholm 1986).

Disturbance is an important component of dwarf lake iris habitats, particularly in immediate shoreline areas. In these sites, cyclical fluctuations of Great Lakes levels and other factors, such as wind, waves and winter ice formations, are significant natural disturbance features (Van Kley 1989). These disturbance processes create a ragged forest edge as well as forest openings and gaps in the canopy that provide microsites for subsequent colonization by dwarf lake iris (Van Kley 1989).

2.3.1.7 Other

There is no other information at this time.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range

The concentration of dwarf lake iris near the shores of northern Lakes Michigan and Huron makes it particularly vulnerable to a host of human activities that can modify, fragment, or destroy its habitat. These activities fall into three primary categories: residential development, recreational development and activities, and road construction and maintenance.

Loss of shoreline habitat is increasing along Lakes Michigan and Huron in part due to residential—especially second home—development. Habitat is physically destroyed by home construction, driveways, access roads, associated landscaping, and long-term maintenance, such as mowing (Penskar, pers. comm. 1998). Home development can also fragment habitat. However, this species is a persistent and rather ecologically resilient plant that can withstand some level of disturbance and can often recolonize small disturbed areas if it flourishes nearby (Penskar *et al.* 2001). In Canada, a tendency to maintain native plants as part of the natural landscaping around small cottages might be beneficial to dwarf lake iris by maintaining openings in the canopy (COSEWIC 2004).

Because of closer proximity to southern population centers, dwarf lake iris habitat in Michigan's northern Lower Peninsula is probably under the greatest pressure from home development (Penskar, pers. comm. 1998). The risks are highest in Cheboygan and Alpena Counties, since remaining habitat in Emmet and Presque Isle counties lies primarily on state-owned land. Development is also increasing in Mackinac County, while installation of sewer lines in Cedarville and Hessel in Chippewa County will accelerate development there as well. Similar pressures exist in Door County, Wisconsin, where subdivisions of 25 to 30 homes have already been developed on two dwarf lake iris sites (Penskar, pers. comm. 1998).

Two of the largest occurrences of dwarf lake iris, accounting for 34% of the known Canadian population, are found at protected sites on national and provincial parks (COSEWIC 2004). The main threat to dwarf lake iris on private property is cottage development; however, cottage owners sometimes maintain natural landscaping around cottages, allowing dwarf lake iris to survive (COSEWIC 2004).

The shores of the Great Lakes provide extensive recreational opportunities. Tourism is a leading industry in both Michigan and Wisconsin, due in great part to the recreational opportunities associated with the Great Lakes. This makes the coastal areas a major focus of economic opportunity, especially for small northern communities with limited economic options.

Major recreational activities along the northern Great Lakes shores include sightseeing, fishing, camping, hiking, boating, skiing, and hunting. With the influx of vacationers from the south, the market for constructed attractions, such as golf courses, amusements and shopping, has also increased (Penskar, pers. comm. 1998). The nexus of this development is the Mackinac Straits area of Michigan (Mackinac, Emmet, and Cheboygan counties) and Door County, Wisconsin.

In Michigan, marina development along the Great Lakes is being fueled by high demand and the State of Michigan's Harbor Development Fund. The secondary effects of marina construction on development of surrounding areas are of the greatest concern for conservation of shoreline habitats. This is also true of other major developments which, although they do not impact dwarf lake iris directly, can stimulate additional development that reduces and fragments the iris's habitat (Penskar, pers. comm. 1998).

Because of the increasing development pressure on privately owned shorelines, more people are funneled onto publicly owned lands, increasing risks to habitat that is considered to be protected (Penskar, pers. comm. 1998). Many of the largest dwarf lake iris occurrences are on state or federal lands; however, management plans addressing species protection in dedicated and multiple-use areas are largely lacking.

Some forms of park development may actually improve habitat by creating canopy openings. In Peninsula State Park in Wisconsin, the park's network of trails allows light to penetrate to the forest floor, thus stimulating vegetative reproduction. Most likely to benefit from this sort of management are inland localities along ancient shorelines, where dwarf lake iris is declining due to advanced forest succession (Penskar, pers. comm. 1998).

Approximately one half of the occurrence records for dwarf lake iris mention proximity to roads or trails. This is likely due in large part to the suitability of old beach ridges—classic dwarf lake iris habitat—as roadbeds (Penskar, pers. comm. 1998). When roads and trails were pierced through these habitats, dwarf lake iris often spread vigorously into the created sunny clearings. However, proximity to roads has also brought high risks to dwarf lake iris.

Great threats are posed by road maintenance activities, such as mowing, grading, brush and tree removal, and herbicide spraying. The Michigan Department of Transportation (MDOT) has successfully minimized impacts by designating sensitive rights-of-way as Protected Areas and permitting only shoulder mowing in those areas (David Schuen, MDOT,

pers. comm. 2011). Since dwarf lake iris grows beyond the roadside ditch and generally beyond the back slope, it is not impacted by shoulder mowing (Schuen, pers. comm. 2011). Other maintenance activities on MDOT rights-of-way are allowed only as specified by a state threatened species permit on a case-by-case basis. Pesticide use is not permitted.

