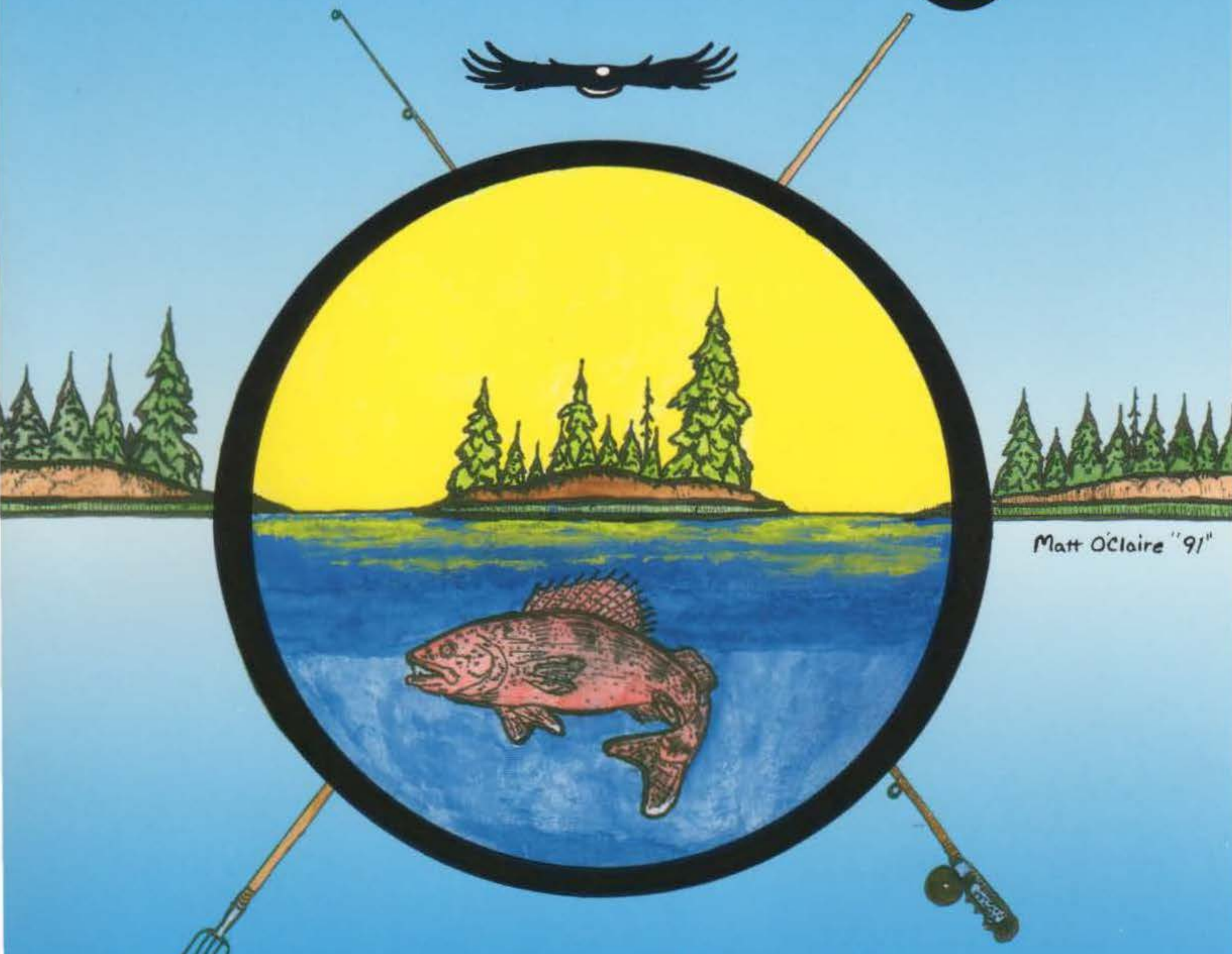
CASTING LIGHT UPON THE WATERS



A JOINT FISHERY ASSESSMENT
OF THE WISCONSIN CEDED TERRITORY

Casting Light Upon the Waters:
A Joint Fishery Assessment of the Wisconsin Ceded Territory

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United States Senate

SELECT COMMITTEE ON INDIAN AFFAIRS
WASHINGTON, DC 20510-6450

March 1, 1991

Controversies surrounding the exercise of Indian treaty fishing rights are not new, and they have been successfully resolved in other states. Thus, when the tribal governmental leadership of the six Chippewa tribes of Wisconsin approached the Select Committee on Indian Affairs for assistance in addressing the violence that has erupted at the boat landings for the past several years during spring fishing season, I met with representatives of the President of the United States, the Wisconsin congressional delegation, the Governor of the State of Wisconsin, the leadership of the Wisconsin state legislature, the Wisconsin Attorney General, and the elected leadership of the six tribes. What emerged from those meetings was the commonly-shared perception that the fires of controversy were being fueled by a campaign of misinformation regarding the impact of Indian treaty fishing on the fishery resource. Accordingly, working with my Wisconsin colleagues in the House and Senate, we secured an appropriation of Federal funds to enable a joint Federal, State and Tribal assessment of the fishery resource in the State of Wisconsin.

