The Nature Conservancy

SAVING THE LAST GREAT PLACES ON EARTH

November 2004

Biological Ranking Criteria for Conservation of Islands in the Laurentian Great Lakes

The Nature Conservancy
Great Lakes Program
8 S. Michigan Avenue, Suite 2301
Chicago, Illinois 60603

Phone: (312) 759-8017
Fax: (312) 759-8409
Email: greatlakes@tnc.org
Web: nature.org/greatlakes

Biological Ranking Criteria for Conservation of Islands in the Laurentian Great Lakes

PREPARED BY

David N. Ewert, *The Nature Conservancy (Lansing, Michigan)*
Michele DePhilip, *The Nature Conservancy (Chicago, Illinois)*
Daniel Kraus, *Nature Conservancy of Canada (Guelph, Ontario)*
Mary Harkness, *The Nature Conservancy (Minneapolis, Minnesota)*
August Froehlich, *The Nature Conservancy (Dublin, Ohio)*

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INTRODUCTION

WHY RANK ISLANDS?

It is important to develop scientific criteria to rank Great Lakes islands or groups of islands (island complexes or archipelagos) so that efforts to conserve these unique features and their biota are well focused. Some 30,000 islands in the Great Lakes[1] and connecting channels, extending east in the St. Lawrence River to Ile d'Orleans, are the subject of this report. These islands form the largest freshwater island system in the world. There is an urgency to rank these globally important islands in both the United States and Canada, especially given ongoing programs to transfer ownership of islands from U.S. federal agencies, including the Bureau of Land Management, Coast Guard, and Army Corps of Engineers, to other ownership. Given increasing development pressure and other threats to the biological integrity of Great Lakes islands, landowners, public agencies, and conservationists are increasingly questioning which islands have the highest value and most need to be conserved.

PURPOSE

The purpose of this project is to develop a ranking system, based on a subset of biodiversity parameters, that will provide a foundation and rationale to prioritize island conservation efforts in the Great Lakes basin. This ranking system emphasizes: (1) U.S. federal trust resources[2], and (2) native species and communities that are largely restricted to the Great Lakes region or that are globally significant. This ranking system provides an objective method that can be used at multiple spatial scales to define priorities.

The project team anticipates that the ranking system, though specifically designed to meet needs of the USFWS, will have broad application to United States and Canadian organizations interested in evaluating islands in the Great Lakes, including participants in the State of the Lakes Ecosystem Conference (SOLEC) (Bertram and Stadler-Salt 2000) and the islands group funded by the Great Lakes National Program Office of the Environmental Protection Agency. The ranking system will evolve with use and modifications should be explored by different groups to achieve organization-specific objectives.

[1] Defined as all islands in the Great Lakes and connecting waters and then east in the St. Lawrence River to Ile d'Orleans near Quebec City where aquatic systems are influenced by marine processes.

[2] Resources considered to be of national or international importance, no matter where they occur. This includes federally (U.S.) listed endangered or threatened species, wetlands, U.S. Fish and Wildlife Service lands, interjurisdictional fisheries, and species protected by treaty or international convention, such as migratory birds and marine mammals.

Our work was undertaken at the request of the Great Lakes Basin Ecosystem Team of the U.S. Fish and Wildlife Service (USFWS) for these purposes:

- facilitate sound, science-based decision-making for refuge acquisition, restoration, and recreation projects;
- develop preliminary project proposals to change National Wildlife Refuge boundaries;
- facilitate habitat conservation planning;
- facilitate consultation for federally listed species;
- identify data gaps related to USFWS's trust resources in island and coastal areas;
- focus educational campaigns that promote island conservation; and,
- provide information to the United States Army Corps of Engineers for project and permitting evaluation.

CAVEATS

We emphasize that the proposed ranking system is an initial framework to evaluate islands based on this subset of biodiversity criteria. Application of the ranking system will be difficult for many islands because data are not available; consequently, many inter-island comparisons are not currently possible. The framework provided here should encourage common approaches to: (1) use of existing data; (2) collection of new data for the purposes of evaluating conservation value of Great Lakes islands; and, (3) defining key issues for future iterations of a ranking system. Use of this ranking system should allow some immediate inter-island comparisons. It is the first step needed to evaluate islands on a basinwide basis for incorporation into a decision support system.

ISLAND DEFINITION

The project team defined an island as "Any land mass within the Great Lakes or connecting channels that is surrounded by an aquatic environment." We chose this simple definition to facilitate application of the ranking system spatially and temporally. This definition includes artificial islands. We recognize that, depending on water level, an island can at times be connected to the mainland during low water periods or be submerged during high water periods. Consequently, any particular site could be an island, part of the mainland, or part of a reef as water levels fluctuate; however, the island ranking system outlined in this report may be most useful for permanent islands.

ISLAND GROUPS, COMPLEXES, AND ARCHIPELAGOS

In addition to an island-specific value, an island may have additional value because it is part of an island group, complex, or archipelago that functions as a larger system via connections with associated islands and/or the mainland. Islands may be linked to one another by dispersing biota or natural processes which play vital roles in ecological dynamics and other factors. Defining island groups, archipelagos, or complexes is challenging because island linkages may be species, process (e.g., sediment transport), temporal, and/or site specific.

Although the project team did not develop criteria to rank island groups, we tentatively defined an archipelago as "a large group of related islands and island groups." This term can be used as a descriptor for broad and distinct island areas (e.g., Western Lake Erie archipelago). An island group is tentatively defined as "a complex assemblage of islands with similar or complementary ecological features and processes." Island groups typically include many smaller islands that function as an ecosystem. Further advances in developing an island classification system should result in more precise definitions of island archipelagos and groups.

TYPES OF LAURENTIAN GREAT LAKES ISLANDS

The morphology and distribution of Great Lakes islands, except artificial islands, is a result of geology, glacial processes (including isostatic rebound), water level, and process of depositional and erosion. For example, water level fluctuations can significantly increase or decrease the size of islands, and erosion and deposition can greatly alter the shape of some islands. Consequently, features of Great Lakes islands can vary over time and space, which ultimately determines their stability and biological characteristics.

Islands in the Great Lakes can be coarsely categorized according to their bedrock and surfical geology. Precambrian islands of basalt and granite dominate the northern shores of Lake Superior, Lake Huron and the St. Lawrence River; Precambrian and Cambrian sandstone formations comprise islands of the southern shore of Lake Superior; limestone and dolomite characterize many islands in northern Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario; and, islands composed of glacial deposits are scattered throughout the Great Lakes (Crispin *in* Vigmostad 1999). Deltaic islands are locally found at mouths of rivers, especially the St. Clair River, a connecting channel.

SIGNIFICANCE OF LAURENTIAN GREAT LAKES ISLANDS

Due to their relative isolation, islands are important conservation areas that support distinctive flora and fauna (see Vigmostad 1999[3]). Collectively, the Great Lakes islands support biological legacies found nowhere else in the world. These islands, while very young geologically (less than 12 thousand years old), have already diverged from the mainland in some attributes and thus provide unique conservation opportunities. Colonial waterbirds nest by the thousands on islands because of the absence of mammalian predators, the Lake Erie Water Snake has differentiated from mainland Northern Water Snake populations, plant communities differ from their mainland counterparts, and many common mainland species, such as Ruffed Grouse, never reached some islands. The islands can also harbor examples of relatively undisturbed natural communities with comparatively little herbivory, and they serve as

[3] Available at http://greatlakes.fws.gov.

important refugia for migrating birds. Current climate change models suggest that islands may further diverge from mainland systems through persistence of some refugia, local extinctions, and changes in natural processes associated with an anticipated drier and warmer climate (Hansen et al. 2003). Further, islands may be relatively vulnerable to change because species and communities may be more susceptible to stochastic change due to their isolation and relatively small populations. Yet, at least some islands may be relatively protected from anthropogenic threats to their biota (Soule *in* Vigmostad 1999, Manny 2003). The Great Lakes islands are truly natural experiments in progress, a quality shared with islands worldwide.

Many islands also have rich cultural, economic, and recreational values; however, ranking islands based on these values is outside the scope of this work.

APPLICATION AND METHODS

APPLICATION OF THE RANKING SYSTEM

This ranking system is designed to prioritize conservation actions based on biodiversity criteria. In addition to ranking islands to help prioritize conservation action, the ranking process will highlight geographic and thematic areas where collection of additional data is needed.

Existing data sets are noted for each criterion (see criteria descriptions). As other consistent and comparable data sets that are appropriate and useful for ranking islands become available or known to the project team, this information will be adopted or adapted as needed.

The ranking system can also be used to guide collection of comparable data during field inventories and research. These data should be incorporated into integrated data management systems, such as decision support systems, to facilitate inter-island comparisons and ultimately contribute to basinwide assessments. In addition, data gaps, data quality and consistency issues, data collection and management issues, research and inventory needs, and related issues will become evident during the ranking process and thus suggest future work.

The ranking system can also be applied at different spatial scales and for specific evaluation purposes. For example, some may be interested in ranking all islands for all biological criteria throughout the Great Lakes, while others may be interested in using the complete ranking system for all islands in only one of the Great Lakes. Others may evaluate only one, or a subset, of the criteria, but with a basinwide or more local perspective. The scoring procedures can also be used to compare portions of islands. This may be especially important when efforts are made to prioritize areas on larger islands, such as Manitoulin Island. Furthermore, this ranking system should complement work done to identify Biodiversity Investment Areas, which are landscapes of exceptional quality within the nearshore areas of the Great Lakes (Reid et al. 2000). Originally designed to be applied on an island by island basis, we reiterate that the same scoring procedures can be applied to individual sites on islands as well.

Criteria are not weighted, but depending on the user's purpose for evaluating islands, criteria could be weighted by selecting a subset of the criteria to prioritize conservation work.

Ultimately, island scores could be grouped into three tiers: high, medium, and low. Where scores for all criteria are available, high, medium, and low categories could be defined using one or more of the following methods: (1) tails of a normal curve; (2) including the highest ranked island for any one criterion; and, (3) other methods yet to be defined. Defining tails of a normal curve is premature now because of the small number of islands that have sufficient data to develop scores for all criteria. Additional data collection and assessment will be necessary before islands can be confidently placed in high, medium, and low tiers.

Finally, this ranking system provides an objective basis for comparing islands, based on a select set of biodiversity criteria. This ranking system, when coupled with the contingencies associated with protection (e.g., land availability, owner interest in protection, availability of funds, urgency) will ultimately determine conservation outcomes.

CRITERIA AND SCORING SYSTEM USED TO RANK ISLANDS

This ranking system includes nine biologically-based criteria. The project team identified several criteria on which to rank Great Lakes islands, based primarily on biotic characteristics. Each criterion is scored on a 1-30 point basis. This was done to: (1) ensure consistency and concordance with the 30-point scoring system developed by Wires and Cuthbert (2001) for colonial nesting waterbirds in the Great Lakes; and (2) provide relatively fine resolution in the scores.

The criteria are organized under several broader biotic Criterion Groups: Birds, Fish, Endangered and Threatened Species, and Species and Communities of Special Interest.

A. Criterion Group: Birds
   - Criterion 1: Presence of Nesting Colonial Waterbirds
   - Criterion 2: Presence of Roosting, Foraging Shorebirds
   - Criterion 3: Presence of Roosting, Foraging Waterfowl
   - Criterion 4: Stopover Sites for Landbirds

B. Criterion Group: Fish
   - Criterion 5: Occurrence of Nursery/Spawning Areas for Native Interjurisdictional Fishes

C. Criterion Group: Endangered and Threatened Species
   - Criterion 6: Number of State/Provincial Endangered and Threatened Species
   - Criterion 7: Number of Federally Endangered and Threatened Species

D. Criterion Group: Species and Communities of Special Interest
   - Criterion 8: Species and Communities Identified in the Conservation Blueprint for the Great Lakes
   - Criterion 9: High Quality Sites for a Species or Community

This ranking system emphasizes special biological diversity features and includes many of the features (e.g., Great Lakes shoreline communities, concentrations of species of special interest) used to identify Biodiversity Investment Areas (Reid et al. 2000, Rodriguez and Reid 2001).

Widespread communities and species are not included with this ranking system but will be incorporated in gap studies designed to characterize Great Lakes islands along with overlays of existing land protection (see http://www.nemw.org/islands.htm). Also, we did not consider potential habitat for species in the ranking system except for stopover sites for landbirds (Criterion 4) and nursery/spawning areas for fishes (Criterion 5). Ultimately, predicting suitable habitat (identified with remote sensing imagery) for species of special interest could enhance the island ranking process.