Road construction projects under the jurisdiction of counties or municipalities can have much greater impacts on dwarf lake iris. There is currently no program for protecting dwarf lake iris growing along local roads either in Wisconsin or Michigan. The Emmet County Road Commission (Michigan) has mowed dwarf lake iris where it occurs on the road shoulder (Penskar, pers. comm. 1998). In Wisconsin, the species occurs within mowed areas on some rural Door County roads (Joel Trick, U.S. Fish and Wildlife Service, pers. comm. 2011), and a few sites may have been affected by snow removal and de-icing with salt (Penskar, pers. comm. 1998). Long-term effects of these activities are unknown, although clearly restricted in scope to rights-of-way.

Roads in proximity to dwarf lake iris populations also create risks to the species by providing access routes for construction of residences and driveways (Penskar, pers. comm. 1998). This development further destroys and fragments the species' habitat.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes

At the time of listing, Faith T. Campbell reported that dwarf lake iris was being offered for sale in garden catalogs and that the potential existed for increased commercial trade of this species (USFWS 1988). Some online garden catalogs offer dwarf lake iris for sale, but this does not appear to be a significant threat to the species.

Federal regulations (50 CFR 17.61) make it unlawful to sell or to offer for sale in interstate or foreign commerce any endangered plant, and this prohibition is extended to threatened plants with one exception. Seeds of cultivated specimens of threatened species are exempt, provided that a statement that the seeds are of "cultivated origin" accompanies the seeds or their container (50 CFR 17.71).

2.3.2.3 Disease or predation

Neither disease nor predation was known to be a threatening factor at the time of listing. In Brown County, Wisconsin, more than 15 years of data indicated that pathogens posed no threat to long-term survival of dwarf lake iris; however, slug herbivory appeared to contribute to localized extinction in low-sun microsites (Michael Morgan, University of

Wisconsin-Green Bay, pers. comm. 2005). Disease and predation do not appear to be threats to dwarf lake iris in Michigan (Gary Hannan, Eastern Michigan University, pers. comm. 2005).

2.3.2.4 Inadequacy of existing regulatory mechanisms

In the vast majority of instances involving destruction of dwarf lake iris plants or habitat, persons responsible are unaware of the plant's presence and/or its importance. Lack of informative educational programs contributes to this problem, especially on lands owned by private individuals.

The Act provides protection to federally listed plants on Federal land, but provides limited protection to federally listed plants on state or private property. Dwarf lake iris is listed as "threatened" in both Michigan and Wisconsin through individual state laws.

In Michigan, Part 365, Endangered Species Protection, of the Natural Resource and Environmental Protection Act makes it illegal to take (collect, pick, cut, dig up, or destroy in any manner), possess, transport, import, export, process, sell or offer for sale, or buy or offer to buy any plant listed as endangered or threatened by the Federal government (M.C.L.A. 324.36501 – 07). Wisconsin state law [Wis. Stats., s. 29.604(4)(c)] makes it illegal to cut, root up, sever, injure, destroy, remove, transport, or carry away a listed plant on public lands or lands that an individual does not own. However, the law provides an exception on private lands for forestry, agriculture, and utility activity.

In Canada, dwarf lake iris is on Schedule 1 of the Species at Risk Act (SARA) as a threatened species (Government of Canada 2006). SARA makes it an offense to kill, harm, harass, capture or take an individual of a listed species that is extirpated, endangered or threatened; possess, collect, buy, sell or trade an individual of a listed species that is extirpated, endangered or threatened, or its part or derivative; or damage or destroy the residence of one or more individuals of a listed endangered or threatened species or of a listed extirpated species if a recovery strategy has recommended its reintroduction (S.C. 2002, c. 29).

Dwarf lake iris is also listed as threatened under Ontario's Endangered Species Act of 2007 (S.O. 2007, c. 6.). The Ontario law prohibits the killing, harming, harassing, capturing, taking, possessing, transporting, collecting, buying, selling, leasing, trading or offering to buy, sell, lease or trade a species on the Species at Risk in Ontario List [S.O. 2007, c. 6, s. 9 (1)].

2.3.2.5 Other natural or manmade factors affecting its continued existence

The main natural threat to dwarf lake iris is forest succession. Specifically, the invasion of deciduous species can result in reduced light levels and increased leaf litter, which inhibits successful reproduction, as discussed in section 2.3.1.6. The long-term survival of dwarf lake iris requires some form of disturbance that alters or suppresses succession, which aids in maintaining occupied habitat as well as creating new areas of suitable habitat (Makholm 1986). This disturbance has traditionally been the result of storms, wind throw, fluctuating lake levels, and winter ice formations that damage or down trees to create gaps in the canopy that create the partial shade conditions preferred by dwarf lake iris (Makholm 1986). Human activities, involving clearing trees and mowing vegetation for the maintenance of existing roads, trails, and paths, has also aided in providing this necessary disturbance (Makholm 1986).

Orange hawkweed (*Hieracium aurantiacum* L.), an exotic species, has similar ecological requirements and may compete with dwarf lake iris for its open habitat. This species has been observed invading existing dwarf lake iris colonies, and it occupies areas that could have potentially supported dwarf lake iris (Gibson and Makholm 1988).