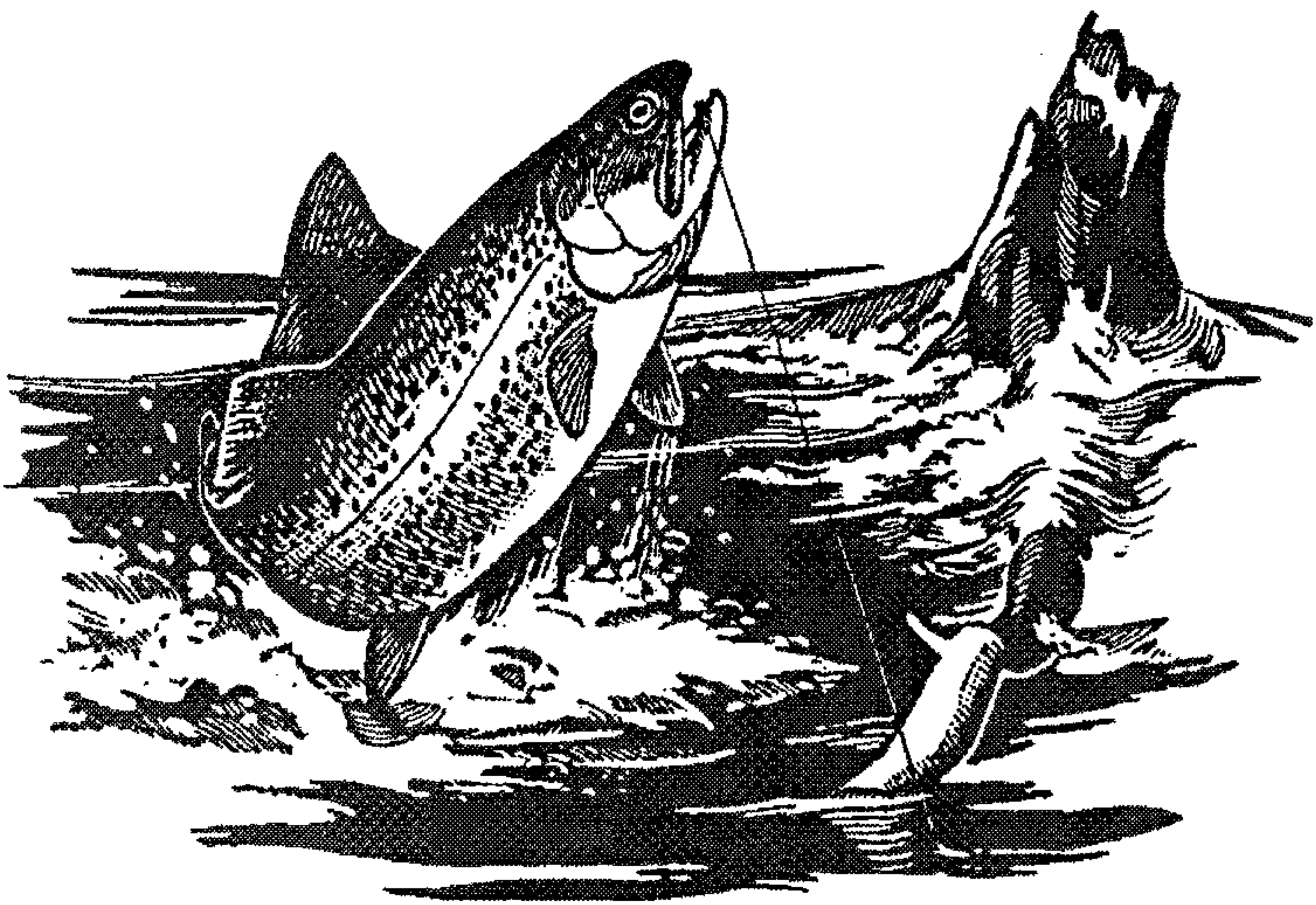
Applying state of the art methods, the results of this jointly-conducted assessment confirm that fish populations are not being overexploited in most cases and that current fish populations meet or exceed agreed-upon population goals. The assessment was conducted by the governmental entities with jurisdictional responsibility for the fishery resource, and there is consensus as to their findings and conclusions.

Working together, these governments have forged a mechanism for informing the public of the truth about the status of the Wisconsin fishery resource. Working together, these governments can continue and expand upon their joint monitoring and assessment efforts to assure the integrated management of fishery resources in the State of Wisconsin.

I wish to thank all of the parties who participated in this assessment. I believe that in so doing, you have laid the foundation for new and more constructive relationships between the governments of the United States, the State of Wisconsin, and the Chippewa tribes.

Sincerely,

DANIEL K. INOUYE
Chairman



April 3, 1991

Honorable Daniel Inouye
United States Senate
Washington, D.C.

Dear Senator Inouye:

We are pleased to provide Casting Light Upon the Waters — A Joint Fishery Assessment of the Wisconsin Ceded Territory. We greatly appreciate your interest and support in the fishery resources of Wisconsin. Thank you for the financial support that made this report possible.

The governments and agencies involved assigned a team of competent professionals to undertake this study. These individuals have worked hard and the report represents their best judgment, given the time and data available. We commend these individuals for their hard work, cooperation, and commitment to objectivity.

We have confidence in the validity of the report's findings and recommendations. We pledge to use them to strengthen cooperation and to make sound decisions in managing the resource. We realize that this report represents the dawn of a new era of cooperation, rather than an end in itself.

We trust that you will agree, and we urge you to continue your support so that we can build on this effort. We must work together in pooling our resources and in identifying the policy changes that are necessary to support this new era of cooperation.

SIGNATURE

Carroll D. Besadny, Secretary
Wisconsin Department of Natural Resources

James H. Schlender, Executive Administrator
Great Lakes Indian Fish & Wildlife Commission

Earl J. Barlow, Area Director
Bureau of Indian Affairs

James C. Gritman, Regional Director
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Robert R. Jackson, Chairman
Joint Assessment Steering Committee

Donald Moore, Sr. Chairman
Bad River Band of Lake Superior Tribe of Chippewa Indians of Wisconsin

Gaiashkibos, Chairman
Lac Courte Oreilles Band of Lake Superior Chippewa Indians

Michael W. Allen, Sr., President
Lac du Flambeau Band of Lake Superior Chippewa Indians

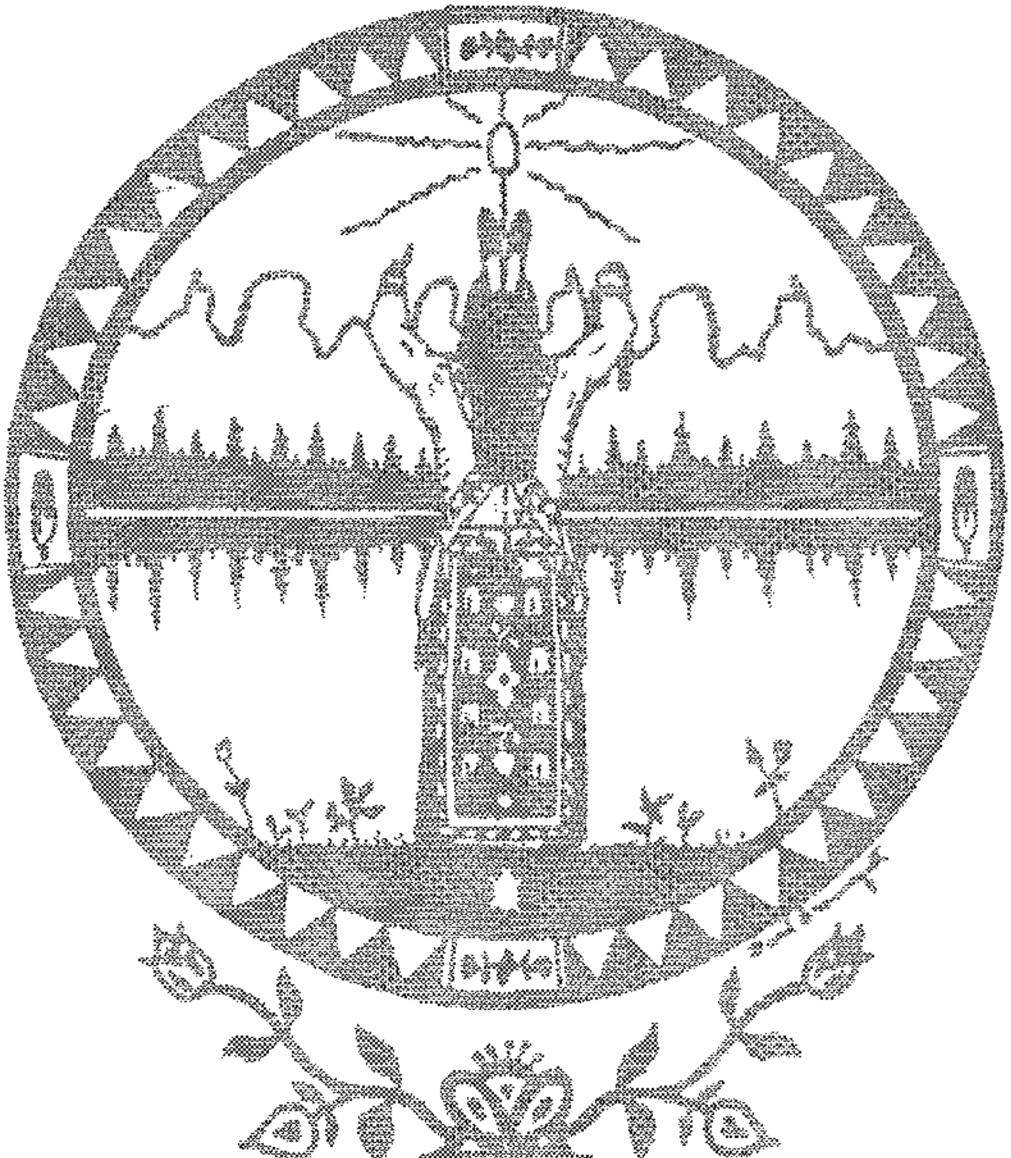
Patricia M. DePerry, Chairman
Red Cliff Band of Lake Superior Chippewa Indians

