Resource Conservation Opportunities and Management Guidelines

The general ecosystem integrity of lakes is dependent on preserving natural habitat components and the processes that sustain them. These include water quality, aquatic vegetation, submerged deadwood, and naturally sloped and vegetated shorelines. Natural systems vary in productivity and diversity and maximum natural diversity should be maintained in individual lakes. It is the goal of the state to encourage the lasting conservation of biological diversity (Michigan Natural Resources and Environmental Code, P. A. 451, 1994, Part 355). Suitable natural and diverse habitat allows existence of productive and diverse animal communities.

Human development and vegetation control activities threaten habitat, productivity, and diversity of biological communities in our lakes. Habitat degradation continues to increase as human populations increase and lake properties become more developed. Some of the most prominent development activities directly affecting lakes presently include dredging for marinas and docks; filling for yard, building and seawall development; and vegetation removal programs along the shoreline and within the lake. Land use in the uplands of the watershed can significantly affect lake water quality, especially with respect to nutrients.

Most moderate and large lakes have the morphometry that provides for both the establishment of rooted vegetation in the littoral zone and a larger open water zone in the middle of the lake. This pattern has not changed since the earliest map records were made in Michigan. In other words, the vegetated areas of most lakes today are the same as in recent history. Management of public trust resources requires suitable preservation and management of this important habitat component. Recreation and reasonable use of a lake by property owners is also a management goal of the Department of Natural Resources. The objectives of lake management programs are to optimize social benefits, insure sustainable resources for the future, and maintain ecosystem integrity. Management of natural resources requires consideration of the affects of all alterations caused by development on and in a lake. It must also be recognized that some lakes are shallow and have always had vegetation growing throughout the lake. This is a natural condition of some lakes. Extensive native vegetation removal and alteration should not occur in these natural ecosystems, or a healthy system and its multiple benefits can be lost.

Non-indigenous species can threaten native vegetation and reduce overall diversity and community productivity in some situations. At present, species of concern include Eurasian water-milfoil, curly-leaf pondweed, purple loosestrife, and *Phragmites*.

Resource Assessments and Management Plans

Watershed assessments and plans should be developed for all lakes. Assessments provide a complete historical and present review of the lake's physical, biological, and social characteristics. Suitable plans can then be made to insure proper management for long-term health of the ecosystem, and allow reasonable public and riparian use. Basic criteria and outlines are listed in Appendix 9.

Overall Development

Alteration or development of Michigan lakes should not exceed 25% of any habitat component, water quality should be maintained within Michigan Surface Water Quality Standards, and no loss of navigable waters should occur. Development of 25% or less of the lake is recommended to provide reasonable riparian owner access and recreational use, while preserving ecological integrity, sustaining natural resources for future generations, and protecting the public trust. Development

activities should be viewed from a whole lake perspective, as well as individual habitat components and individual properties. Examples of habitat components include shoreline slope and structure, vegetation (trees and shrubs) within the shoreline ecotone, emergent and submergent vegetation (distribution, composition, and architecture), submerged deadwood, lake level, bottom contours and composition, and surface water area. These objectives can be achieved on individual properties by maintaining naturally sloped shorelines, with a 35-ft vegetated buffer strip above the ordinary high water mark, and using 25% or less of the shoreline property for access and use of the lake. Boat docks and other structures should not interfere with navigation or natural movements of water or animals. A narrow boating lane can be cut through dense surface vegetation if needed, while preserving the ecological values and wave dampening features of this important habitat component.

The natural habitat features of many lakes are presently altered well beyond 25% and will require considerable restoration effort. The cumulative effects of habitat alterations must be considered in all lake management activities, including legal permitting activities for development. Cumulative habitat effects are the result of many small changes of habitat components at individual sites over a long period of time. During the past 150 years, the shorelines of many lakes have been completely denuded of natural forest and emergent vegetation, have been filled with beach sand, and have had natural slopes altered with vertical seawalls. Many of these lakes concurrently have aquatic vegetation removal programs, marinas and docks, excessive nutrient additions, and dredging and filling activities.

It is essential that managers define the appropriate spatial, temporal, and compositional scales to evaluate the effects of cumulative habitat modifications within our lake ecosystems. Considerable regulatory effort, as well as public and local community support, will likely be necessary to accomplish protection and restoration programs. An aggressive educational campaign addressing resource needs and appropriate watershed management for lakes should be initiated in Michigan. Ecological research evaluating the effects of cumulative habitat alterations on Michigan lake ecosystems is needed.

Water Quality

Lake water quality should be maintained above Michigan Surface Water Quality Standards for dissolved solids, hydrogen ion concentration, taste or odor producing substances, toxic substances, nutrients, microorganisms (bacteria), dissolved oxygen, and temperature. Other inorganic and organic components should be maintained at natural levels. Water quality sampling should be conducted to evaluate these parameters. Sediment coring should be conducted to evaluate historical nutrient enrichment patterns.