Other factors that can be used to rank the potential of an island for conservation of biodiversity are listed in Appendix I. Subsequent ranking methods may wish to include one or more of these factors, which can be grouped into three categories: (1) additional conservation values (including both biodiversity and landscape context values not in the current island ranking system); (2) opportunity or feasibility (including social, economic, and political factors); and, (3) threats (after Kintsch 2003).

In Appendix II we present a method for evaluating contaminants on islands. We decided not to include contaminants as part of this ranking system because our goal for this ranking system was to consider only biodiversity values. Contaminants, and other threats to island biodiversity, should be evaluated systematically when conservation strategies are developed and implemented.

TESTING THE RANKING SYSTEM

We tested the usefulness of applying these criteria on island groups in northern Lake Michigan, the western basin of Lake Erie, and a portion of Georgian Bay, Lake Huron. These island groups were selected for testing because they are in different lakes, are relatively data-rich, and offer opportunities to evaluate islands using different combinations of data sets, including the comparability of data from different states and provinces. Results of this test are presented in Appendix III.

AVAILABILITY OF CURRENT ISLAND RANKING SYSTEM AND LINKS TO DATA SOURCES

The most current version of the island ranking system can be obtained by contacting:

David Ewert
The Nature Conservancy
100 East Grand River
Lansing, MI 48906
Email: dewert@tnc.org
Phone: (517) 316-2256

We welcome comments on the ranking system (please contact David Ewert). The island ranking system will be available on the web site of the Great Lakes Program of The Nature Conservancy (http://nature.org/greatlakes), Nature Conservancy of Canada (http://www.natureconservancy.ca), and the Great Lakes Basin Ecosystem Team of the USFWS (http://greatlakes.fws.gov). Links to data sources are indicated under each ranking criterion. A form that can be used to score islands is included in Appendix IV. A scoring database is also referenced in Appendix IV; electronic versions of the form and the database are available from the Great Lakes Program of The Nature Conservancy (greatlakes@tnc.org).

ASSESSING THE RELIABILITY OF DATA USED IN THE RANKING SYSTEM

Because of the unevenness of data available to rank islands, we provide a data reliability rating scheme adapted from The Nature Conservancy's Measures of Success team to document confidence in the data used to evaluate each criterion (Tables 1 and 2).

Table 1. Reliability Ratings for Non-GIS Data

Level of Agreement/Consensus[a]	Amount of Evidence/Data[b]	Reliability Rating
High	High	Very good
High	Low	Good
Low	High	Fair
Low	Low	Poor

[a] Level of agreement/consensus:

High: 3-5 independent experts (in literature, or communication) agree on the interpretation of the discussion, data set, or other evidence. Or, the results are agreed upon by more than one data source (GIS-based assessment, expert opinion, research, etc.).

Low: Experts do not agree on the interpretation of the discussion, data set, or other evidence. Or, opposing or inconclusive results are obtained from data sets from more than one location or investigation (GIS, expert opinion, etc.)

[b] Amount of evidence/data:

High: Assessment is based on recent data and/or on a significant and clear correlation between the status of the criterion and a measured indicator documented in the Great Lakes region.

Low: Assessment is based on a prediction from an indirect measure not yet demonstrated to have a strong relationship with the criterion parameters in the Great Lakes region.

Table 2. Reliability Ratings for GIS Data

Level of Data Maintenance and Supporting Information	Reliability Rating
Nearly all data are frequently updated/maintained, and all data have highly credible, supporting information (e.g., metadata, peer-reviewed/published literature, multiple experts reaching consensus, etc.)	Very good
Most data are frequently updated/maintained, and/or the majority have good supporting information	Good
Most data are not frequently updated or maintained, and/or rely heavily on expert opinion with no identified references	Fair
Data are based on general opinion, best guesses, etc. without quantifiable data to back up the opinion and/or have no associated dates on which timeframe of assessment can be based	Poor

CRITERIA DESCRIPTIONS

CRITERION GROUP: BIRDS

Criterion 1: Presence of Nesting Colonial Waterbirds

We adopted the procedures for ranking sites with nesting colonial waterbirds using the method developed by Wires and Cuthbert (2001). We did not use the Important Bird Areas Program criteria because the Wires and Cuthbert ranking system was developed specifically to assess the relative importance of sites in the Great Lakes for nesting colonial waterbirds. We made one minor adjustment to this system: assigning points for each of the nesting marsh terns to ensure the maximum score for Criterion 1 was identical to the maximum score for all other criteria in the ranking system (30 points).

Three categories for ranking nesting sites for waterbirds were developed by Wires and Cuthbert (op. cit.): (1) sites for waterbirds overall; (2) sites for Common Tern (*Sterna hirundo*); and, (3) sites for marsh nesting terns (Black Tern (*Chlidonias niger*) and Forster's Tern (*Sterna fosteri*). All species of waterbirds are included with this ranking system, even those considered to be overabundant, such as Ring-billed Gull (*Larus delawarensis)* and Double-crested Cormorant (*Phalacrocorax auritus*). We did not exclude these species given the extreme population fluctuations some of these species have exhibited over the long term in the Great Lakes region.

Many colonial waterbirds reach their northern limits in the Great Lakes so that southern islands tend to rank higher than northern islands for this criterion. This criterion includes several species of waterbirds that nest very locally, occasionally, and/or in very small numbers on Great Lakes shorelines or islands: Snowy Egret (*Egretta thula*), Cattle Egret (*Bubulcus ibis*), American White Pelican (*Pelecanus erythrorhynchos*), Great Black-backed Gull (*Larus marinus*), Little Blue Heron (*Egretta caerulea*), Glossy Ibis (*Plegadis falcinellus*), and Little Gull (*Larus minutus*).

Data Sources for Criterion 1

There are good, standardized data sets across all Great Lakes islands for ranking Criterion 1. Data for scoring this criterion are available from Linda Wires (wires001@umn.edu), the Great Lakes Basin Ecosystem Team of the USFWS[4], the Canadian Wildlife Service[5], and Important Bird Areas Program databases (for Canada see http://www.bsc-eoc.org/iba/IBAsites.html).

Criterion 1, Part 1: Prioritizing Sites for General Colonial Waterbird Use

Scoring Procedure for Criterion 1, Part 1. The maximum score that an island can receive for Part 1 of Criterion 1 is 16 points (Table 3).

[4] Contact Chris Castiglione (Chris_Castiglione@fws.gov) for more information.

[5] Contact Chip Weseloh (Chip.Weseloh@ec.gc.ca) for more information.

Table 3. Scoring Procedure to Rank Islands for General Colonial Nesting Waterbird Use

Scoring Category	Score	Species (Alpha Code)
Known breeding by selected species	1 point each, maximum of 9 points for this category	*One point for each of the following species breeding on an island:* American White Pelican (AMWP) Black Tern (BLTE) Black-crowned Night-Heron (BCNH) Caspian Tern (CATE) Cattle Egret (CAEG) Common Tern (COTE) Double-crested Cormorant (DCCO) Forster's Tern (FOTE) Glossy Ibis (GLIB) Great Black-backed Gull (GBBG) Great Blue Heron (GTBH) Great Egret (GREG) Herring Gull (HERG) Little Blue Heron (LTBH) Little Gull (LIGU) Ring-billed Gull (RBGU) Snowy Egret (SNEG)
Top 5 breeding sites for selected species	1 point each	*If an island was one of the top five sites in terms of number of breeding pairs as of the last census for the following species, one point for each species (see Cuthbert, Wires, McKearnan, and Joshi 2001)* Black-crowned Night-Heron (BCNH) Caspian Tern (CATE) Great Egret (GREG) Great Blue Heron (GTBH)
Total numbers of selected species	1 point each	*If an island has any of the following, one point each:* 1000+ Double-crested Cormorants (DCCO) 1000+ Herring Gulls (HERG) 10,000+ Ring-billed Gulls (RBGU)

Criterion 1, Part 2: Prioritizing Common Tern Sites

The Common Tern is considered separately from the other waterbird species and the marsh nesting terns because historically this species has used many islands throughout the Great Lakes for nesting. A major factor influencing movement among islands is water level. Common Terns appear to prefer small islands, often slightly elevated above lake level. When water levels are low, terns often occupy many small sites.

When water levels rise, they are often encountered on fewer larger islands. Therefore, this species requires a suite of options over time. The ranking system outlined below attempts to capture the historic and current importance of specific islands. Note that the scoring procedure applies only to islands with a history of nesting by Common Tern.

Scoring Procedure for Criterion 1, Part 2. The maximum score that an island can receive for Part 2 of Criterion 1 is 12 points.

Table 4. Scoring Procedure to Rank Islands for Common Tern

Scoring Category	Score	Island Use/Productivity/Management Potential
Consistency of use	1 point	Island is used occasionally (1-2 years per decade)
	2 points	Island is used sporadically (3-4 years per decade)
	3 points	Island has been used fairly consistently (every 2-3 years) since the 1970s or used consistently during the 1990s
History of recent use	1 point	Island used one or more times between 1977-1989
	2 points	Island used one or more times between 1989-1996
	3 points	Island used one or more times from 1997-present
Level of productivity	1 point	Island has consistently low or no productivity (no fledglings or <10% of nests produce 1 or more fledglings)
	1.5 points	No information available on productivity
	2 points	Island has moderate productivity (some years productive; other years no or low productivity)
	3 points	Island is currently productive (>25% of nests produce 1 or more fledglings)
Potential for management[a]	1 point	Island has no potential for management
	2 points	Island has potential for management
	3 points	Island is currently managed or has high management potential

[a] Specific criteria for management can be obtained from Linda Wires, University of Minnesota (wires001@umn.edu).

Criterion 1, Part 3: Prioritizing Marsh Nesting Tern Sites

Scoring Procedure for Criterion 1, Part 3. The maximum score that an island can receive for Part 3 of Criterion 1 is 2 points.

Table 5. Scoring Procedure to Rank Islands for Marsh Nesting Terns

Score	Species (Alpha Code)
One point for each of the following species breeding in coastal wetlands adjacent to an island one or more times since 1976:	
1 point	Black Tern (BLTE)
1 point	Forster's Tern (FOTE)

Criterion 2: Presence of Roosting or Foraging Shorebirds

Great Lakes islands may serve as important stopover sites for shorebirds, especially emergency stopover sites (Robert Russell, U.S. Fish and Wildlife Service, pers. comm.) and for nesting Spotted Sandpipers and Killdeers (Hatt et al. 1948; Robert Russell, pers. comm.; Francesca Cuthbert, University of Minnesota, pers. comm.). The Piping Plover, a federally endangered and threatened species, is not included in this category but is considered under Criterion 7.

Criteria from the Important Bird Areas Program (Commission for Environmental Cooperation 1999) and the Western Hemisphere Shorebird Reserve Network (see http://www.manomet.org/WHSRN) were slightly modified for the 25 and 30 point scores while criteria for lower scores were adopted from early versions of the Important Bird Areas Program and Robert Russell (pers. comm.). The relative importance of islands as roosting sites for shorebirds will likely vary as water levels fluctuate, so threshold numbers needed for each score may not be reached annually. Consequently, we modified the Important Bird Areas Program and the Western Hemisphere Shorebird Reserve Network criteria to read "20% of years monitored over a 40-year interval" instead of "annually." Intervals between peak low and peak high water periods vary dramatically (approximately 10-40 years); we chose a 40-year time span because that is approximately the longest time period recorded by the U.S. Army Corps of Engineers between high and low water levels.

There are few data to evaluate use of islands by shorebirds (Mike Tansy, pers. comm.), so most islands cannot be ranked with this criterion. It is important to encourage focused Great Lakes island shorebird migration surveys. Ideally, these surveys will take place on a representative set of islands so that shorebird use of islands not sampled can be predicted.

Data Sources for Criterion 2

No standardized database exists for consistent storage and management of shorebird stopover data for the Great Lakes basin. The Important Bird Areas Program provides the best available data summaries to initiate assessment of islands as stopover sites and nesting areas for shorebirds (see

http://www.audubon.org/bird/iba/). The significance of some island areas for shorebirds has been determined in Canada (see http://www.bsc-eoc/iba/IBAsites.html). Estimates of population numbers of shorebird species can be found in the United States Shorebird Conservation Plan (see http://www.manomet.org/WHRSN). This information will be supplemented by local expertise.