Eugene W. Taylor, President
St. Croix Chippewa Indians of Wisconsin

Raymond A. McGeshcick, Sr., Chairman
Sokagon Chippewa Community of Wisconsin (Mole Lake Band)

CONCUR:

Honorable Daniel Inouye
United States Senate



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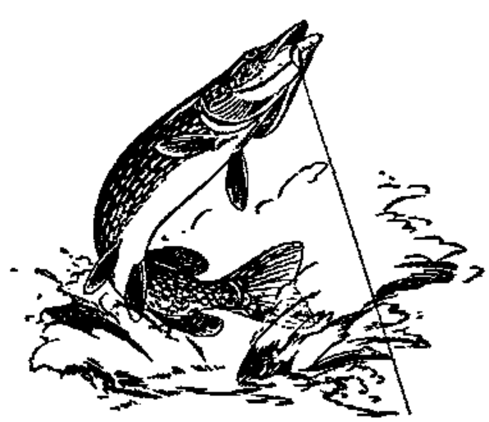


INTRODUCTION

This report provides an objective statement about the rights reserved by the Chippewa Indians, the status of the fishery resources, and the rights of the State of Wisconsin to use those resources. It discusses how the management agencies measure the number of fish taken by the various harvest methods and the techniques used to translate those data into impacts of the harvest on the fishery resource.

A steering committee composed of federal, state, and tribal officials was formed to implement the action plan included in Senator Inouye's appropriation legislation. The Committee identified two main objectives:

1. Prepare a report on the status of the fishery resources in the ceded territory that would address two primary questions -"Has Chippewa spearing harmed the resource?" and "Is the fish population in the ceded territory healthy?"
2. Develop capabilities for generating fish population data for the various waters to form the data base needed for managing the joint fishery.

Their answers to these questions are: NO! - Chippewa spearing has not harmed the resource; and YES! - the fish population in the ceded territory is healthy.

Chippewa treaty fishing rights are being exercised within an environment of changing societal pressures on Wisconsin's fishery resources. The outcry raised among some sectors in response to the Chippewa Indians' harvest of fish by spears and nets has focused on questions about what the real impact of the tribal harvest is in comparison to the other factors that affect the resource.

Human societies have long used and valued the fishery resources of the ceded territory. Fish were a staple in the diet of pre-settlement tribal societies. Chippewa tribal harvesting rights remain in effect, and are protected by treaty. Angling is valued as a wholesome recreational activity that also provides food and is a major component of the regional tourism industry. The Indian and non-Indian cultures and economics of northern Wisconsin have much at stake in the current and future status of the fishery resources.

Wisconsin Governor Tommy Thompson and the tribal governmental leadership were concerned about the increasing boat landing protests and claims of resource over-exploitation and sought increased Federal involvement to help resolve the controversy. Senator Daniel K. Inouye, Chairman of the Senate Select Committee on Indian Affairs, and the Wisconsin Congressional Delegation responded by securing a $300,000 appropriation from Congress. Senator Inouye proposed that the funding be used to address the public fear and uncertainty related to impacts of the hunting, fishing, and gathering rights claimed by the Chippewa Indians. Federal courts have ruled that the Chippewa Tribes retained those rights when they ceded the northern third of Wisconsin to the U.S. government in treaties. The agencies that are responsible for resource management and for serving the needs of the user public have now joined forces to respond to the fear and uncertainty generated by biased perceptions of treaty fishing and the unknown effects of many stresses on the resource. The time has come to set a new course for the future to manage the fisheries on a joint, sustainable basis for all generations to come.

Tribal and Federal fish population assessment capabilities have been enhanced with equipment purchased through this appropriation. Setting a course for the future requires a firm grasp of where we are now. Since 1983, the management agencies have taken great strides in increasing their knowledge of the walleye resource, in their realization of the need for more information on which to set tribal harvest quotas, and to address questions of "equity" among fishers and fisheries. The long term sustainability of the resource requires continuing assessments and more thorough data analyses. During the preparation of this report the several management agencies involved realized that they had some common understandings - the most important being their shared concern for the resource. This report has also helped to solidify on-going cooperative efforts for fisheries assessment, enhancement and protection. The Joint Assessment Steering Committee that prepared this report has worked diligently to provide objective answers to the questions about the impact of Indian spearfishing on the stability of fish populations in the ceded territory and about the present status of the resource. The stage is now set for an on-going commitment by the respective agencies to incorporate and integrate the findings of this report into management plans for the future. Wisconsin's fishery resources can only benefit from this new committment.

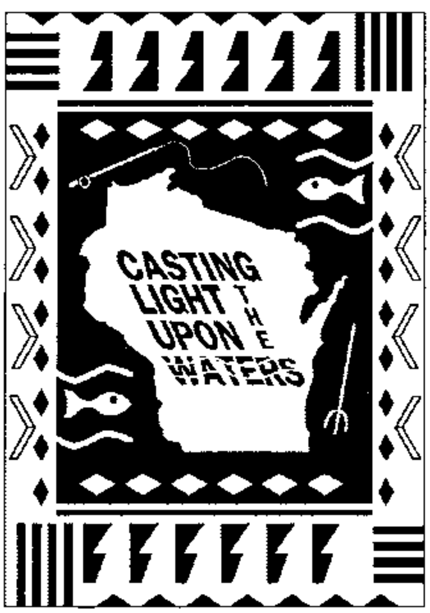
Objectives of this Report

In an effort to expedite a resolution to the spearfishing dispute, Senator Daniel K. Inouye (D-Hawaii), Chairman of the Senate Select Committee on Indian Affairs, authored a $300,000 congressional appropriation to fund a study of northern Wisconsin's fishery resources. Senator Inouye believes that such a study would provide objective fishery data that would have credibility with all parties and that would promote cooperation between the State of Wisconsin and the Chippewa Indians regarding the implementation of off-reservation treaty rights.