Water quality degradation in most inland lakes results from development in the uplands and along the immediate shoreline of the lake. Industrial discharges are more of a concern for Great Lakes water quality than for inland lakes. Protection of water quality in lakes will require reducing artificial drainage from roadways, agriculture, urban areas, as well as from residences within the watershed and along the shoreline of the lake. Natural shoreline buffers need to be established and maintained between residential lawns and the shoreline of lakes, and riparian lawn fertilization should be discontinued or modified where it affects water quality. Central wastewater systems should be developed where septic systems are contributing nutrients to the lake.

Shoreline Development

Alteration of natural shorelines should consider potential effects on habitat and biological communities, as well as the natural aesthetic aspects of lakes. Naturally sloped and vegetated

shorelines should be preserved as much as possible. Shoreline vegetation should be maintained to provide natural rates of deadwood to fall into the lake, and to provide adequate habitat to maintain plant and animal communities. Natural buffer-strips should be maintained a minimum distance of 35 ft above the ordinary high water mark of a lake.

Inland lakes should be managed to contain appropriate levels of deadwood in the littoral zone. Natural levels of 2-inch and larger logs within north temperate lakes range from 470 to 1,545/mi. Tree densities (2-inch and larger) within 33 ft of the shoreline in natural lakes range from 363 to 1,017/acre. Long-term management for natural deadwood inputs to lakes should consider planning for appropriate shoreline tree densities. Existing deadwood present in lakes and shoreline deadwood should be protected from removal. Extensive logging practices and uncontrolled development of shorelines have significantly reduced deadwood inputs to Michigan lakes for over 100 years. Rehabilitation programs designed to compensate for deadwood losses should be considered. Recruitment of coarse deadwood in temperate deciduous forests was approximately estimated at 2.52 logs/ha/yr (MacMillan 1981). This is equivalent to 4 logs/mi/year within 33 ft of the shoreline. Approximately 25% of these would be expected to fall into the lake. Tributary streams are particularly important to restoring natural deadwood inputs to the Great Lakes.

Degradation of littoral zone deadwood abundance, aquatic vegetation abundance, fish production, amphibian abundance, and fish and bird community composition have all been related to development of lake shorelines. Some of these changes were visible at dwelling densities of less than 2 per mile of shoreline. Changes in all of these resource components were visible at dwelling densities between 5 and 10 per mile of shoreline. Many Michigan lakes have dwelling densities far exceeding this level of development. Managers should recognize that resources in many Michigan lakes are in a degraded state and should incorporate development characteristics in their assessments. Shoreline protection, restoration, and rehabilitation activities should be included in all management plans and activities.

Dredging and Filling

Placement of permanent structures or other types of fill below the ordinary high water mark should be avoided, including beach sanding (except for natural habitat restoration). The placement of fill material in such a way that it creates a barrier to movements of water, fish, and wildlife, and even wave energy should be avoided and existing structures removed where possible. Furthermore, fill and structures that remove navigable waters or impede navigation (including shoreline access), should not be allowed because they degrade public trust resources. Seawalls should not be constructed and existing seawalls should be removed where possible. Documented needs for erosion control should use rip-rap of natural or limestone materials placed above the ordinary high water mark. Temporary docks should not interfere with fishing or navigation.

Dredging activities should be limited as much as possible. Protection of the littoral zone is especially important, as most dredging and filling activities occur in shallow water for commercial, residential, and recreational development.

Aquatic Vegetation

Native plants should not be removed or reduced in our lakes. Non-indigenous plants should be controlled, provided that the most selective methods that protect native plants are used. Plant communities should be protected and restored to provide lasting conservation of natural biological diversity and to maintain natural levels of production. Native species, natural diversity and architectural types, and total surface coverage and biomass of native plants should not be changed or

reduced. Shallow lakes that naturally have extensive native plant cover should be maintained in their natural condition. Programs and techniques that reduce native plant or animal diversity, distribution, or abundance should not be allowed. Removal of native plants and animals promotes colonization by non-indigenous species.

Generally, inland lakes in Michigan with moderate levels of submersed plant coverage (25–35% coverage of total lake surface) have the best overall fisheries. Likewise, a mosaic of open water and 40-50% aquatic plant cover (emergent/submerged plants) is ideal for many species of wildlife. Diminished fish production is usually associated with plant coverage below these levels. Higher levels of plant coverage have high fish production, but may induce poor size structure for some fish species, especially panfish. Acceptable growth and size structure for other fish species, such as largemouth bass, and better ecological characteristics for amphibians, birds, and other aquatic organisms may compensate for the less optimal panfish population size structure. Lakes with human development along the shoreline most likely already have degraded plant communities. Biological degradation generally increases as development increases. Past and present dredging and filling activities within a waterbody need to be incorporated in evaluations of native plant communities.

Recreation needs of boaters and riparian owners must be balanced with natural resource needs to conserve biological diversity and productivity. Most natural deepwater Michigan lakes have sufficient surface acreage free of vegetation to provide adequate and balanced boater use. True “nuisance” levels of native plants that might exclude boating in areas rarely exist in deep lakes, and these are natural components of a healthy ecosystem where they occur. Natural wetland areas should be left in a natural condition. Removal of native plants promotes introduction and expansion of non-indigenous species that can reduce boater use and impair ecosystem integrity. Programs designed to remove native surface vegetation from lakes should not occur. Maintenance of boat lanes for dockage can be accomplished using mechanical harvesting methods when necessary. Shoreline erosion and plant loss should be important criteria in the regulation of commercial shipping on the Great Lakes.