Scoring Procedure for Criterion 2

Table 6. Scoring Procedure to Rank Islands for Shorebirds

Score	Presence
10 points	4,000 – 9,999 shorebirds during a migration season in at least 20% of years monitored over a 40-year interval
20 points	10,000 – 14,999 shorebirds during a migration season in at least 20% of years monitored over a 40-year interval
25 points	15,000 – 20,000 shorebirds during a migration season in at least 20% of years monitored over a 40-year interval **or** 1% to 5% of a subspecies or flyway population during a migration season
30 points	Greater than 20,000 shorebirds during a migration season in at least 20% of years monitored over a 40-year interval **or** >1% of the global population of a species during a migration season **or** >5% of a subspecies or flyway population of a species during a migration season

Criterion 3: Presence of Roosting, Foraging Waterfowl

Approximately 3 million waterfowl migrate through the Great Lakes region annually (Great Lakes Basin Commission *in* Bookhout et al. 1989). Areas where aquatic vegetation and/or invertebrates are relatively abundant (see Bookhout et al. 1989) are likely to attract the greatest diversity and abundance of migrants, so islands with these features are probably better stopover and resting sites than islands without marshes or shoals. Hemi-marshes (wetlands with a mosaic of open water and stands of emergent plants) are especially important to waterfowl (Bookhout et al. 1989).

Great Lakes islands also support relatively small numbers of nesting waterfowl and other species such as Common Loon. Small islands may provide consistent breeding sites for Canada Goose (*Branta canadensis*), Common Merganser (*Mergus merganser*), Red-breasted Merganser (*Mergus serrator*), Gadwall (*Anas strepera*), and Mallard (*Anas platyrhynchos*) (see Hatt et al. 1948, Anonymous 1979, Mike Tansy, pers. comm.), while larger islands (e.g., Isle Royale, Drummond Island, Beaver Island, and Manitoulin Island) may support additional nesting species, including Wood Duck (*Aix sponsa*), Green-winged Teal (*Anas crecca*), American Black Duck (*Anas rubripes*), Blue-winged Teal (*Anas discors*), Ring-necked Duck (*Aythya collaris*), Common Goldeneye (*Bucephala clangula*), and Hooded Merganser (*Lophodytes cucullatus*) (Hatt et al. 1948, Brewer et al. 1991).

Because so few waterfowl nest or winter on or near islands, the ranking system focuses on waterfowl use of islands as stopover sites. We adopted components of both early and current versions of Important Bird Areas criteria (Commission for Environmental Cooperation 1999; D. Niven, National Audubon Society, pers. comm.) for our scoring protocol. As with shorebirds, it would be useful to describe ecological and physical characteristics of islands used by waterfowl so that scores from these islands can be extrapolated to unsampled islands.

Data Sources for Criterion 3

Recommended data sources for scoring this criterion include the Important Bird Areas Program (see http://www.audubon.org/bird/iba and http://www.bsc-eoc.org/iba/IBAsites.html), Ducks Unlimited, and state/province natural resource agencies.

Scoring Procedure for Criterion 3

Table 7. Scoring Procedure to Rank Islands for Waterfowl

Score	Presence
10 points	1,000 – 9,999 waterfowl occurring regularly during migration
20 points	10,000 – 14,999 waterfowl occurring regularly during migration
25 points	15,000 – 20,000 waterfowl occurring regularly during migration **or** 1% to 5% of a subspecies or flyway population occurring regularly during migration
30 points	Greater than 20,000 waterfowl occurring regularly during migration **or** >1% of a global population occurring regularly during migration or >5% of a subspecies or flyway population occurring regularly during migration

Criterion 4: Stopover Sites for Landbirds

The Great Lakes area may be especially challenging for migrants given the juxtaposition of the lakes to extensive urban and agricultural landscapes, which may be relatively unsuitable for many migrants. Islands may be important refugia for migrants flying over the Great Lakes (Scharf 1973; Scharf *in* Vigmostad 1999), especially during storms (see Janssen 1976) or when they are "caught" over the Great Lakes at sunrise, with the mainland out of sight (see Scharf 1973; Scharf *in* Vigmostad 1999; Diehl et al. 2003; most landbirds migrate at night and drop to land at sunrise). Protection of stopover sites for landbirds may be critical as mortality rates of at least one landbird, Black-throated Blue Warbler (*Dendroica caerulescens*), may be "at least 15 times higher during migration compared to that in stationary (i.e., breeding and wintering grounds) periods; ≥85% of apparent annual mortality of *D. caerulescens* occurred during migration" (Sillett and Holmes 2002). Important island stopover sites for landbirds have been identified by Scharf (1979), The Nature Conservancy (1999), and through the Important Bird Areas Program (Chipley et al. 2003).

The distribution of landbirds during migration in the Great Lakes region is very poorly known (Ewert and Hamas 1996). Consequently, criteria for assessing the relative importance of islands to landbirds during migration will need future refinement. We decided to integrate several approaches to rank islands for landbird stopover sites: (1) criteria defined by the Important Bird Areas Program (Commission for Environmental Cooperation 1999; Judy Pollock, National Audubon Society, pers. comm.); (2) the stopover site classification system developed by Mehlman et al. (in prep.); and, (3) results of studies conducted on islands and in the Great Lakes region on landbird stopover sites.

Important Bird Areas Programs, at local levels, use the following qualitative definition of sites with important congregations of migratory landbirds as (quoted with minor modifications):

> *The site is regularly an important migratory stopover site, 'bottleneck,' or migratory corridor for migratory landbirds (other than raptors). Concentration refers to seasonal totals rather than those occurring over a brief period of time. No absolute thresholds have been set because quantitative data are limited. Sites nominated should contain exceptional numbers and/or diversity of migratory landbirds.*

Two quantitative definitions of important bird sites have also been proposed: (1) greater than 500,000 passerines estimated to pass through the site in a short period (Commission for Environmental Cooperation 1999); or, (2) "40 birds/ha are estimated to occur in an area at any one time" (Commission for Environmental Cooperation 1999). Only small, barren islands are unlikely to meet the criterion of "40 birds/ha estimated to occur in an area at any one time."

Others (Judy Pollock, pers. comm.) have defined sites with congregations of migratory birds as:

> *...a regular migratory stopover or corridor for migratory birds (other than raptors). Sites nominated should contain exceptional numbers and/or diversity of migratory landbirds. Concentrations refer to seasonal totals rather than those occurring over a brief period of time. Other evidence (e.g., number of species observed, landscape configuration, isolation from other appropriate habitat) will also be used to identify important stopover sites for migratory landbirds.*

Biologists also consider nominating stopover sites as important bird areas that "annually holds very high densities of migrant landbirds on multiple dates during migration, several times above numbers in similarly sized comparable areas OR throughout spring or fall migration holds above average numbers of migrants compared to similarly sized areas."

A review of literature on Great Lakes and island stopover sites suggests that key factors likely to determine the importance of an island to migrating landbirds are relative isolation of the island from other land masses (islands and mainland), and presence of shelter and food on the island.

Islands, peninsulas, and Great Lakes mainland shorelines may attract migrants (Scharf 1973) up to 40 km (24 miles) offshore (Diehl et al. 2003). Some of these areas may have relatively little food or shelter (see Dunn 2001) while other areas may be food-rich (see Ewert and Hamas 1996). Evidence from very small islands (<100 acres or 40 ha) in the Caribbean region and Florida Keys within 60-120 miles (100-200 km) of the mainland suggests that at least some migrants reaching these islands cannot gain sufficient reserves to migrate and thus starve (Spendelow 1985). These discoveries indicate that relative isolation and food resources of an island are especially important parameters to rank islands for stopover sites for landbirds. Further, islands without food and shelter, but within sight distance of other islands, may result in migrants

flying to these islands or the mainland. Although data are lacking on this specific interaction, migrants in some places (e.g., Cape May, New Jersey) undertake diurnal flights at altitudes typically between 50-150 m that reverse the appropriate direction of migration. This has been attributed, at least in part, to migrants searching for better cover and/or food (Wiedner et al. 1992). Consequently, we need to account for these local movements in our ranking system.

The scoring procedure below makes the following assumptions for landbird stopover sites in Great Lakes islands:

1. Relative isolation of an island is more important in defining its relative importance as a stopover site than food and resources on the island; and,
2. Distances selected to rank islands are based on distribution of islands in the Great Lakes and the approximate distance an island might be seen by a landbird while flying 50-150 m (roughly 160-500 feet) above the water level (see Wiedner et al. 1992).

The assumptions need testing but provide a starting point from which to consider ranking islands as landbird stopover sites.

Data Sources for Criterion 4

Recommended data sources for scoring this criterion include the Important Bird Areas Program[6], extrapolations from studies of stopover sites on Great Lakes shorelines, or expert opinion.

Scoring Procedure for Criterion 4

Because there are few data on landbird stopover sites from islands, both abiotic (as an assumed correlate of biotic data) and biotic characteristics are used to rank Great Lakes islands as stopover sites (Table 8). Note that isolated islands with few resources rank highly as these islands may serve as essential, emergency refugia even though food and shelter are scarce.

[6] See http://www.audubon.org/bird/iba and http://www.bsc-eoc/iba/IBAsites.html for more information.

Table 8. Scoring Procedure to Rank Islands for Landbird Stopover Sites

Score	Important Bird Area Designation		Abiotic Characteristics		Biotic Characteristics
0 points	None	**and**	(1) Island has **no** standing trees or surface water (e.g., lakes, ponds, permanent wetlands, and streams); *and* (2) Island is located <1 mile (1.6 km) from other islands or the mainland.	***or, if known,***	(1) Island attracts relatively low concentrations of migrants; *or* (2) Island attracts <40 birds/ha regularly during migration.
2.5 points	None	**and**	(1) Island has standing trees and/or surface water; *and* (2) Island is located <1 mile (1.6 km) from other islands, but >1 mile (1.6 km) from mainland.	**and, if known,**	(1) Island attracts relatively high concentrations of migrants; *or* (2) Island attracts >40 birds/ha at least once during migration.
5 points	None	**and**	(1) Island has **no** standing trees or surface water; *and* (2) Island is located 1–5 miles (1.6–8 km) from other islands and the mainland.	**and, if known,**	(1) Island attracts relatively high concentrations of migrants; *or* (2) Island attracts >40 birds/ha at least once during migration.
10 points	None	**and**	(1) Island has standing trees and/or surface water; *and* (2) Island is located 1–5 miles (1.6–8 km) from other islands and the mainland.	**and, if known,**	(1) Island attracts relatively high concentrations of migrants; *or* (2) Island attracts >40 birds/ha at least once during migration.
15 points	None	**and**	(1) Island has **no** standing trees or surface water; *and* (2) Islands is located >5 and up to 10 miles (8–16 km) from other islands and the mainland.	**and, if known,**	(1) Island attracts relatively high concentrations of migrants; *or* (2) Island attracts >40 birds/ha at least once during migration.

Table 8. Continued

Score	Important Bird Area Designation		Abiotic Characteristics		Biotic Characteristics
20 points	Identified as stopover sites of **regional** significance by the Important Bird Areas Program.	***or***	(1) Island has standing trees and/or surface water; *and* (2) Islands is located >5 and up to 10 miles (8–16 km) from other islands and the mainland.	**and, if known,**	(1) Island attracts relatively high concentrations of migrants; *or* (2) Island attracts >40 birds/ha at least once during migration.
25 points	Identified as stopover sites of **continental** significance by the Important Bird Areas Program (1% or more of a subspecies population occurring regularly at a site during migration).	***or***	(1) Island has **no** standing trees and/or surface water; *and* (2) Island is located >10 miles (16 km) from other islands and the mainland.	**and, if known,**	(1) Island attracts relatively high concentrations of migrants; *or* (2) Island **consistently** attracts >40 birds/ha at least once during migration.
30 points	Identified as stopover sites of **global** significance by the Important Bird Areas Program (1% or more of a global population occurring regularly at a site during migration).	***or***	(1) Island has standing trees and/or surface water; *and* (2) Island is located >10 miles (16 km) from other islands and the mainland.	**and, if known,**	(1) Island attracts relatively high concentrations of migrants; *or* (2) Island c**onsistently** attracts >40 birds/ha at least once during migration.

CRITERION GROUP: FISH

Criterion 5: Occurrence of Nursery/Spawning Areas for Native Interjurisdictional Fishes

Nearshore areas[7] of the Great Lakes, including nearshore areas of islands, provide critical spawning and nursery areas for many Great Lakes fishes (Manny and Kennedy 2004). Nearly all Great Lakes fish species use the nearshore waters for one or more critical life stages or functions. The island will score points under this criterion if:

1. One or more interjurisdictional species (species that migrate and move among different jurisdictions) or special concern species use the island nearshore and adjacent offshore habitats for spawning or nursery; and/or,
2. The island nearshore and offshore areas are suitable spawning and nursery habitats for interjurisdictional species or special concern species, irrespective of the amount of available habitat around an island.

We excluded two interjurisdictional fish species, Chinook Salmon (*Oncorhynchus tshawytscha*) and Coho Salmon (*Oncorhynchus kisutch*), from our scoring system because they are not native to the Great Lakes. We included abiotic criteria associated with nursery and spawning areas (Criterion 5, Part 2) so that all islands could be scored for this criterion.