Directives for conducting the fisheries study were provided in the Report of the Senate Committee on Appropriations, dated April 24, 1990:

"The Committee...directs the Bureau of Indian Affairs to make $300,000 available for an independent assessment of the status of the fishery resources in the State of Wisconsin. This study is to be conducted jointly by the Federal, State, and six Chippewa Tribal governments. Assessing this resource is an important step toward preventing further violence while attempts to resolve the fishing rights controversy continue."

The Bill states that "these funds should be made available only when the State of Wisconsin has identified and committed the funds it will provide for this purpose."



Department of Interior Agencies, the Bureau of Indian Affairs, and the U.S. Fish and Wildlife Service formed a Steering Committee to accomplish the intent of the legislative appropriation. The Steering Committee consists of representatives from the following Federal, State and six Chippewa Tribal Governments:

- U.S. Fish and Wildlife Service - the lead Federal Agency for technical fishery matters.
- U.S. Bureau of Indian Affairs - the Federal Agency responsible for administering the $300,000 appropriation.
- Wisconsin Department of Natural Resources - the State Agency responsible for management of Wisconsin's fisheries resources and for administering State funds committed for this purpose.
- Great Lakes Indian Fish and Wildlife Commission - the lead Tribal agency for technical fishery matters.
- Chippewa Indian Tribal Governments:
  - Bad River Band of Lake Superior Tribe of Chippewa Indians of Wisconsin
  - Lac Courte Oreilles Band of Lake Superior Chippewa Indians
  - Lac du Flambeau Band of Lake Superior Chippewa Indians
  - Red Cliff Band of Lake Superior Chippewa Indians
  - St. Croix Chippewa Indians of Wisconsin
  - Sokaogon Chippewa Community of Wisconsin (Mole Lake Band)

These six Chippewa Tribal governments participate through their Voigt Inter-tribal Task Force representatives. The Voigt Task Force is charged with the primary responsibility for inter-tribal co-management in Wisconsin, Michigan and Minnesota and recommends regulation for adoption by the six Wisconsin Chippewa Tribal governments.

An action plan for a joint, independent assessment on the status of fishery resources in northern Wisconsin was formulated and adopted by the Steering Committee. The publication of this report was the Committee's primary objective. Steering Committee decisions are made by consensus, defined as a collective opinion to which no party objects. The Steering Committee will remain active to provide inter-agency dialogue on State/Tribal fishery issues.

Description of Ceded Territory

The northern portion of Wisconsin was ceded by the Lake Superior Chippewa Tribes to the United States in treaties in 1837 and 1842. The area encompasses 22,400 square miles. The ceded territory now includes all or parts of 30 Wisconsin counties.

Six Chippewa reservations are located within the ceded territory. The reservations and their approximate sizes are: Bad River (125,000 acres), Lac Courte Oreilles (70,000 acres), Lac du Flambeau (70,000 acres), Mole Lake (2,000 acres), Red Cliff (14,000 acres), and St. Croix (2,000 acres). The larger reservations are "checkerboarded" with privately owned lands. The St. Croix Reservation consists of scattered parcels of land in three counties.

Northern Wisconsin is a transition zone between the boreal forest to the north and the prairie and hardwood forest to the west and south. As a result, the region has a wide diversity of soils, vegetation, and land use. The northern and eastern portions are heavily forested, while the southern and southwestern portions have significant agricultural lands. Most of the publicly-owned lands are in the forested areas.

The region has a humid continental climate with warm to cool summers and cold winters. In areas adjacent to Lake Superior, the climate is tempered by a lake effect. This results in less cold winters, cooler summers, and more snowfall. All inland waters have thick covers of ice in winter, except those streams and spring ponds that have substantial groundwater flow. The frost-free growing season ranges from 90 to 120 days and is longer near Lake Superior. Precipitation averages about 30 inches per year.

There are 2,300 lakes larger than 25 acres in the ceded territory. Clusters of lakes occur in the east (Vilas and Oneida Counties) and the west (Sawyer and Burnett Counties). The region forms the headwaters of several watersheds, including Lake Superior, and the Wolf, Wisconsin, Chippewa, and St. Croix rivers. Trout streams are common throughout northern Wisconsin but are most abundant in the east and southeast. Warmwater streams are also numerous, especially in the south-central portion of the ceded territory.

The fishery resources of the reservations are quite diverse. The Lac du Flambeau Reservation has 158 lakes totalling 20,000 acres and 15 rivers and creeks that flow for 34 miles. The Lac Courte Oreilles Reservation encompasses portions of 3 major lakes: the Chippewa Flowage, Lac Courte Oreilles, and Grindstone Lake. The Bad River Reservation has two major streams that flow into Lake Superior and support anadromous runs of walleye, sturgeon, trout, and salmon. One of the most significant wetlands on Lake Superior is on the Bad River Reservation. The Red Cliff Reservation has a few small streams that flow into Lake Superior. The parcels of land that make up the St. Croix Reservation adjoin several lakes. The Mole Lake Reservation has one small lake and a connecting stream.

Although northern Wisconsin is characterized as rural and isolated, the population of the region has increased significantly within the last two decades. The population of the State of Wisconsin increased from 4,417,821 in 1970 to 4,891,769 in 1990, an increase of 10.7%. In comparison, county populations within the ceded territory increased from 584,953 in 1970 to 684,726 in 1990, an increase of 17.1%, a rate much higher than that of the state as a whole.

The populations of Wisconsin's six Chippewa reservations have experienced even more rapid growth. Chippewa tribal members residing on or near reservations increased from 2,917 in 1970 to 7,540 in 1990, an increase of 158.5%. There are no indications that this trend will change in the near future given the large numbers of tribal members of child bearing age.

The impact of population growth on Wisconsin's fishery resource is difficult to assess because of the lack of historical habitat inventories. The fact that the human population has increased significantly raises questions about how this growth has affected water quality and aquatic habitats, and how these impacts will be monitored in future years.

References

Wisconsin Legislative Reference Bureau. 1990. State of Wisconsin 1989-90 Blue Book. Madison, WI. 989pp.

United States Census Bureau. 1990. U.S. Census.

Rights to Fish

Treaty Rights

To understand the Chippewa treaty rights that are at issue in Northern Wisconsin, one must understand the nature of Indian tribes and tribal authority. Tribes are distinct political and legal entities recognized by the United States of America in its Constitution, in numerous federal laws and executive orders and by the federal judiciary. Tribes occupy a unique position within the United States Constitutional system. They possess sovereign powers, yet, like the states,they are subject to the dominion of the federal government. At the same time, they are different than the states.

Indian tribes were independent and sovereign nations in their own right before the arrival of Europeans in North America. In fact, the relationship between Indian tribes and European nations was that of one government to another under principles of international law that endure today. Just as the United States has always recognized Great Britain as a sovereign nation, the European nations recognized Indian tribes as sovereign nations in earlier times.