Control of aggressive non-indigenous aquatic plants is generally beneficial provided the integrity of native plant communities is maintained. Species of particular concern are Eurasian water-milfoil, curly-leaf pondweed, purple loosestrife, and giant reed. Long-term planning and control for most non-indigenous species will be necessary because they are difficult to eradicate once established. Generally, non-indigenous plant control programs should be developed as part of holistic lake management plans to insure all ecological and social issues are considered.

Control programs must have appropriate quantitative evaluations of plant distribution, species composition, abundance, and historical information when available. Ancillary information, such as residential water well information, must be included to help determine appropriate control techniques. The most selective methods should be used for control programs. For example, the aquatic weevil *Euhrychiopsis lecontie* is very selective for Eurasian water-milfoil. This weevil has been effective in controlling Eurasian water-milfoil. Herbicides use and mechanical harvesting can reduce populations of herbivorous weevils, and should be avoided when weevils are present.

Both mechanical and chemical methods of non-indigenous plant control have limitations. Mechanical harvesting is more labor intensive and usually is limited to the upper portions of the plant. More frequent applications are sometimes necessary. Mechanical harvesting causes plant fragmentation, which can be a concern with Eurasian water-milfoil because new plants can grow from small fragments.

At the present time, there are no herbicides that are selective for only non-indigenous plants. The use of broad spectrum and contact herbicides is not recommended because they kill most plant life they contact. This leaves bottom areas of the lake open to invasion by aggressive non-indigenous species.

Some chemicals that act as a systemic herbicide provide more selective control of Eurasian water-milfoil. These chemicals also have effects on other plants and it is necessary to have appropriate plant community information to determine when they may be used. Often, curly-leaf pondweed replaces Eurasian water-milfoil when it is removed. Curly-leaf pondweed can be controlled with mechanical harvesting, but selective chemicals are presently not available for this plant. It is important that control methods for curly-leaf pondweed control turion formation, because turions form new plants.

Control programs need to consider all alternatives. Significant infestations of non-indigenous species should have stepwise control programs that reduce plant levels over several years. Treatments restricted to one-third of the vegetated community will insure some habitat will always be available for animal communities.

The use of copper products to control algae is a serious concern due to toxic effects on biological communities and long-term accumulation in lake sediments. Control of algae should be limited as much as possible. Watershed nutrient control programs should be implemented where pollution occurs. Most chemical aquatic macrophyte control programs have associated algal control (due to nutrient releases), which needs to be considered in overall lake management activities.

Swimmer's Itch

Chemical control of swimmers itch needs to be carefully considered because of the longevity and toxic effects of copper used to kill host snails. Chemical control programs should insure there are reasonably significant levels of human health afflictions. Research should be conducted in Michigan to evaluate the effectiveness of control programs and their effects on lake ecology. Control programs focused on treatment of water birds with drugs should be evaluated and used when possible.

Dams and Lake-Level Control

Man-made dams on lakes and tributaries should be removed or managed to insure natural downstream movement of deadwood, natural upstream and downstream fish movements, and appropriate habitat needs of plant and animal communities. Lake-levels should not be controlled and stabilized by dams or augmentation wells. Natural seasonal and long-term water fluctuations are important to preserve abundance and diversity of vegetation, spawning and nursery areas for fish and wildlife, and to prevent shoreline erosion. Beaver and beaver dam removal for "nuisance purposes" must be critically examined considering their value for deadwood and nutrient inputs and the creation of habitat beneficial to many species of wildlife.

Non-indigenous Species

Regulatory agencies should continue to implement existing regulations pertaining to the importation of non-indigenous species into Michigan, and more stringent regulations should be developed. The commercial shipping industry should be regulated to prevent any new invaders from entering the Great Lakes basin. Local agencies and groups should be encouraged to post educational materials at access sites to prevent introductions into inland water bodies.

Research

Human development activities, and how they affect the basic processes that preserve the ecological integrity of Michigan lakes, are the greatest threat to protecting natural resource public trusts and sustaining the resources of our lakes for future generations. Scientific information is paramount in

understanding lake ecosystems and forms the basis for resource management. Historically, research activities have established general relationships between plants and animals and their habitats. Only recently have studies established cause-and-effect relationships between human development activities and natural resources. These types of studies are critical for regulatory protection efforts and necessary to support legal litigation. Development continues to expand in Michigan and it is imperative that adequate research be conducted to support management, education, regulatory, and judicial initiatives for Michigan lakes. Recommended areas of research are listed below:

- Determine the cumulative effects of development on the ecological integrity and biological communities of Michigan lakes.
- Determine appropriate management and research sampling programs for aquatic plants, shoreline vegetation, amphibians, reptiles, mollusks, mammals and birds.
- Determine the effectiveness of swimmers itch control programs.
- Determine the effects of copper introductions into lakes.
- Determine the effects of plant control programs on native and non-indigenous plants.