Data Sources for Criterion 5

Information for Part 1 can be derived from several sources: the *Atlas of the Spawning & Nursery Areas of Great Lakes Fishes* (Goodyear et al. 1982)[8]; Environment Sensitivity Atlas (Environment Canada – Environmental Protection Branch 1994)[9]; fisheries reports produced by state, provincial, or federal natural resource management agencies (e.g., Hintz 2001); unpublished studies/validated personal observations; and, the U.S. Geological Survey Great Lakes Science Center[10]. Even though data in the *Atlas of Spawning & Nursery Areas of Great Lakes Fishes* are at least 20 years old and not available for all islands, this publication provides the most comprehensive, recent, and consistent basinwide documentation of spawning and nursery areas for the Great Lakes.

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[7] We adopted the following working definition of nearshore areas: "the near shore waters largely occupy a band of varying water depth around the perimeter of each lake between the land and deeper offshore waters of the lake. The band begins at the shoreline or the lakeward edge of the coastal wetlands and extends offshore to the deepest lake-bed depth contour at which the thermocline typically intersects with the lake bed in later summer or early fall" (*in* Bertram and Stadler-Salt 2000).

[8] Available for both United States and Canadian waters at http://www.glsc.usgs.gov/_files/atlas/volumes/volume01.pdf.

[9] Available at http://www.on.ec.gc.ca/search/metadata.cfm?ID=359&Lang=e.

[10] Contact Kurt Kowalski (kurt_kowalski@usgs.gov) for more information.

Part 2 can be assessed using digital medium-resolution vector maps of the Great Lakes and St. Lawrence River shoreline that were compiled by the Great Lakes Environmental Research Laboratory (GLERL)[11]. The data were originally produced by the Detroit District, U.S. Army Corps of Engineers and Water Issues Division of Environment Canada – Ontario Region for the International Joint Commission's Levels Reference Study, and used to assess the influence of lake levels on shore erosion. Additional information for Part 2 can be derived from substrate mapping, personal information, the Great Lakes Basin Ecosystem Team of the USFWS, or land cover data.

Criterion 5, Part 1: Known Use by Interjurisdictional Fish Species

Scoring Procedure for Criterion 5, Part 1. For each of the following species that uses the island and/or associated offshore habitats for spawning and/or nursery areas, 0.8 point is given. Islands can receive a maximum of 12 points for Part 1 of Criterion 5 (Table 9).

[11] See http://www.glerl.noaa.gov/data/char/ for more information.

Table 9. Scoring Procedure for Known Use by Interjurisdictional Fish Species[a]

Score	Common Name (Scientific Name)
0.8 points each	Lake Sturgeon (*Acipenser fulvescens*)
	American Eel[b] (*Anguilla rostrata*)
	Lean Lake Trout (*Salvelinus namaycush namaycush*)
	Deepwater Lake Trout (*Salvelinus namaycush* subspecies)
	Brook Trout (*Salvelinus fontinalis*)
	Atlantic Salmon[b] (*Salmo salar*)
	Kiyi (*Coregonus kiyi*)
	Shortjaw Cisco (*Coregonus zenithicus*)
	Bloater (*Coregonus hoyi*)
	Lake Herring (*Coregonus artedii*)
	Lake Whitefish (*Coregonus clupeaformis*)
	Northern Pike (*Esox lucius*)
	Yellow Perch (*Perca flavescens*)
	Eastern Sand Darter (*Ammocrypta pellucida*)
	Walleye (*Stizostedion vitreum vitreum*)

[a] These fish species are included because they are of particular interest to the USFWS in the Great Lakes.

[b] Native to Lake Ontario only.

Criterion 5, Part 2: Suitable Habitat for Interjurisdictional Fish Species

Scoring Procedure for Criterion 5, Part 2. If the island nearshore and offshore areas contain one or more of the following habitat types, then 3 points are given per habitat type, up to a maximum of 18 points (Table 10).

Table 10. Scoring Procedure for Suitable Habitat for Interjurisdictional Fish Species

Score	Habitat Type
3 points each	Gravel substrate
	Nearshore cobble/boulders
	Offshore shoals and reefs
	Shoreline wetlands/emergent aquatic vegetation
	Submerged aquatic vegetation
	Sand

CRITERION GROUP: ENDANGERED AND THREATENED SPECIES

Criterion 6: Number of State/Province Endangered and Threatened Species

Each Great Lakes state and province has identified species that are endangered or threatened within its jurisdiction. Some of these state- and provincially-listed species are also federally listed by the United States and Canada; federally listed species are addressed in Criterion 7. Some colonial nesting waterbird species, which were addressed in Criterion 1, are also endangered or threatened within states and provinces. We assigned fewer points for state- and provincially-listed species than for federally-listed species because more of the state- and provincially-listed endangered species are likely to be at the edge of their range rather than being of national or global concern. Some state and provincially listed species are globally secure and generally common. For example, the Yellow-throated Warbler (*Dendroica dominica*) is state-listed in Michigan but common in central and southern Ohio.

Data Sources for Criterion 6

Natural Heritage Programs and Conservation Data Centres are the recommended primary data sources for documented records of species in states and provinces (see Appendix V for a list of these programs). Not all sites with, or used by, a endangered or threatened species have been located, but these programs have compiled the best available information using field inventories, literature searches, breeding bird atlases, and numerous other sources. Additional information on species and communities used to score this criterion is available from NatureServe's Explorer (see http://www.natureserve.org/explorer/).

Scoring Procedure for Criterion 6

An island receives three points for each state- or provincially-listed endangered or threatened species that inhabits or consistently uses it, up to a maximum of 30 points. Each species can contribute a maximum of three points, regardless of the number of states and provinces that list the species.

Records of species habitation or use of an island must be no more than 25 years old. All state- or provincially-listed species receive three points regardless of their local population status (viable or non-viable) on the island in question because this information is frequently lacking. However, the islands should not receive points for species occurrences specifically recorded as "historic," "extirpated," or extremely poor quality. An island receives the same number of points (3) for each endangered or threatened species.

To avoid redundancy in scoring methods, federally listed species and colonial nesting waterbird species are excluded from consideration in this criterion.

Criterion 7: Number of Federally Endangered and Threatened Species

Canada and the United States maintain independent lists of endangered and threatened species. In the Great Lakes region, the Canadian list is considerably longer than the United States list, and includes many species whose range barely reaches Canada but are common in the United States (those with G5 ranks; see Appendix VI). Similarly, some of the species federally listed in the United States are common and widespread in Canada. The disparity in number of species listed in Canada, from a ranking perspective, results in potential bias in ranking Canadian islands compared to United States islands. To minimize bias, we propose that species federally listed in **both** Canada and the United States receive the most points, followed by species federally listed by **either** Canada or the United States, and finally those species listed as endangered or threatened by each state or province (see Criterion 6). Thus, islands with relatively large numbers of federally listed species and with species federally listed in both Canada and the United States will receive the highest number of points.

Data Sources for Criterion 7

Natural Heritage Programs and Conservation Data Centres are the recommended primary data sources for documented records of species in states and provinces (see Appendix V for a list of these programs). Not all sites with, or used by, a endangered or threatened species have been located, but these programs have compiled the best available information using field inventories, literature searches, breeding bird atlases, and numerous other sources. Additional information on species used to score this criterion is available from NatureServe's Explorer (see http://www.natureserve.org/explorer/).

Appendix VI lists the federally endangered or threatened species that may be found on Great Lakes islands in Canada and the United States. Lists of federally endangered and threatened species are available on the internet for both Canada (see http://www.cosewic.gc.ca/index.htm) and the United States (see http://ecos.fws.gov/tess_public/TESSWebpageUsaLists?state). A composite list of endangered or threatened species found in Canada and the United States is available from NatureServe (see http://www.natureserve.org).

Scoring Procedure for Criterion 7

Given these considerations and caveats, the following scoring procedure is proposed (Table 11). Records of species habitation or use of an island must be no more than 25 years old. All federally listed species present on an island are considered toward the point total regardless of their local population status (viable or non-viable) on the island in question because this information is frequently lacking or is not yet consistently ranked from one state or province to another. However, the islands should not receive points for species occurrences specifically recorded as "historic," "extirpated," or extremely poor quality. No distinction is made between endangered and threatened species. Candidate endangered and threatened species are not included. Canada listed species are not considered in the scoring procedure for United States islands, and U.S. listed species are not considered in the scoring procedure for Canadian islands.

Table 11. Scoring Procedure Used to Rank Islands for Federally Listed Species

Score	Number of Species
0 points	No federally listed endangered or threatened species occur on the island
5 points	1 single-nation species (a species that is federally listed in either Canadian or the United States but not both) occurs on the island but no binational species (species that is federally listed by both Canada and the United States)
10 points	2 single-nation species and no binational species
15 points	3 or more single-nation species and no binational species
20 points	1 binational species and any number (including 0) of single-nation species
25 points	2 binational species and any number (including 0) of single-nation species
30 points	3 or more binational species and any number (including 0) of single-nation species

CRITERION GROUP: SPECIES AND COMMUNITIES OF SPECIAL INTEREST

Criterion 8: Species and Communities Identified in the Conservation Blueprint for the Great Lakes

The Conservation Blueprint for the Great Lakes (U.S. portion) lists native species and natural communities of conservation interest (see The Nature Conservancy 2000). Nature Conservancy of Canada will complete a similar list and blueprint for the Canadian portion of the Great Lakes ecoregion by the end of 2004 (Henson and Brodribb, in prep.). In both the United States and Canadian Great Lakes blueprints, species and communities that are endemic, largely restricted to, or best represented in the Great Lakes ecoregion are identified as priority conservation targets. Those species and communities targeted in the U.S. portion of the Blueprint **and** found on Great Lakes islands are listed in Appendix VII. To avoid redundancy in scoring methods, species that are also either federally listed, state/province listed, or are colonial nesting waterbirds have been removed from the list in Appendix VII; they are already addressed by Criteria 1, 6, and 7.

Data Sources for Criterion 8

Natural Heritage Programs and Conservation Data Centres are the recommended primary data sources for documented records of species and communities in states and provinces (see Appendix V for a list of these programs). Not all sites having species and communities listed in Appendix VII have been located, but these programs have compiled the best available information on species and community occurrences using field inventories, literature searches, breeding bird atlases, and numerous other sources. Electronic copies of the Blueprints are available from the Great Lakes Program of The Nature Conservancy and Ontario office of the Nature Conservancy of Canada. Additional information on species and communities used to score this criterion is available from NatureServe's Explorer (see http://www.natureserve.org/explorer/).

Scoring Procedure for Criterion 8

An island receives three points for each species or community listed in Appendix VII that inhabits or consistently uses the island, up to a maximum of 30 points.

Records of species and communities on an island must be no more than 25 years old. All species and communities included in Appendix VII receive three points regardless of their biological "health" (or condition or quality) because this information is frequently lacking or is not yet consistently ranked from one state or province to another. However, the islands should not receive points for occurrences specifically recorded as "historic," "extirpated," or extremely poor quality.

Criterion 9: High Quality Sites for a Species or Community

Islands supporting the very best examples of a given species or community, across the species' or community's range, also receive points under Criterion 9. However, range-wide data sets allowing such determinations to be made, as noted earlier, are not readily available for most species and communities. Consequently, only islands that support very high quality sites for a G1-G3 species, T1-T3 subspecies or variety, or G1-G3 community in the Great Lakes will receive points. Species and communities to be scored under this criterion are listed in Appendix VIII.

Data Sources for Criterion 9

Natural Heritage Programs and Conservation Data Centres are the recommended primary data sources for documented records of species and communities in states and provinces (see Appendix V for a list of these programs). Not all sites having G1-G3 species, T1-T3 subspecies or varieties, and communities have been located, and many have not received quality ranks, but these programs have compiled the best available information using field inventories, literature searches, breeding bird atlases, and numerous other sources.

Scoring Procedure for Criterion 9

Points are added to an island's score if it has high quality occurrences of species, subspecies, varieties, or communities that have a NatureServe global rank of G1, G2, or G3, or T1, T2, or T3. An island may have up to 30 points for all ranked species and communities (Table 12).

High quality colonial nesting waterbird sites are addressed in Criterion 1 and therefore are not included in this scoring procedure. Under the NatureServe system for ranking the quality of species and community occurrences[12], occurrences ranked A, A?, or AB are considered high quality. Records of species and communities on an island must be no more than 25 years old.

Table 12. Scoring Procedure for Ranking High Quality Occurrences (with a Rank of A, A?, or AB) on Islands

Score	NatureServe Global Rank
5 points/taxon or community	G3, T3
7 points/taxon or community	G2, T2
10 points/taxon or community	G1, T1

[12] See chapter five of the Element Occurrence Data Standard available at http://whiteoak.abi.org/eodraft/.