Historically, tribes possessed all of the rights and powers inherent in any sovereign nation. Thus, tribes enjoyed the complete right of self-government, to make their own rules and laws, and to be governed by them, in all areas of tribal life.

Today, tribes no longer possess all attributes of sovereignty because of how they fit into the United States constitutional system. The Constitution recognizes, defines, and allocates power among the governments of the United States, the several States, and Indian tribes. Each type of government has those powers that the Constitution allows.

Tribes no longer are independent nations that are separate from and independent of the United States. Indian tribes have been integrated into the United States system of government under the domain of the United States and they enjoy a quasi-sovereign status that is different from that of the several States.

Generally, today tribes possess those attributes of full sovereignty they once enjoyed that were not relinquished voluntarily by treaty, that Congress has not taken away, or that are not inconsistent with the unique status of tribes as "domestic dependent nations."

United States Authority Over Indian Tribes & the Trust Relationship

United States authority in the area of Indian affairs has been broadly interpreted. Congress has enacted many statutes that regulate nearly all aspects of tribal life, including commercial transactions, land purchases and disposal, trespass, and settlement by non-Indians within reservation boundaries. Those statutes also govern the furnishing of goods, services, and money by the federal government.

The United States Constitution confers upon Congress the power to regulate "commerce" with Indian tribes. The United States Supreme Court has interpreted this provision as giving Congress nearly total authority over Indian tribes. However, tribal sovereignty is retained and, until Congress acts, tribal powers persist.

Congress exercises its authority over Indian tribes within the limits of the Constitution. Thus, for example, when Congress takes Indian property for non-Indian use, the United States is liable under the fifth amendment to the Constitution for payment of just compensation. Likewise, if Congress were to take away treaty rights, the United States may be liable to pay just compensation.

The United States Supreme Court used the term "domestic dependent nations" to describe the unique status of tribes within the United States Constitutional system. The United States chose to allow tribes to continue their existence and to function as governments, albeit in a different and limited way. This choice placed the federal government in a position of special responsibility to Indian tribes and tribal members. The federal government must act as "trustee" on behalf of and for the benefit of Indian tribes. It must carry out its duties under the Constitution, treaties, and other laws to protect the rights and interests of tribes and tribal members. This is a fiduciary relationship like that of a trustee to a trust fund, a partner to a co-partner, or a guardian to a ward.

Tribal Authority & State Authority Over Indian Tribes

State authority to regulate Indian affairs is limited. Tribal sovereignty and applicable federal laws create two separate, but related barriers to state power. Generally, a state may not infringe on a tribe's right of self-government. A state may not interfere with any federal law, including a treaty, that recognizes or establishes tribal powers or rights. This is the general principle of preemption — federal laws prevent the application of state laws in an area of primary federal jurisdiction.

Congress may choose to confer limited authority upon states in Indian affairs and has done so on many occasions. The most relevant to Wisconsin is Public Law 83-280, adopted in 1953. Through this law, Congress delegated to Wisconsin and a number of other states jurisdiction over most crimes and over many civil matters occurring on reservation.

Treaties

The United States Constitution also gives the federal government exclusive authority to enter into treaties. As the United States expanded westward and encountered tribes, it was the federal government, not the states, that entered into numerous treaties with Indian tribes. Over 300 treaties were signed with tribes covering many subjects, including peace, removal, land cession, and the establishment of Indian reservations.

These treaties are part of the supreme law of the land, and are binding upon the states and superior to any state law. Treaties remain part of the law of the land unless and until they are modified or terminated by Congress.

"Treaty rights" quite simply are the benefits guaranteed to the parties of a treaty. They are like contract rights. Each party to a contract has certain rights under the contract. One party must honor the benefits that the agreement ensures for the other party. Like rights that endure under the terms of a contract, treaty rights must be honored regardless of when a treaty was made unless Congress chooses to modify or terminate the treaty.

From a tribal perspective, treaty rights are those rights that a tribe has kept and not given up in a treaty. Through treaties, Indian tribes gave up some aspects of their sovereignty while holding onto others. Properly speaking, treaties between tribes and the federal government involve the granting of certain rights to the United States by the tribes, not the granting of rights or privileges from the United States to the tribes.

Off-reservation treaty rights to hunt, fish, and gather are among the rights reserved by the Chippewa tribes. These rights were not given up in the Treaties of 1837 and 1842, or in any subsequent treaties. This reservation of rights is similar to an easement or the retention of mineral rights by a seller of real estate.

Numerous court decisions have ruled that treaties are to be liberally construed in favor of Indian signatories. Language used in treaties should not be construed to the Indians' disadvantage. Ambiguous wordings in a treaty are to be resolved in favor of the Indians, especially if a term may have more than one meaning. Finally, treaties are to be construed as they would have been understood by the Indians when the treaty was signed.

These same principles are found in contract law. When a dispute arises, a contract will be construed against the party that drafted it. Ambiguous provisions of contracts whose terms heavily favor the party that occupied the superior bargaining position often will be construed to the benefit of the other party or as the other party understood them.

Chippewa Off-Reservation Rights in Wisconsin

In 1983, in what is commonly referred to as the Voigt case, the United States Court of Appeals for the Seventh Circuit determined that the Chippewa tribes had reserved off-reservation hunting, fishing, and gathering rights in the territories ceded by the tribes in the Treaty of 1837 and the Treaty of 1842. The off-reservation hunting, fishing, and gathering rights affirmed in the Voigt case are part of the sovereign rights that the Chippewa have always had and that have never been voluntarily given up or extinguished by the federal government.

The treaty provisions at issue in the Voigt case are the following:

1) *"The privilege of hunting, fishing, and gathering the wild rice, upon the lands, the rivers and the lakes included in the territory ceded, is guaranteed to the Indians, during the pleasure of the President of the United States" (Treaty of 1837).*

2) *"The Indians stipulate for the right of hunting on the ceded territory, with the other usual privileges of occupancy, until required to be removed by the President of the United States" (Treaty of 1842).*

The ceded territory involved in the Voigt case essentially consists of the northern one-third of Wisconsin. The 1837 ceded territory consists of approximately the southwestern one-half of that area. The 1842 ceded territory consists of approximately the northeastern one-half of that area, including the southern shore of Lake Superior. The 1842 ceded territory also includes portions of Lake Superior itself. However, Lake Superior is not involved in the Voigt case by agreement of the parties.

The Voigt Case

The Voigt case has been pending in the United States District Court, Western District of Wisconsin, since 1973. It has been the subject of 6 trials at the District Court level, 3 appeals to the Seventh Circuit Court of Appeals and 1 Petition for review to the United States Supreme Court.

Suit was filed by the Lac Courte Oreilles Band of Lake Superior Chippewa Indians against the State of Wisconsin and a number of state officials challenging the power of the State to regulate the off-reservation harvest by tribal members. The Tribe claimed that state laws interfered with tribal hunting, fishing, and gathering and was therefore in violation of the guarantees provided in the Treaties of 1837 and 1842.