Climate change may constitute a new threat for dwarf lake iris. In the Great Lakes region, the climate will likely grow warmer and probably drier overall during the 21st century (Kling *et al.* 2003). Average temperatures in the Great Lakes region could increase by 3 to 7°C in winter and 3 to 11°C in summer by the year 2100. While average annual precipitation could increase by 10-20 percent, significant changes in the seasonal precipitation cycle are likely, with winter and spring rain increasing and summer rain decreasing by up to 50 percent (Kling *et al.* 2003). A warmer, drier summer will affect surface and groundwater levels, as well as soil moisture, which is projected to decrease by 30 percent in summer (Kling *et al.* 2003).

Earlier models had indicated that increased precipitation, higher air temperatures, and reduced ice cover would increase evaporation in the Great Lakes, resulting in lake level drops of 1.5 feet to as much as 8 feet (Sousounis and Glick 2000). However, more recent models show a more variable response in lake levels. A majority of the model simulations run by Angel and Kunkel (2010) resulted in reductions in lake levels, yet also showed a high degree of uncertainty in possible future lake levels, depending on future emissions. Furthermore, Hayhoe *et al.* (2010) suggest that the competing effects of shifting precipitation and warmer temperatures will result in little change in Great Lake levels until the end

of the century, when net decreases in lake levels are expected under higher emission scenarios.

Regional warming may result in shifts in forest distribution (Kling *et al.* 2003). As the extent of canopy cover and leaf litter influence dwarf lake iris populations, changes to forest species composition and/or distribution of forest cover across the landscape could affect the long-term survival of the species. Drier conditions could also have a significant adverse effect on the suitability of microhabitats, particularly in open sites with constant solar exposure (Morgan 1989). How Great Lakes water levels may change and what effect this may have on habitat availability and suitability for dwarf lake iris is unclear. We lack sufficient certainty to know specifically how climate change will affect this species.

2.4 Synthesis

Overall, the total population of dwarf lake iris appears relatively stable. Since its listing, the number of known dwarf lake iris occurrences has increased from approximately 118 to 143 extant occurrences. Distribution of dwarf lake iris across its range in Michigan, Wisconsin, and Ontario, Canada has not substantially changed.

Propagation of dwarf lake iris occurs predominantly through the spreading of vegetative rhizomes. While sexual reproduction does occur, low seed production and germination rates as well as limited pollination all contribute to its rarity. This characteristic ultimately leads to lower genetic diversity among colonies; however, the iris' clonal habits allow it to persist for long periods of time.

One of the most significant threats to dwarf lake iris is destruction and fragmentation of its habitat. Residential development and recreational activities are both increasing in areas where dwarf lake iris is known to occur. Road construction and maintenance activities, such as mowing, grading and herbicide spraying, have the potential to harm dwarf lake iris. Most of the Canadian sites no longer extant had been converted to residential or road development.

Natural disturbance from cyclical fluctuations of Great Lakes levels and other factors, such as wind, waves and winter ice formations, is an important component of dwarf lake iris habitats, particularly in immediate shoreline areas, as it modifies habitat and maintains forest openings necessary for the species' growth and reproduction. Climate change represents a new, unknown threat for dwarf lake iris. Regional warming, resulting in drier conditions during the growing season and potentially lower Great Lakes levels, may have a significant, but uncertain, effect on the suitability of microhabitats.

Although the known threats from habitat loss and fragmentation have not significantly diminished and climate change represents a new, unknown threat, it

appears that this species has not declined since its listing. Dwarf lake iris continues to be a rare endemic plant species with a limited distribution; however, no new information is available to suggest this species' status has changed since listing, and its long-term status appears to be stable. The species continues to meet the definition of a threatened species under the Act; and therefore, no change in classification is warranted.

3.0 RESULTS

3.1 Recommended Classification

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change is needed

3.2 Recovery Priority Number

No change is needed; remains 8C.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

Complete the recovery plan for *I. lacustris*. This plan will identify objective recovery criteria and develop a recovery strategy.

Develop a monitoring schedule to ensure the continued health and stability of the known *I. lacustris* occurrences. An established monitoring system will aid in determining population trends within and among colonies.

Establish a public outreach program to increase public awareness of *I. lacustris* and to notify private landowners of the species' presence. This informative program will promote overall recovery of the species and decrease unintentional destruction on both public and private land.

Develop state and Federal management plans that address protection of *I. lacustris* in dedicated and multiple-use areas.

Develop Best Management Practices for use by State and County Highway Departments for roadside populations of *I. lacustris*.

Encourage research to better understand how vegetation management of existing sites can be designed to benefit *I. lacustris*.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Iris lacustris*

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: 8C

Review Conducted By: Barbara Hosler and Jeremy Banfield

FIELD OFFICE APPROVAL:
Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve Scott Hicks Date 7-12-11
Scott Hicks

REGIONAL OFFICE APPROVAL:
Acting **Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Midwest Region**

Approve [signature] Date 8/4/11