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APPENDICES

APPENDIX I. LIST OF OTHER CRITERIA THAT COULD BE USED TO RANK ISLANDS IN THE GREAT LAKES

The following data layers are available from Nature Conservancy of Canada[1] for all islands in the Canadian portion of the Great Lakes: island perimeter, name (reference point) of each island, distance to nearest island/mainland, land use on the adjacent mainland, water depth around island (<2 m depth), biogeographic zones, mean air temperature, shoreline diversity (substrate type), maximum elevation of islands, vegetation type (25 m X 25 m resolution), special features (tracked element occurrences, endangered and threatened species, rare species, areas of natural and scientific interest, life science areas), ownership status, including protected status (i.e., national and provincial parks, Ontario Living Legacy lands, and Nature Conservancy of Canada properties), physiography, and development (e.g., roads, houses, marinas, airports, transmission lines, lighthouses etc.). The Great Lakes coastal aquatic gap analysis project (see http://www.glc.org/habitat/coastal_aquatic_gap.pdf) also provides data layers which can be used for ranking purposes (see http://www.glsc.usgs.gov/GLAP.htm)[2]. Data on island area, perimeter, shape diversity (perimeter, area, circumference relationship), distance to other islands/mainland, prevailing winds, circulation patterns, proximity to urban development, fragmentation by infrastructure will be available from the Great Lakes Basin Ecosystem Team of the U.S. Fish and Wildlife Service[3].

CONSERVATION VALUE

Isolated islands versus archipelagos of islands; distance from mainland, other islands
Island area
Island perimeter
Climatic buffer potential
Landform/physiography/physical uniqueness (e.g., soils, surficial deposits, bedrock geology)
Percent of island area in natural cover, other cover (i.e., land use)
Percent of island shoreline in natural cover (e.g., Environment Canada and United States Coast Guard 1994)
Wetlands on an island
Lakes on an island
Ecological complexity of shoreline
Ecological diversity of an island (uplands, wetland, bathymetry)
Extraordinary numbers of certain taxa
Representation: how well does an island or island archipelago represent the range of ecological diversity of islands in the Great Lakes basin (e.g., soils, bedrock, vegetation communities etc.)? (see Albert et al. 1997)
Flora (including application of Floristic Quality Index, floristic diversity)

[1] Contact Daniel Kraus (daniel.kraus@natureconservancy.ca) for more information.

[2] Contact Jim McKenna (jim_mckenna@usgs.gov) for more information.

[3] Contact Chris Castiglione (chris_castiglione@fws.gov) for more information.

Number of breeding bird species (potentially considering Partners in Flight ranks)
Number of disjunct species
Potential habitat for extirpated, endangered, threatened, and rare species
Associated reefs, shoals, rocks, sandbars

THREATS

Accessibility
Agriculture
Climate change
Contaminants (including atmospheric deposition)
Development (urban and recreational)
Dredging
Erosion (anthropogenically induced)
Fragmentation
Hydrological change
Inappropriate forestry
Introduced species
Invasive species, degree of infestation
Jetties
Lack of knowledge
Lack of understanding, commitment to protection
Land cover change (i.e., presettlement to 1992)
Mining
Noise, light pollution
Overabundant species (e.g., overbrowsing by herbivores such as deer or snowshoe hares)
Poaching
Recreational use
Regulated water levels
Shoreline hardening
Towers
Wind farms

OPPORTUNITIES AND FEASIBILITY: ABILITY TO ABATE THREATS

Ownership patterns
World Conservation Union (IUCN) protected status
Conservation lands
Public interest in conservation
Cost
Interest and will of advocates
Funding availability
Cultural values
Recreation
Historical

APPENDIX II. POTENTIAL CRITERIA TO RANK CONTAMINANTS FOR ISLAND ASSESSMENTS

Relatively few islands have contaminants (Judy Sefchick-Edwards, pers. comm.) although sediments in surrounding nearshore waters may be contaminated. Of those islands that have contaminants present, the level of contamination is typically low and usually associated with structures such as lighthouses and associated buildings and infrastructure. Potential contaminants include heavy metals (especially lead from paint, electrical equipment, pipelines, and lead shot, and mercury from lenses), organics from dumped or improperly stored paint, chemicals, and fuel, asbestos from insulation, and leakage from septic systems. Sites on islands with urban centers are more likely to suffer from contaminated surface water, groundwater, or soil from surrounding areas. Information on island contamination is available from the U.S. Coast Guard.

Given these concerns, we propose the following ranking system, which is built upon the U.S. Fish and Wildlife Service Environmental Assessment form. Note that the ranking for contaminants has negative values as contaminants generally lower the conservation value of an island.

Table II-1. Proposed Scoring Procedure for Contaminants

Score	Contaminant Presence
0 points	No known contaminants; **or** existing contaminants pose no threat to ecological or human health and do not require removal; **or** existing contaminants can be legally, safely, and inexpensively removed without permits or specialized equipment and specially trained personnel.
-10 points	Presence of heavy metals, fuels (oils and gas), asbestos, PCBs, or other materials (including nearshore sediments) that require removal with specialized equipment and specially trained personnel. Surface water, groundwater, and soil are not, or very locally, contaminated. No evidence of mineral extraction or dumps.
-20 points	Presence of heavy metals, fuels, asbestos, PCBs, or other materials that require removal with specialized equipment and specially trained personnel. One or more of the following are contaminated: nearshore sediments, surface water, groundwater, or soil; **or** there is evidence of mineral extraction or dumps.
-30 points	Presence of heavy metals, fuels, asbestos, PCBs or other materials that require removal with specialized equipment and specially trained personnel. Nearshore water/sediments, surface water, groundwater, and soil contamination is extensive. Mineral extraction and/or several dumps present.

APPENDIX III. RESULTS OF TESTING THE ISLAND RANKING SYSTEM

We applied the island ranking system to three groups of islands, one each in northern Lake Michigan (Michigan), the western Lake Erie basin (Ohio and Ontario), and Georgian Bay, Lake Huron (Ontario) (Map 1). The northern Lake Michigan islands were evaluated because they are relatively well known, under one jurisdiction (Michigan) and available data are most comparable. The western Lake Erie islands were selected to evaluate how the ranking system can be applied to a binational group of islands. The Georgian Bay islands were tested to see if relatively similar islands could be distinguished from each other by the ranking system. Furthermore, each of these island groups is: (1) a priority in the Conservation Blueprint for the Great Lakes; (2) heavily threatened by anthropogenic change; and, (3) of immediate interest to conservation groups.

The scores for each island in each island group are presented in Table III-1. These scores must be interpreted cautiously given the incomplete sets of data available to rank the islands. For Criterion 2 (shorebird stopover) and Criterion 3 (waterfowl stopover), no islands were known to support sufficient numbers of migratory waterfowl and/or shorebirds to score points, or data were lacking. These two criteria did not affect island rank. For the remaining criteria, many islands could be scored. It should be emphasized, however, that direct comparisons of scores, both within and among island groups, are usually not possible given the incomplete knowledge available for these islands.

For both the islands in northern Lake Michigan and the western Lake Erie basin, island scores varied widely (from the highest to lowest scores) and had approximately the same point range. This seems to reflect at least the large differences in size of the islands within each group, the local distribution of globally rare species and communities and the varying distances between islands. Scores for Georgian Bay islands were generally very similar (13 of 16 islands had identical scores) and ranked in the lower middle third of the islands scored.

Biodiversity value of islands are clearly distinguished from each other with this ranking system. Island groups (e.g., Beaver Island archipelago, and Pelee and Kelley's Islands in Lake Erie) identified as conservation sites in the Blueprint scored highly with the island ranking system. In addition, other islands not explicitly identified as conservation sites (e.g., Hog Island in Lake Michigan) ranked highly. The results of the ranking system, then, seem to be generally consistent with previous conservation planning efforts while providing additional information that can be used to fine-tune conservation actions for islands. Additional application of the ranking system will be useful to further test the value of the ranking procedures.

Map 1. Island Groups Included in the Test of the Ranking System

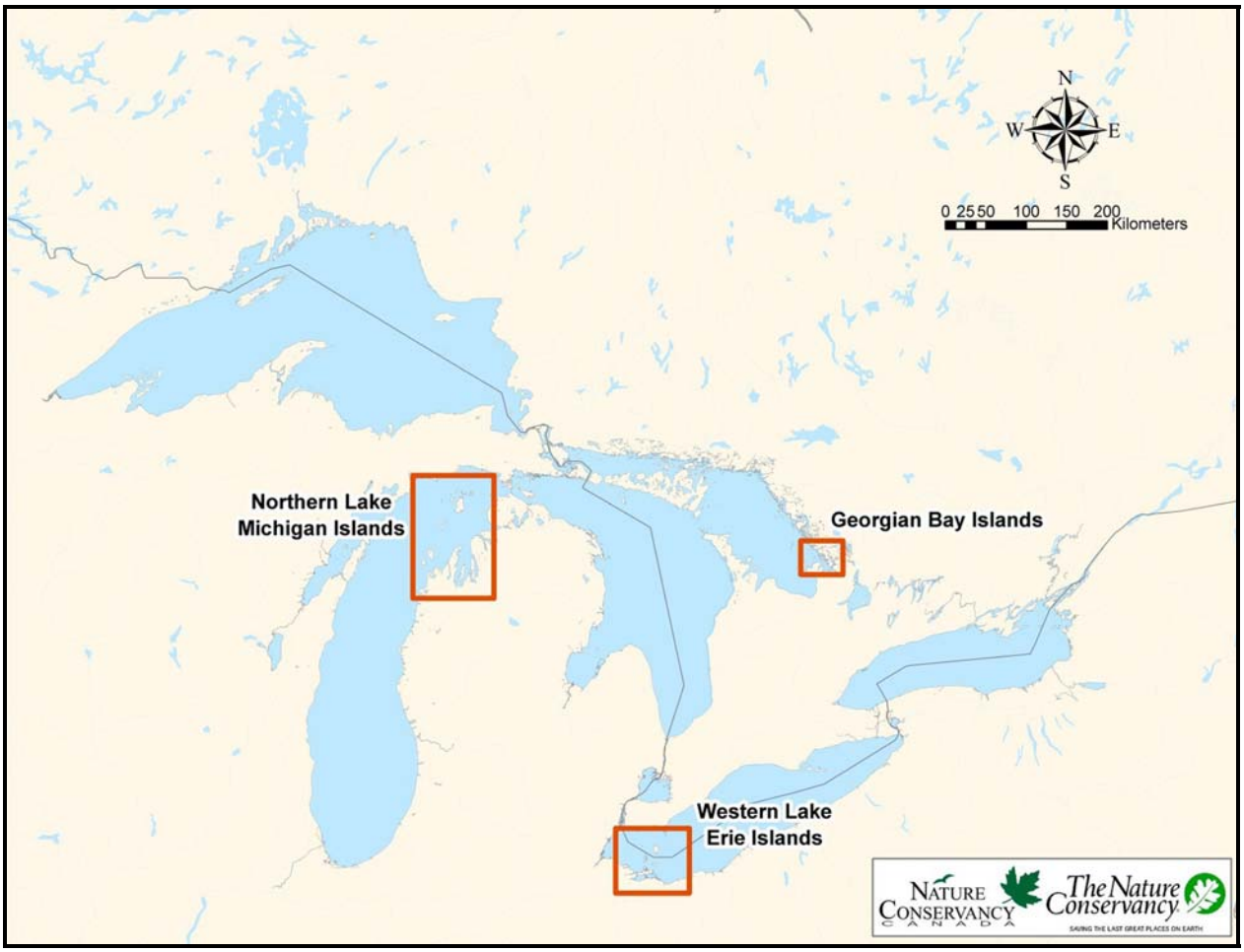

Table III-1. Island Scores from the Test of the Ranking System

Island (State/Province)	C1	C2	C3	C4	C5	C6	C7	C8	C9	Total Score
Northern Lake Michigan islands sorted by score:										
Beaver Island (MI)	4	0	0	10	11.4	30	25	3	20	103.4
Hog Island (MI)	4	0	0	0	8.4	18	20	0	40	90.4
South Manitou Island (MI)	3	0	0	10	4.6	24	20	3	20	84.6
South Fox Island (MI)	0	0	0	10	7.6	24	20	0	20	81.6
High Island (MI)	5.5	0	0	10	9.8	18	25	0	10	78.3
Garden Island (MI)	0	0	0	10	7.6	12	20	0	20	69.6
North Manitou Island (MI)	0	0	0	10	7.6	15	25	0	0	57.6
North Fox Island (MI)	0	0	0	10	4.6	12	20	0	0	46.6
Gull Island (MI)	6	0	0	20	10.6	0	0	0	0	36.6
Whiskey Island (MI)	3	0	0	10	7.6	0	0	0	0	20.6
Squaw Island (MI)	2	0	0	10	6.8	0	0	0	0	18.8
Trout Island (MI)	2	0	0	10	3.8	0	0	0	0	15.8
Hat Island (MI)	9	0	0	0	0.8	3	0	0	0	12.8
Grape Island (MI)	3	0	0	0	3.8	3	0	0	0	9.8
Shoe Island (MI)	0	0	0	0	0	3	0	0	0	3.0
Pismire Island (MI)	2	0	0	0	0.8	0	0	0	0	2.8