In 1978, the Federal District Court granted summary judgment in favor of the State of Wisconsin and dismissed the action. It held that all rights under the treaties had been revoked by the Treaty of 1854. In 1983, the Seventh Circuit Court of Appeals reversed the District Court ruling, holding that the rights reserved by the Treaties of 1837 and 1842 had not been revoked or terminated and continue to exist. The appellate court returned the case to the District Court for further proceedings to determine the scope of the treaty rights, the extent to which the State may regulate the exercise of those rights and what damages, if any, the tribes may recover as a result of the State's infringement of the treaty rights.

The State of Wisconsin petitioned the United States Supreme Court to review the Seventh Circuit Court's decision. The Supreme Court chose not to review the case.

After the decision of the Seventh Circuit Court of Appeals, the five other Chippewa Bands located in Wisconsin joined in the lawsuit (Bad River, Lac du Flambeau, Mole Lake, Red Cliff, and St. Croix) and the six plaintiff tribes proceeded with the case in the District Court.

The District Court then divided the proceedings into three phases:

Phase I: Declaratory Phase—determination of the nature and scope of the treaty rights;

Phase II: Regulatory Phase—determination of the permissible scope of state regulation; and

Phase III: Damages Phase—amount of damages, if any, to which the tribes are entitled for infringement on treaty rights.

Phase I proceedings to determine the nature and scope of the treaty rights were held in December, 1985, before Judge James Doyle. Judge Doyle ruled that all resources in the ceded territory could be harvested by tribal members using all modern methods of harvest. Judge Doyle further ruled that the resources could be personally consumed or be traded or sold to anyone using the modern-day market economy. Finally, the Judge held that the tribes are entitled to as much of the resources as will ensure them a modest living.

Upon Judge Doyle's death in 1987, the case was assigned to Judge Barbara Crabb. The State sought to appeal Judge Doyle's ruling. However, Judge Crabb denied this request and proceeded with the case at the District Court level.

On August 21, 1987, Judge Crabb reaffirmed the standard principles enunciated in other treaty rights cases from throughout the country. She held that the State may regulate in the interests of conservation provided that such regulations are reasonable and necessary for the conservation of a particular species or resource in a particular area, that they do not discriminate against Indians, and that they are the least restrictive alternative available. Judge Crabb also ruled that the State may impose such regulations as are reasonable and necessary to protect public health and safety. However, she held that the tribes possess the authority to regulate their members and that effective tribal self-regulation precludes state regulation.

By agreement of all parties and of the court, Phase II was divided into "subphases" intended to address certain discrete regulatory questions or resources. The subphase proceedings that focused on walleye and muskellunge harvests were held in October, 1988. Many of the issues originally scheduled for trial at this subphase were resolved by mutual agreement. On March 3, 1989, Judge Crabb held that, as long as the tribes adopt regulations incorporating the biologically necessary conditions established by the State at trial, the tribes are self-regulating as to walleye and muskellunge. She ordered the State not to interfere with the tribes' regulation of the treaty walleye and muskellunge harvest, except as the tribes have otherwise agreed.

On May 9, 1990, Judge Crabb issued a decision resulting from the deer subphase and from various other issues presented for her resolution. Consistent with her decision on walleye/muskellunge harvests, Judge Crabb enjoined the enforcement of state law provided that the tribes enact a system of regulations consistent with her decision. The tribes have done so.

The most significant aspect of the May 9, 1990, deer decision is Judge Crabb's ruling that the tribal allocation of treaty resources is a maximum of 50% of the resource available for harvest.

As to fish species other then walleye and muskellunge, the tribes and the State have agreed that quotas are not necessary at this time. However, if the harvest increases significantly, a quota system for the species involved will be implemented.

On February 21, 1991, Judge Crabb issued her long-awaited timber decision. She ruled that the Chippewa tribes did not reserve a treaty right to harvest timber commercially. However, the tribes do have a treaty right to gather miscellaneous forest products, such as maple sap, birch bark, and fire wood; subject to non-discriminatory state and county regulations.

The timber decision is the final step at the District Court level. After a final judgment is entered (expected in the near future), the parties will have to decide what issues, if any, they wish to appeal.

At this time, neither the tribes nor the State have indicated which issues, if any, they may chose to appeal. It is possible that the Voigt case could be appealed to the United States Supreme Court after review by the Seventh Circuit Court is completed.

Court Cases and Other Sources on Which the Above Statements are Based:

U.S. Constitution
Article II, Sec. 8, Par. 3 (Indian Commerce Clause).
Article II, Sec. 10, Par. 1 (Treaty Clause).
Article. VI, Par. 2 (Supremacy Clause).

Treaties
1837 (7 Stat. 526).
Treaty of 1842 (7 Stat. 591).
Treaty of 1854 (10 Stat. 1109).

Voigt Decisions:

United States v. Bouchard, 464 F.Supp. 1316 (W.D. Wis. 1978) (Judge Doyle's ruling that Chippewa off-reservation rights had been terminated by the Treaty of 1854).

Lac Courte Oreilles v. Voigt (LCO I), 700 F. 2d 341 (7th Cir. 1983), cert. denied 464 U.S. 805 (1983) (7th Circuit ruling that Chippewa off-reservation rights have not been terminated).

Lac Courte Oreilles v. State of Wisconsin (LCO III), 653 F.Supp. 1420 (W.D. Wis. 1987) (Feb. 1987 Doyle Decision —determination of scope and extent of Chippewa off-reservation rights).

Lac Courte Oreilles v. State of Wisconsin (LCO IV), 668 F.Supp. 1233 (W.D. Wis. 1987) (Aug. 1987 Crabb Decision outlining legal principles applicable to the Voigt case).

Lac Courte Oreilles v. State of Wisconsin (LCO V), 686 F.Supp. 226 (W.D. Wis. 1988) ("Moderate living" decision).

Lac Courte Oreilles v. State of Wisconsin (LCO VI), 707 F.Supp. 1034 (W.D. Wis. 1989) (Walleye/Muskellunge decision).

Lac Courte Oreilles v. State of Wisconsin (LCO VII), 740 F.Supp 1400 (W.D. Wis. 1990) (Deer/Allocation decision).

Lac Courte Oreilles v. State of Wisconsin (LCO VIII), ____ F. Supp. ______ (W.D. Wis. 1990) (Oct. 1990 Damages decision).

U.S. Supreme Court Decisions

United States v. Wheeler, 435 U.S. 313 (1978) (Congress has plenary authority over Indian Tribes, but tribal powers persist until Congress acts).

Shoshone Tribe v. United States, 299 U.S. 476 (1937) (United States must pay just compensation for taking of Indian property).

Rights of State Users

The litigation involving treaty rights has focused primarily on the harvest rights of the Chippewa bands. The rights of non-Indian users were not directly at issue. However, the treaties, like any contract did secure rights for both parties. While the Chippewas retained harvest rights under the treaties of 1837 and 1842, the United States gained ownership of the property in the northern third of Wisconsin.

Among the rights obtained by the United States and transferred to the State of Wisconsin upon statehood was the right to manage the fish and game within the ceded territory. Judge Crabb has ruled that the management authority lies with the State and not with the tribes. The Court requires the State to manage the ceded territory fishery for the benefit of all current and future users. The tribes may challenge any State action that they believe infringes on their treaty rights.

The State's management responsibility must take into account one very important factor. The tribes are entitled to up to 50% of the harvestable resource. State users are entitled to the remaining allowable harvest. The State of Wisconsin must regulate its users to ensure that the state harvest, when combined with the Chippewa harvest, does not result in an over-harvest situation. Furthermore, the Voigt case requires the state to manage the resources of the ceded territory for the benefit of all current and future users, both tribal and non-tribal.

For some wildlife species regulated by quota, the Chippewa harvest has resulted in a lower number of tags or permits available for the non-Indian harvester. For species not regulated by quota, but subject to a potential over-harvest (e.g. walleye and muskellunge), lower state bag limits may be necessary. For other species, such as rough fish, bass and panfish, the resource can support the Chippewa harvest without the need for additional state regulations on non-treaty users. If the Chippewa harvest of a species should increase substantially, additional state regulations would be necessary.

Cherokee Nation v. Georgia, 30 U.S. (5 Pet.) 1 (1831) (Indian tribes are "domestic dependent nations" and United States has trust duty toward tribes).

U.S. v. Winans, 198 U.S. 371 (1905) (reserved rights doctrine).
Jones v. Meehan, 175 U.S. 1 (1899) (canons of treaty construction outlined).

The Great Lakes Indian Fish and Wildlife Commission

Mailing address:
P.O. Box 9, Odanah, WI 54861
Telephone: 715-682-6619
Fax: 715-682-9294
Natural Resource Programs:
Biological Services (Inland Fisheries, Great Lakes Fisheries, Wildlife, Environment), Conservation Enforcement, Public Information, Policy Analysis, Natural Resources Development
Current operating budget: $3,047,644.

The Great Lakes Indian Fish and Wildlife Commission was formed in 1984 by sovereign tribes of Chippewa Indians to provide coordination and services for the implementation of treaty rights to fish, hunt, and gather in the treaty-ceded territory, and to represent tribal interests in natural resource management in the ceded territory. Currently the Commission has 13 member tribes: 6 in Wisconsin, 4 in Minnesota, and 3 in Michigan.

The Great Lakes Indian Fish and Wildlife Commission is governed by a Board of Commissioners, one from each member tribe. The Voigt Inter-tribal Task Force, a committee of the Commission, is responsible for oversight of the Commission's programs within the ceded territory. The Task Force approves model harvest regulations for enactment by the tribes, recommends budgets for adoption by the Commission, and provides policy direction to the staff for interacting with state and federal resource management agencies.

The Great Lakes Indian Fish and Wildlife Commission is funded primarily by appropriations from the United States Congress. The Commission receives appropriated funds from the Bureau of Indian Affairs through Self-Determination contracts authorized by the Indian Self-Determination Act of 1976.

The Commission staff is organized into the following divisions: Conservation Enforcement, Biological Services, Public Information, Intergovernmental Affairs, Natural Resources Development, and Administration.

The Conservation Enforcement Division is delegated the power to enforce tribal laws governing off-reservation fishing, hunting, and gathering. The permanent staff includes 22 trained and certified officers. A satellite station is situated on each of the Wisconsin Chippewa reservations.

The Biological Services Division is further subdivided into these sections: Inland Fisheries, Great Lakes Fisheries, Wildlife, and Environment. The Inland Fisheries Section has a permanent staff of 2 professional biologists and 2 technicians, as well as dozens of seasonal personnel to assist in harvest monitoring and fishery assessment. The Director of the Biological Services Division serves as the Commission's coordinator on the State/Tribal Technical Working Group for Inland Fisheries. The FY 1990 budget of the Inland Fisheries Section was $177,075. In FY 1991 it will be $217,088.

The programs of the Commission are documented in detail in annual reports, in the bimonthly newsletter Masinaigan, and in a variety of other reports, pamphlets, and videotapes. Inquiries may be addressed to the Public Information Office.

Bad River Band of Lake Superior Tribe of Chippewa Indians of Wisconsin

Mailing address:
Tribal Natural Resources Department
P.O. Box 39 Odanah, WI 54861
Telephone: 715/682-7103
Fish Hatchery 715/682-5974
Fax: 715/682-6679
Natural Resource Programs:
Fish and Game Management, Forestry Management, Environmental Protection, Realty Development, Water Resources Management, Wisconsin Conservation Corps
Current operating budget: $352,000

The Bad River Indian Reservation encompasses approximately 125,000 acres. The Kakagon and Bad River systems flow within reservation boundaries and into Lake Superior. These river systems converge in a large wetland area often referred to as the Sloughs. A wide variety of forest resources and vegetative cover types are also found on the reservation and provide economic benefits and essential habitats for tribal members and numerous wildlife species. The Tribe has formed the Bad River Natural Resources Department and given it responsibility for maintaining and enhancing the resources of reservation lands and waterways. Since the Bad River Tribe retains treaty-reserved fishing rights in the waters of western Lake Superior, effective management of shared Lake Superior fish stocks is a major responsibility.

The Bad River Natural Resources Department is staffed by 7 full-time and up to 7 seasonal positions. Full-time personnel include the following: Department Administrator, Fisheries Specialist, Tribal Conservation Warden, Forestry Technician, Fish and Wildlife Technician, Realty Specialist, and Environmental Specialist. Seasonal employees include a five man Fish Hatchery Crew and additional project-specific employees. A Wisconsin Conservation Corps crew of 7 trainees also proves valuable assistance to the Bad River Natural Resources Department in its management activities.

Fisheries management and enhancement activities include management of a coolwater fish hatchery and an on-reservation and Lake Superior fisheries management program. Personnel from the Bad River Tribe, Wisconsin Department of Natural Resources, and U.S. Fish and Wildlife Service are now entering the fourth year of cooperative data collection for shared walleye stocks within the greater Chequamegon Bay area. Additional accomplishments include implementation of a cooperative stocking effort along with the Cable Area Chamber of Commerce's Fish for the Future organization. This effort has blossomed into a model of cooperation between user groups. A seasonal fish hatchery operation stocks an average of 6 million walleye fry and fingerlings into reservation waters annually. Fish and wildlife data collection activities are on-going.

Conservation wardens enforce tribal natural resources ordinances and assist in monitoring harvest activities, both within reservation boundaries and in Lake Superior waters.

Bureau of Indian Affairs forestry management personnel and the Bad River forestry technician conduct an ecologically sound forest use and management plan for the reservation. The Bad River forestry management program has developed a tribal logging enterprise that provides economic benefits to the tribe and provides valuable on-reservation forestry management. State, federal and tribal fire control personnel work cooperatively.

The Bad River Natural Resources Department has recently added an environmental specialist position to monitor environmental conditions within reservation boundaries.