Table III-1. Continued

Island (State/Province)	C1	C2	C3	C4	C5	C6	C7	C8	C9	Total Score
Georgian Bay islands sorted by score:										
251-Alexander Islands - American Camp (ON)	0	0	0	0	6	6	10	9	0	31.0
253A-Alexander Islands (ON)	0	0	0	0	3	6	10	3	5	27.0
253-Alexander Islands (ON)	0	0	0	0	3	6	10	6	0	25.0
250C-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
250-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
250B-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
250D-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
251A-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
251C-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
252-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
252A-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
252B-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
253B-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
251B-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0
250A-Alexander Islands (ON)	0	0	0	0	3	6	10	3	0	22.0

Table III-1. Continued

Island (State/Province)	C1	C2	C3	C4	C5	C6	C7	C8	C9	Total Score
Western Lake Erie islands sorted by score:										
Pelee Island (ON)	12	0	0	30	19	27	25	18	7	138.0
Kelleys Island (OH)	1	0	0	10	18.2	30	25	6	0	90.2
North Bass Island (OH)	1	0	0	5	12.2	30	20	0	0	68.2
Middle Bass Island (OH)	0	0	0	0	12.2	30	25	0	0	67.2
East Sister Island (ON)	6	0	0	0	6.8	15	20	6	5	58.8
Middle Island (ON)	5	0	0	0	0.8	15	20	9	0	49.8
Middle Sister Island (ON)	1	0	0	0	6.8	9	20	3	5	44.8
West Sister Island (OH)	7	0	0	20	7.6	0	0	0	0	34.6
North Harbour Island (ON)	1	0	0	0	0	6	20	0	5	32.0
Hen Island (ON)	0	0	0	0	3.8	6	20	0	0	29.8
Green Island (OH)	1	0	0	0	6.8	18	0	0	0	25.8
Ballast Island (OH)	1	0	0	0	9.8	9	0	0	0	19.8
South Bass Island (OH)	0	0	0	0	12.2	0	0	0	0	12.2
Sugar Island (OH)	1	0	0	0	9	0	0	0	0	10.0
Rattlesnake Island (OH)	1	0	0	0	6.8	0	0	0	0	7.8
Starve Island (OH)	0	0	0	0	6.8	0	0	0	0	6.8
Harbor Island (ON)	0	0	0	0	0	0	0	0	5	5.0
Little Chicken Island (ON)	1	0	0	0	3.8	0	0	0	0	4.8
Big Chicken Island (ON)	1	0	0	0	3.8	0	0	0	0	4.8
Mouse Island (OH)	0	0	0	0	0.8	0	0	0	0	0.8
Chick Island (ON)	0	0	0	0	0	0	0	0	0	0

APPENDIX IV. ISLAND RANKING FORM

The following table is a copy of the Microsoft Excel-based form that can be used for scoring islands. Users will still need to refer to this report for detailed guidance on how to assign point totals. This form is contained in the file "Island Ranking Form.xls." Users can obtain an electronic copy of this form from the Great Lakes Program of The Nature Conservancy (greatlakes@tnc.org). Users can enter data for one island per form. The form will automatically tally both subtotals for various criteria groups and the total final score for the island.

A Microsoft Access 2000 database (Island Ranking.mdb) is also available from the Great Lakes Program. This database assumes the user has familiarity with Access tables and queries and with relational databases in general. It contains a table for each of the nine criteria, where users fill in points for the islands. Each criterion table's column headings are labeled, but if users are not sure what numbers or scores should go in each column, they can open the table in Design view, where it provides a description of what data should be stored in each column. Again, users will still need to refer to this report for detailed guidance on how to assign points. Each of the nine criterion scoring tables is linked to a table called "Great Lakes Island List," which is a master list of Great Lakes islands. If users are scoring islands, and an island of interest is not included in the pull-down menus for the nine criterion tables, just open the "Great Lakes Island List" and add the new island there. The new island will then automatically appear in the pull-down menus for the nine criteria scoring tables.

To get the total score for each island, users should run the query "Island Score." Users should note that **each** of the nine criteria for a given island **must** have a point value filled in, or else the query cannot calculate the island's final score. (So even if there are no data for a particular criterion at a given island, or if it receives zero points for the particular criterion, the island still needs to be added to that criterion's table and a score of zero entered.)

BIOLOGICAL RANKING CRITERIA FOR CONSERVATION OF ISLANDS IN THE LAURENTIAN GREAT LAKES

Scoring Sheet

Island Name: _____

Lake/Channel: _____

Criterion Group/Criterion	Description	Score	Maximum Possible Points
Criterion Group: Birds			
Criterion 1:	*Presence of nesting colonial waterbirds*		
	Part 1. General colonial waterbird use		
	Known breeding by selected species		9
	Top five breeding sites for selected species		4
	Total numbers of selected species		3
	Part 2. Common tern sites		
	Consistency of use		3
	History of recent use		3
	Productivity		3
	Potential for management		3
	Part 3. Marsh nesting tern sites		2
Criterion 2:	*Presence of roosting, foraging shorebirds*		30
Criterion 3:	*Presence of roosting, foraging waterfowl*		30
Criterion 4:	*Stopover sites for landbirds*		30
Subtotal		***0***	***120***
Criterion Group: Fish			
Criterion 5:	*Occurrence of nursery/spawning areas for native interjurisdictional fishes*		
	Part 1. Known use by interjurisdictional fish species		12
	Part 2. Suitable habitat for interjurisdictional fish species		18
Subtotal		***0***	***30***
Criterion Group: Endangered and Threatened Species			
Criterion 6:	*Number of state/provincial endangered and threatened species*		30
Criterion 7:	*Number of federally endangered and threatened species*		30
Subtotal		***0***	***60***
Criterion Group: Species and Communities of Special Interest			
Criterion 8:	*Species and communities identified in the Conservation Blueprint for the Great Lakes*		30
Criterion 9:	*High quality sites for a species or community*		30
Subtotal		***0***	***60***
Grand Total		**0**	**270**

APPENDIX V. LIST OF NATURAL HERITAGE PROGRAM CONTACTS (CURRENT AS OF AUGUST 2004)

Illinois Natural Heritage Database Program
Phone: (217) 782-2685
Web: http://dnr.state.il.us/conservation/naturalheritage/index.htm

Indiana Natural Heritage Data Center
Phone: (317) 232-4052
Web: http://www.state.in.us/dnr/naturepr/center.html

Michigan Natural Features Inventory
Phone: (517) 373-1552
Web: http://www.msue.msu.edu/mnfi

Minnesota Natural Heritage and Nongame Research
Phone: (651) 296-2835
Web: http://www.dnr.state.mn.us/ecological_services/nhnrp.index.html

New York Natural Heritage Program
Phone: (518) 402-8935
Web: http://www.nvnho.org

Ohio Natural Heritage Database
Phone: (614) 265-6543
Web: http://www.dnr.state.oh.us/odnr/dnap/dnap.html

Ontario Natural Heritage Information Centre
Phone: (705) 755-2159
Web: http://www.mnr.gov.on.ca/MNR/nhic/nhic.htm

Pennsylvania Natural Heritage Program (West)
Phone: (412) 288-2777
Web: http://www.paconserve.org

Quebec Conservation Data Centre
Web: http://www.menv.gouv.qc.ca/biodiversite/centre/htm

Wisconsin Natural Heritage Program
Phone: (608) 266-7012
Web: http://www.dnr.state.wi.us/org/land/er/nhi/index.htm

APPENDIX VI. FEDERALLY LISTED (CANADA AND/OR UNITED STATES) ENDANGERED OR THREATENED SPECIES ASSOCIATED WITH GREAT LAKES ISLANDS FOR SCORING CRITERION 7

Lists of federally endangered and threatened species are available on the internet for both Canada (see http://www.cosewic.gc.ca/index.htm) and the United States (see http://ecos.fws.gov/tess_public/TESSWebpageUsaLists?state).

NatureServe's global ranks[1] are also included in this list for reference. Current species rankings and other information is available from NatureServe's Explorer (see http://www.natureserve.org/explorer/). Global ranks (Granks) are defined as follows:

G1:	5 or fewer examples worldwide; critically imperiled
G2:	6-20 examples worldwide; imperiled
G3:	21-100 examples worldwide; vulnerable
G4:	>100 examples worldwide; apparently secure
G5:	Common; secure
GNR:	Rank not yet assessed ("**n**ot **r**anked")
H:	Possibly extinct ("**h**istoric")
T:	Indicates rank applies to a subspecies or variety
Q:	Indicates taxonomy is unresolved ("**q**uestionable")

[1] See http://www.natureserve.org/explorer/ranking.htm for more information on global ranks.

Table VI-1. Federally Listed (Canada and/or United States) Endangered or Threatened Species Associated with Great Lakes Islands for Scoring Criterion 7

Country Where Federally Listed	Common Name (Scientific Name)	Global Rank
Mollusks		
Canada & United States	Northern Riffleshell (*Epioblasma torulosa rangiana*)	G2T2
Canada	Snuffbox (*Epioblasma triquetra*)	G3
Canada	Wavy-rayed Lampmussel (*Lampsilis fasciola*)	G4
Canada	Rayed Bean (*Villosa fabalis*)	G2
Fish		
Canada	Shortjaw Cisco (*Coregonus zenithicus*)	G3
Canada	Lake Chubsucker (*Erimyzon sucetta*)	G5
Canada	Spotted Gar (*Lepisosteus oculatus*)	G5
Canada	Deepwater Sculpin (*Myoxocephalus thompsoni*)	G5
Canada	Pugnose Shiner (*Notropis anogenus*)	G3
Canada	Northern Madtom (*Notorus stigmosus*)	G3
Canada	Channel Darter (*Percina copelandi*)	G4
Insects		
United States	Hine's Emerald Dragonfly (*Somatochlora hineana*)	G2G3
United States	American Burying Beetle (*Nicrophorus americanus*)	G2G3
Amphibians		
Canada	Smallmouth Salamander (*Ambystoma texanum*)	G5
Canada	Blanchard's Cricket Frog (*Acris crepitans blanchardi*)	G5
Canada	Fowler's Toad (*Bufo fowleri*)	G5
Reptiles		
Canada & United States	Lake Erie Water Snake (*Nerodia sipedon insularum*)	G5T2
Canada	Blue Racer (*Coluber constrictor flaviventris*)	G5T5
Canada	Eastern Fox Snake (*Elaphe gloydi*)	G5T3
Canada	Black Rat Snake (*Elaphe obsoleta obsoleta*)	G5T5
Canada	Eastern Hognose Snake (*Heterodon platirhinos*)	G5
Canada	Queen Snake (*Regina septemvittata*)	G5
Canada	Eastern Massasauga (*Sistrurus catenatus catenatus*)	G3G4T3
Canada	Butler's Garter Snake (*Thamnophis butleri*)	G4
Canada	Spiny Softshell (*Apalone spinifera*)	G5
Canada	Common Musk Turtle (*Sternotherus odoratus*)	G5
Birds		
Canada & United States	Piping Plover (*Charadrius melodus*)	G3
Canada	Henslow's Sparrow (*Ammodramus henslowii*)	G3G4
Canada	Northern Bobwhite (*Colinus virginianus*)	G5
Canada	Acadian Flycatcher (*Empidonax virescens*)	G5
Canada	American Peregrine Falcon (*Falco peregrinus anatum*)	G4T3
Canada	Least Bittern (*Ixobrychus exilis*)	G5
Canada	Loggerhead Shrike (*Lanius ludovicianus*)	G4
Canada	Prothonotary Warbler (*Protonotaria citrea*)	G5
Canada	King Rail (*Rallus elegans*)	G4G5
Canada	Barn Owl (*Tyto alba*)	G5
Canada	Hooded Warbler (*Wilsonia citrina*)	G5
United States	Kirtland's Warbler (*Dendroica kirtlandii*)	G1
United States	Bald Eagle (*Haliaeetus leucocephalus*)	G4

Table VI-1. Continued

Country Where Federally Listed	Common Name (Scientific Name)	Global Rank
Mammals		
Canada	Caribou (*Rangifer tarandus*)	G5
Canada	Gray Fox (*Urocyon cineroargentatus*)	G5
United States	Indiana Bat (*Myotis sodalis*)	G2
United States	Eastern Gray Wolf (*Canis lupus*)	G4
United States	Puma (*Puma concolor couguar*)	G5TH
Plants		
Canada & United States	Pitcher's Thistle (*Cirsium pitcheri*)	G3
Canada & United States	Lakeside Daisy or Rubberweed (*Hymenoxys herbacea*)	G2
Canada & United States	Prairie White-fringed Orchid (*Platanthera leucophaea*)	G2
Canada	Scarlet Ammannia (*Ammannia robusta*)	G5
Canada	Forked Three-awned Grass (*Aristida basiramea*)	G5
Canada	Gattinger's Agalinis (*Agalinis gattingeri*)	G4
Canada	Skinner's Agalinis (*Agalinis skinneriana*)	G3
Canada	Wild Hyacinth (*Camassia scilloides*)	G4G5
Canada	Small White Lady's-slipper (*Cypripedium candidum*)	G4
Canada	Horsetail Spikerush (*Eleocharis equisetoides*)	G4
Canada	Kentucky Coffeetree (*Gymnocladus dioica*)	G5
Canada	Golden Seal (*Hydrastis canadensis*)	G4
Canada	American Water-willow (*Justicia americana*)	G5
Canada	Dense Blazing Star (*Liatris spicata*)	G5
Canada	Cucumber Tree (*Magnolia acuminata*)	G5
Canada	Red Mulberry (*Morus rubra*)	G5
Canada	Eastern Prickly Pear Cactus (*Opuntia humifosa*)	G5
Canada	American Ginseng (*Panax quinquefolius*)	G3G4
Canada	Pink Milkwort (*Polygala incarnate*)	G5
Canada	Hop Tree (*Ptelea trifoliate*)	G5
Canada	Climbing Prairie Rose (*Rosa setigera*)	G5
Canada	Deerberry (*Vaccinium stamineum*)	G5
United States	Dwarf Lake Iris (*Iris lacustris*)	G3
United States	Small Whorled Pogonia (*Isotria medeoloides*)	G2
United States	Michigan Monkey-flower (*Mimulus glabratus michiganensis*)	G5T1
United States	Houghton's Goldenrod (*Solidago houghtonii*)	G3

APPENDIX VII. SPECIES INCLUDED IN THE CONSERVATION BLUEPRINT FOR THE GREAT LAKES (U.S.) FOR SCORING CRITERION 8

Species and communities included in the Conservation Blueprint for the Great Lakes (The Nature Conservancy 2000, The Nature Conservancy 1999, and Ewert 1999) that occur on Great Lakes islands are used to score Criterion 8. To avoid double-counting, those species that are both included in the Blueprint and federally listed in Canada and/or the United States are excluded from this list and scoring procedure.

SPECIES

Table VII-1 is a list of animal and plant species included in the Blueprint and used to score Criterion 8. Federally endangered or threatened species are not included in this list because these species are considered under Criterion 7. Additional information about these species is available from NatureServe's Explorer (see http://www.natureserve.org/explorer/).

COMMUNITIES

Plant communities listed in Table VII-2 are either endemic to the Great Lakes basin or largely limited[1] to the Great Lakes basin and are known or likely to occur on Great Lakes islands. Most of these communities are globally rare. Descriptions of these communities are available on-line from NatureServe's Explorer (see http://www.natureserve.org/explorer/) or by request from Natural Heritage programs in each state or province. Some community names have been updated since the Great Lakes plan was completed; not all of those changes are reflected here. However, the unique identifiers are unchanged.

[1] Primarily located in the Great Lakes ecoregion (as defined by The Nature Conservancy) but also extending to one or two other ecoregions (The Nature Conservancy 1999).

Table VII-1. Species Included in the Conservation Blueprint for the Great Lakes (U.S.) for Scoring Criterion 8

Common Name (Scientific Name)	Global Rank[a]
Mollusks	
Round Pigtoe (*Pleurobema sintoxia*)	G4
Salamander Mussel (*Simpsonaias ambigua*)	G2
Hubricht's Vertigo (*Vertigo hubrichti*)	G3
Insects	
Lake Huron Locust (*Trimerotropis huroniana*)	G2G3
Fish	
Lake Sturgeon (*Acipenser fulvescens*)	G3
Birds	
American Bittern (*Botaurus lentiginosus*)	G4
Black Tern (*Chlidonias niger*)	G4
Sedge Wren (*Cistothorus platensis*)	G5
Trumpeter Swan (*Cygnus buccinator*)	G4
Black-throated Blue Warbler (*Dendroica caerulescens*)	G5
Cerulean Warbler (*Dendroica caerulea*)	G4
Prairie Warbler (*Dendroica discolor*)	G5
Wood Thrush (*Hylocichla mustelina*)	G5
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	G5
Black-and-white Warbler (*Mniotilta varia*)	G5
Connecticut Warbler (*Oporornis agilis*)	G4
American White Pelican (*Pelecanus erythrorhynchos*)	G4
Sharp-tailed Grouse (*Tympanuchus phasianellus*)	G4
Golden-winged Warbler (*Vermivora chrysoptera*)	G4
Blue-winged Warbler (*Vermivora pinus*)	G5
Canada Warbler (*Wilsonia canadensis*)	G5
Plants	
Cooper's Milkvetch (*Astragulus neglectus*)	G4
Prairie Dunewort (*Botrychium campestre*)	G3G4
Western Moonwort (*Botrychium hesperium*)	G3G4
Rugulose Grape-fern (*Botrychium rugulosum*)	G3
Spoon-leaf Moonwort (*Botrychium spathulatum*)	G3
Hill's Thistle (*Cirsium hillii*)	G3
Ram's Head Lady's Slipper (*Cypripedium arietinum*)	G3
Hill's Pondweed (*Potamogeton hillii*)	G3
Yellow Pitcher Plant (*Sarracenia purpurea* f. *heterophylla*)	G5T2
Great Plains Ladies'-tresses (*Spiranthes magnicamporum*)	G3G4

[a] See Appendix VII or http://www.natureserve.org/explorer/ranking.htm for information on global ranks.

Table VII-2. Communities Included in the Conservation Blueprint for the Great Lakes (U.S.) for Scoring Criterion 8

Common Name	Great Lakes Distribution	Global Rank[a]	Unique Identifier Used by NatureServe
Great Lakes Alkaline Cobble / Gravel Shore	Endemic	G3G4	CEGL005169
Great Lakes Alkaline Open Bluff - Cliff	Endemic	G4G5	CEGL002504
Great Lakes Basalt (Conglomerate) Bedrock Lakeshore	Endemic	GNR	CEGL005215
Great Lakes Beach	Endemic	G3?	CEGL005162
Great Lakes Beachgrass Dune	Endemic	G3G5	CEGL005098
Great Lakes Coastal Marsh Complex	Endemic	G1G3	CECX002002
Great Lakes Dune and Swale	Endemic	G3	CES201.726
Great Lakes Dune Pine Forest	Endemic	G3Q	CEGL002589
Great Lakes Granite (Metamorphic) Rocky Shore	Endemic	GNR	CEGL005216
Great Lakes Granite / Metamorphic Cliff	Endemic	GNR	CEGL005244
Great Lakes Limestone Bedrock Lakeshore	Endemic	G3	CEGL002506
Great Lakes Non-Alkaline Cobble / Gravel Shore	Endemic	G3G4	CEGL002508
Great Lakes Non-Alkaline Open Bluff - Cliff	Endemic	G4G5	CEGL002503
Great Lakes Non-Alkaline Rocky Shore	Endemic	G3G4	CEGL002507
Great Lakes Pine Barrens	Endemic	G2	CEGL005125
Great Lakes Pondweed Submerged Aquatic Wetland	Endemic	GNR	CEGL005152
Great Lakes Shallow Marsh	Endemic	GNR	CEGL005217
Great Lakes Shoreline Cattail Marsh	Endemic	G4?	CEGL005114
Great Lakes Shoreline Cattail - Bulrush Marsh	Endemic	G4?	CEGL005112

Table VII-2. Continued

Common Name	Great Lakes Distribution	Global Rank[a]	Unique Identifier Used by NatureServe
Great Lakes Spruce - Fir Basalt Bedrock Shore	Endemic	GNR	CEGL005214
Interdunal Wetland	Endemic	G3?	CEGL005105
Lakeplain Wet Prairie	Endemic	G2G3	CEGL005109
Lakeplain Wet-Mesic Oak Openings	Endemic	G1	CEGL005120
Lakeplain Wet-Mesic Prairie	Endemic	G2	CEGL005095
Sand Cherry Dune Shrubland	Endemic	G2Q	CEGL005075
Shagbark Hickory / Prickly Ash Alvar Woodland	Endemic	GNR	CEGL005230
Twigrush Wet Prairie	Endemic	G2G3	CEGL005104
White Spruce Rocky Woodland[b]	Endemic	GNR	CEGL005196
Alvar Nonvascular Pavement	Limited	G2	CEGL005192
Annual Alvar Pavement – Grassland	Limited	G2	CEGL005235
Basswood - Ash - Maple Woodland	Limited	G3G5	CEGL005058
Beech - Hardwoods Till Plain Flatwoods	Limited	G2G3	CEGL005173
Boreal Calcareous Seepage Fen	Limited	G2Q	CEGL002496
Chinquapin Oak / Nodding Onion Alvar Woodland	Limited	G1?	CEGL005133
Common Juniper Rocky Krummholz	Limited	G3G4	CEGL005065
Cottonwood Dune	Limited	G1G2	CEGL005119
Creeping Juniper - Shrubby Cinquefoil Alvar Pavement	Limited	G2	CEGL005236
Great Lakes Hemlock - Beech - Hardwood Forest	Limited	G4G5	CEGL005042
Igneous Dripping Bluff / Cliff	Limited	GNR	CEGL002300
Inland Coastal Plain Marsh	Limited	G2?	CEGL005108
Jack Pine / Prairie Forbs Barrens	Limited	G2	CEGL002490
Juniper Alvar Shrubland	Limited	G3	CEGL005212

Table VII-2. Continued

Common Name	Great Lakes Distribution	Global Rank[a]	Unique Identifier Used by NatureServe
Lakeplain Mesic Oak Woodland	Limited	G2	CEGL005054
Leatherleaf - Sweetgale Shore Fen	Limited	GNR	CEGL005228
Little Bluestem Alvar Grassland	Limited	G2	CEGL005234
Midwest Wet-Mesic Dolomite Prairie	Limited	G1G2	CEGL005180
Mixed Conifer / Common Juniper Alvar Woodland	Limited	G2?	CEGL005126
Northeastern Cinquefoil - Sedge Fen	Limited	G3G4	CEGL005140
Northern (Great Lakes) Flatwoods	Limited	G2G3	CEGL005037
Northern White Cedar / Bristleleaf Sedge Forest	Limited	GNR	CEGL006021
Poverty Grass Dry Alvar Grassland	Limited	GNR	CEGL005100
Red Cedar / Early Buttercup Alvar Woodland	Limited	G3?	CEGL005122
River Ledge Alvar Grassland	Limited	G1	CEGL005233
River Ledge Sandstone Pavement	Limited	GNR	CEGL002302
Spruce - Cedar Wet Alvar Woodland	Limited	G1G2	CEGL005211
Sugar Maple - Oak - Hickory Limestone Woodland	Limited	G3	CEGL005059
Tufted Hairgrass Wet Alvar Grassland	Limited	G2	CEGL005110
Twigrush Wet Meadow	Limited	G3G5	CEGL005103
White Cedar Alvar Savanna	Limited	G1G2	CEGL005132
White Cedar Limestone Bedrock Woodland	Limited	G3	CEGL005050

Table VII-2. Continued

Common Name	Great Lakes Distribution	Global Rank[a]	Unique Identifier Used by NatureServe
White Cedar Limestone Talus Woodland	Limited	G3G4	CEGL005172
White Oak - Bur Oak Openings	Limited	G1	CEGL005121
White Pine - White Oak Barrens	Limited	G2?	CEGL005127

[a] See Appendix VII or http://www.natureserve.org/explorer/ranking.htm for information on global ranks.

[b] Not in original ecoregional plan (The Nature Conservancy 1999).

[c] Originally listed as peripheral to Great Lakes ecoregion, but current information suggests it is limited to Great Lakes and one or two other ecoregions.

APPENDIX VIII. G1-G3 OR T1-T3 SPECIES AND COMMUNITIES FOR SCORING CRITERION 9

Species and communities found on Great Lakes islands with a rounded global rank[1] of G1-G3 or T1-T3 are used to score Criterion 9.

[1] See Appendix VI or http://www.natureserve.org/explorer/ranking.htm for information on global ranks.

Table VIII-1. G1-G3 or T1-T3 Species Found in the Great Lakes Ecoregion for Scoring Criterion 9

Common Name (*Scientific Name*)	Global Rank	Unique Identifier Used by NatureServe
Birds		
Piping Plover (*Charadrius melodus*)	G3	ABNNB03070
Henslow's Sparrow (*Ammodramus henslowii*)	G3G4	ABPBXA0030
Kirtland's Warbler (*Dendroica kirtlandii*)	G1	ABPBX03180
American Peregrine Falcon (*Falco peregrinus anatum*)	G4T3	ABNKD06071
Migrant Loggerhead Shrike (*Lanius ludovicianus migrans*)	G5T3Q	ABPBR01037
Reptiles		
Eastern Fox Snake (*Elaphe gloydi*)	G5T3	ARADB13061
Lake Erie Water Snake (*Nerodia sipedon insularum*)	G5T2	ARADB22061
Eastern Massasauga (*Sistrurus catenatus catenatus*)	G3G4T3	ARADE03011
Fish		
Lake Sturgeon (*Acipenser fulvescens*)	G3	AFCAA01020
Shortjaw Cisco (*Coregonus zenithicus*)	G3	AFCHA01140
Pugnose Shiner (*Notropis anogenus*)	G3	AFCJB28080
Northern Madtom (*Notorus stigmosus*)	G3	AFCKA02220
Insects		
Hine's Emerald Dragonfly (*Somatochlora hineana*)	G2G3	IIODO32110
American Burying Beetle (*Nicrophorus americanus*)	G2G3	IICOL42010
Lake Huron Locust (*Trimerotropis huroniana*)	G2G3	IIORT36010
Mollusks		
Northern Riffleshell (*Epioblasma torulosa rangiana*)	G2T2	IMBIV16184
Snuffbox (*Epioblasma triquetra*)	G3	IMBIV16190
Hubricht's Vertigo (*Vertigo hubrichti hubrichti*)	G2T2	IMGAS20381
Rayed Bean (*Villosa fabilis*)	G2	IMBIV47050
Salamander Mussel (*Simpsonaias ambigua*)	G2	IMBIV41010
Mammals		
Indiana Bat (*Myotis sodalis*)	G2	AMACC01100
Plants		
Pitcher's Thistle (*Cirsium pitcheri*)	G3	PDAST2E2A0
Hill's Thistle (*Cirsium hillii*)	G3	PDAST2E1C0
Lakeside Daisy (*Hymenoxys herbacea*)	G2	PDASTDY060
Houghton's Goldenrod (*Solidago houghtonii*)	G3	PDAST8P0W0
Dwarf Lake Iris (*Iris lacustris*)	G3	PMIRI090H0
Skinner's Agalinis (*Agalinis skinneriana*)	G3	PDSCR010T0
Yellow Pitcher Plant (*Sarracenia purpurea* ssp *heterophylla*)	G5T2	PDSAR02073
Michigan Monkey-flower (*Mimulus glabratus* var *michiganensis*)	G5T1	PDSCR1B1A3
Small Whorled Pogonia (*Isotria medeoloides*)	G2	PMORC1F010
Prairie White-fringed Orchid (*Platanthera leucophaea*)	G2	PMORC1Y0F0
American Ginseng (*Panax quinquefolius*)	G3G4	PDARA09010
Prairie Dunewort (*Botrychium campestre*)	G3G4	PPOPH010W0

Table VIII-1. Continued

Common Name (*Scientific Name*)	Global Rank	Unique Identifier Used by NatureServe
Western Moonwort (*Botrychium hesperium*)	G3G4	PPOPH010Q0
Rugulose Grape-fern (*Botrychium rugulosum*)	G3	PPOPH010P0
Spoon-leaf Moonwort (*Botrychium spathulatum*)	G3	PPOPH01140
Ram's Head Lady's Slipper (*Cypripedium arietinum*)	G3	PMORC0Q020
Great Plains Ladies'-tresses (*Spiranthes magnicamporum*)	G3G4	PMORC2B0K0
Hill's Pondweed (*Potamogeton hillii*)	G3	PMPOT030F0
Laurentian Bladder Fern (*Cystopteris laurentiana*)	G3	PPDRY07040

Table VIII-2. G1-G3 Communities Found in the Great Lakes Ecoregion for Scoring Criterion 9

Community Name	Global Name	Global Rank	Unique Identifier Used by NatureServe
Wooded Dune and Swale Complex	Wooded Dune and Swale Complex	G3	CECX002000
Great Lakes Coastal Wetlands Complex		G3G4	CECX005702
Midwest Dry-Mesic Prairie	*Schizachyrium scoparium - Sorghastrum nutans - Bouteloua curtipendula* Dry - Mesic Herbaceous Vegetation	G2G3	CEGL002214
Midwest Dry Sand Prairie	*Schizachyrium scoparium - Danthonia spicata - Carex pensylvanica* - (*Viola pedata*) Herbaceous Vegetation	G2G3	CEGL002318
Red Pine / Blueberry Dry Forest	*Pinus resinosa / Vaccinium* spp. Forest	G3	CEGL002443
White Pine / Blueberry Dry-Mesic Forest	*Pinus strobus* / *Vaccinium* spp. Forest	G3G4	CEGL002444
White Pine / Mountain Maple Mesic Forest	*Pinus strobus* / *Acer spicatum - Corylus cornuta* Forest	G3G4	CEGL002445
Maple - Yellow Birch Northern Hardwoods Forest	*Acer saccharum - Betula alleghaniensis* - (*Tilia americana*) Forest	G3G4	CEGL002457
Northern Maple - Basswood Forest	*Acer saccharum - Tilia americana / Ostrya virginiana* Northern Forest	G3?	CEGL002458
White Pine - Red Oak Forest	*Pinus strobus* - (*Pinus resinosa*) - *Quercus rubra* Forest	G3	CEGL002480
Black Oak / Lupine Barrens	*Quercus velutina* - (*Quercus alba*) - *Quercus ellipsoidalis* / *Schizachyrium scoparium - Lupinus perennis* Wooded Herbaceous Vegetation	G3	CEGL002492
Great Lakes Limestone Bedrock Lakeshore	*Potentilla fructicosa* / *Calamintha arkansana - Potentilla anserina - Primula mistassinica* Sparse Vegetation	G3	CEGL002506
Great Lakes Non-Alkaline Rocky Shore	Non-alkaline Bedrock Great Lakes Shore Herbaceous Vegetation	G3G4	CEGL002507

Table VIII-2. Continued

Community Name	Global Name	Global Rank	Unique Identifier Used by NatureServe
Great Lakes Non-Alkaline Cobble/Gravel Shore	Non-alkaline Cobble - Gravel Great Lakes Shore Sparse Vegetation	G3G4	CEGL002508
Great Lakes White Pine – Hemlock Forest	*Pinus strobus* - *Tsuga canadensis* Great Lakes Forest	G3?	CEGL002590
White Cedar – (Hemlock) Mesic Forest	*Thuja occidentalis* - (*Betula alleghaniensis* – *Tsuga Canadensis*) Forest	G3?	CEGL002595
Hemlock Mesic Forest	*Tsuga canadensis* - (*Betula alleghaniensis*) Mesic Forest	G3G4	CEGL002598
Hemlock – Yellow Birch Wet-Mesic Forest	*Tsuga canadensis* - *Betula alleghaniensis* Saturated Forest	G3	CEGL005003
White Cedar Limestone Bedrock Woodland	*Thuja occidentalis* Limestone Bedrock Woodland	G3	CEGL005050
Sugar Maple-Oak-Hickory Limestone Woodland	*Acer saccharum* - *Ostrya virginiana* - *Carya ovata* - *Quercus rubra* Limestone Woodland	G3	CEGL005059
Common Juniper Rocky Krummholz	(*Quercus rubra*) - *Juniperus communis* / *Juniperus horizontalis* - *Arctostaphylos uva-ursi* Shrubland	G3G4	CEGL005065
Dogwood – Willow – Poison Sumac Shrub Fen	*Cornus amomum* - *Salix* spp. - *Rhus vernix* - *Rhamnus lanceolata* Fen Shrubland	G2G3	CEGL005087
Leatherleaf Kettle Bog	*Chamaedaphne calyculata* Relict Bog Dwarf-shrubland	G3G4	CEGL005092
Interdunal Wetland	*Pentaphylloides floribunda / Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceous Vegetation	G3?	CEGL005105
Interdunal Wetland	*Pentaphylloides floribunda* / *Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceous Vegetation	G3?	CEGL005105
Tufted Hairgrass Wet Alvar Grassland	*Deschampsia cespitosa* - (*Sporobolus heterolepis* - *Schizachyrium scoparium*) - *Carex crawei* - *Senecio pauperculus* Herbaceous Vegetation	G2	CEGL005110
Cottonwood Dune	*Populus deltoides* - (*Juniperus virginiana*) Dune Woodland	G1G2	CEGL005119

Table VIII-2. Continued

Community Name	Global Name	Global Rank	Unique Identifier Used by NatureServe
White Oak - Bur Oak Openings	*Quercus alba* - *Quercus macrocarpa* / *Andropogon gerardii* Wooded Herbaceous Vegetation	G1G3	CEGL005121
Red Cedar / Early Buttercup Alvar Woodland	*Juniperus virginiana* / *Ranunculus fascicularis* Woodland	G3?	CEGL005122
Great Lakes Pine Barrens	*Pinus banksiana* - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation	G2	CEGL005125
Mixed Conifer / Common Juniper Alvar Woodland	*Pinus banksiana* - *Thuja occidentalis* - *Picea glauca* / *Juniperus communis* Woodland	G2?	CEGL005126
White Pine - White Oak Barrens	*Pinus strobus* - *Quercus alba* - (*Quercus ellipsoidalis*) / *Carex pensylvanica* Wooded Herbaceous Vegetation	G2?	CEGL005127
White-cedar - Jack Pine / Shrubby-cinquefoil Alvar Savanna	*Thuja occidentalis* Alvar Wooded Herbaceous Vegetation	G1G2	CEGL005132
Chinquapin Oak / Nodding Onion Alvar Woodland	*Quercus muhlenbergii* / *Poa* spp. - *Allium cernuum* - *Eleocharis compressa* / *Aulacomnium palustre* Woodland	G1?	CEGL005133
Great Lakes Beach	*Cakile edentula* Great Lakes Shore Sparse Vegetation	G3?	CEGL005162
Great Lakes Alkaline Cobble/Gravel Shore	Alkaline Cobble - Gravel Great Lakes Shore Sparse Vegetation	G3G4	CEGL005169
White Cedar Limestone Talus Woodland	*Thuja occidentalis* Limestone Talus Woodland	G3G4	CEGL005172
Alvar Nonvascular Pavement	*Tortella tortuosa* - *Cladonia pocillum* - *Placynthium* spp. Sparse Vegetation	G2	CEGL005192
Spruce-Cedar Wet Alvar Woodland	*Picea glauca* - *Thuja occidentalis* - *Juniperus communis* / *Iris lacustris* - *Carex eburnea* Shrubland	G1G2	CEGL005211
Spruce-Cedar Wet Alvar Woodland	*Picea glauca* - *Thuja occidentalis* - *Juniperus communis* / *Iris lacustris* - *Carex eburnea* Shrubland	G1G2	CEGL005211
Common Juniper - Mixed Deciduous Dry Alvar Shrubland	*Juniperus communis* - *Rhus aromatica* - *Viburnum rafinesquianum* / *Solidago ptarmicoides* Shrubland	G3	CEGL005230

Table VIII-2. Continued

Community Name	Global Name	Global Rank	Unique Identifier Used by NatureServe
River Ledge Alvar Grassland	*Spartina pectinata - Muhlenbergia richardsonis - Sporobolus heterolepis - Solidago ptarmicoides - Euthamia graminifolia* Herbaceous Vegetation	G1	CEGL005233
Little Bluestem Alvar Grassland	*Sporobolus heterolepis - Schizachyrium scoparium* (*Carex scirpoidea* / *Juniperus horizontalis*) herbaceous vegetation	G2	CEGL005234
Annual Alvar Pavement-Grassland	Sporobolus neglectus - S. vaginiflorus - Trichostema brachiatum - Panicum philadelphicum - (Poa compressa) herbaceous vegetation	G2	CEGL005235
Creeping Juniper - Shrubby Cinquefoil Alvar Pavement	*Juniperus horizontalis - Pentaphylloides floribunda* / *Schizachyrium scoparium - Carex richardsonii* Dwarf-Shrubland	G2	CEGL005236
Bur Oak Limestone Savanna	*Quercus macrocarpa / Danthonia spicata* - (*Geum triflorum*) Limestone Wooded Herbaceous Vegetation	G1?	CEGL005237