Lac Courte Oreilles Band of Lake Superior Chippewa Indians

Mailing address:
Route 2, Box 2700, Hayward, WI 54843
Telephone: 715/865-2329
Natural Resource Programs:
Fish Management and Culture, Wildlife, Conservation Law Enforcement, Parks and Recreation
Current operating budget: $183,897

The Lac Courte Oreilles Chippewa Tribe has formed its own Conservation Department. Its responsibilities are to enforce, protect, and conserve the natural resources of the 70,000 acre Lac Courte Oreilles Reservation.

The Conservation Department consists of six full-time staff members: a Director/Biologist; a Senior Game Warden/Fish Specialist; a Safety Officer; a Parks and Recreation Officer; a Conservation Aide; and a Secretary/Dispatcher. All personnel other than the secretary have law enforcement duties.

Conservation Department law enforcement officers enforce tribal codes and ordinances that regulate such activities as non-Indian hunting on tribal lands, wood-cutting, and garbage dumping. Other duties include maintenance of campsites, co-management of snow-mobile trails, and inter-agency assistance.

Duties of the biologists include fish hatchery operations, conducting fisheries and wildlife surveys, water quality monitoring, and natural resource management planning.

Construction of a new tribal fish culture complex will be completed in in the spring of 1991. This complex includes a hatchery building and four fish culture ponds.

Lac Du FlambeauBand of Lake Superior Chippewa Indians

Mailing address:
P.O. Box 67, Lac du Flambeau, WI 54538
Telephone: 715/588-3303, ext. 254 and 256
Fax: 715/588-7930
Natural Resource Programs:
Fish Culture, Fisheries Management, Wildlife, Forestry, Conservation Law Enforcement, Resources Marketing, Water Resources, Parks and Recreation
Current operating budget: $272,000

The Lac du Flambeau Chippewa Tribe operates its own Natural Resource Department under the Constitution and By-Laws of the Band. The Constitution gives the Tribal Council the responsibility "to regulate the use and disposition of tribal property, to protect and preserve the tribal property, wildlife, and natural resources of the Lac du Flambeau Band of Lake Superior Chippewa Indians...".

Eight natural resource programs are conducted by the Department under the general direction of the Tribal Administration. Day to day operations of the Department are managed by the Fish and Game Director, Assistant Fish and Game Director, and Tribal Forester. Currently, 21 people are employed by the Department.

The primary objectives of the fish culture and fisheries management programs are (1) to propagate all species of fish needed for stocking reservation waters and border lakes and, (2) to determine the status of the fish populations in reservation lakes and streams.

Depending on the numbers needed to meet fisheries management objectives, various species of fish are raised by the fish culture program. Fish culture personnel produce walleye, muskellunge, largemouth bass, smallmouth bass, white suckers, fathead minnows, brown, rainbow, and brook trout to various sizes (fry, fingerling, broodstock, etc.) utilizing pond and raceway techniques. In 1989, 14,800,000 walleye fry, 715,000 walleye fingerlings (1 1/2-2.0 inch), and 78,100 other fingerlings were stocked in reservatioin waters. "Other" species included muskellunge, brown trout, brook trout, and largemouth bass.

To develop data on which to base fisheries management objectives for the 158 lakes on the reservation (approximately 20,000 surface acres of water) fisheries assessments techniques, such as creel surveys, population estimates, hydroacoustics, mark-and-recapture, age and growth, etc., are conducted by tribal biologists. Open water creel surveys have been conducted annually since 1985 to identify the major user groups, to determine catch per unit effort, to estimate total harvest, and to gather information on the method of fishing, angler residency, etc.

Interagency coordination/cooperation is required to facilitate the implementation of natural resource plans. The Tribal Natural Resource Department works with the U.S. Fish and Wildlife Service, Great Lakes Indian Fish and Wildlife Commission, Bureau of Indian Affairs, other Tribal Natural Resource Programs, the Wisconsin Department of Natural Resources, the United States Geological Survey, Army Corps of Engineers, and the Town of Lac du Flambeau.

Public involvement in managing reservation resources consists of tribal input by utilizing surveys to determine opinions, concerns, and issues of tribal members. The tribal membership can also express their opinions, concerns, and issues to Tribal Council representatives, by referendum vote, and at Council meetings.

Red Cliff Band of Lake Superior Chippewa Indians

Mailing address:
P.O. Box 529, Bayfield, WI 54814
Telephone: 715/779-5162
Natural Resource Programs:
Fish Management, Fish Culture, Wildlife Management, and Conservation Law Enforcement
Current operating budget: $235,000

The Red Cliff Chippewa Tribe has possessed shared status with the State since 1972 in the management of the fishery resources in the Wisconsin waters of Lake Superior. When the new fishery management agreement was reached with the State in 1985, the Red Cliff Tribe established a unified Fishery Management/ Conservation Enforcement Program with federal funding. That program continues to the present time. The program includes: (1) Fishery Management with a small staff that includes a professional fisheries biologist, two technicians and an office manager; (2) Conservation Enforcement with four Conservation Officers who are graduates of the State Police Academy; (3) a court system comprised of a professional attorney, two tribal judges and two paralegal assistants. The program provides capabilities for fishery resource assessment, research, monitoring of commercial fisheries, licensing and regulation, enforcement, and tribal prosecution of offenders. Because it has a complete program, the Red Cliff Tribe is able to meet the State of Wisconsin as an equal bargaining partner in the fishery management agreements.

In 1985, a 40 foot research/assessment vessel named "The Queen of Bayfield" was purchased. This acquisition enabled the Tribe's Fisheries Department to conduct routine assessments of fishery resources in Lake Superior.

In 1987, lake trout fry acquired from the Iron River National Fish Hatchery were reared and released. In the fall of 1989, eggs of lake trout and lake whitefish were collected during the spawning season. These eggs were incubated and hatched in a small (120 sq. ft.) hatchery building on the reservation. Egg collection and hatchery operation have been conducted annually since 1989.

In the spring of 1990, a sportsmen's group (Fish for the Future) and the Red Cliff and Bad River Bands of Lake Superior Chippewa tried to resolve differences over the tribal spearing controversy by collecting walleye eggs from tribally speared walleyes, incubating them, and rearing the resulting fry in ponds on the reservation.

Current projects include the construction of a fish hatchery/office building for the Red Cliff Fisheries Department. The facility will be used to raise lake trout yearlings in concrete raceways and walleye fry in rearing ponds.

St. Croix Chippewa Indians of Wisconsin

Mailing address:
P.O. Box 287, Hertel, WI 54845
Telephone: 715/349-2195
Natural Resource Programs:
Fish Management, Fish Culture, Wildlife Management, and Conservation Law Enforcement
Current operating budget: $86,000

The St. Croix Chippewa Band's natural resource management program began in 1980 when the council hired a fish and game warden to enforce the St. Croix Tribal Natural Resources Code. The Natural Resources Code regulates on-reservation fishing, trapping, hunting, and gathering of wild rice. Tribal wardens cooperate with local sheriffs' departments, the Wisconsin Department of Natural Resources, and the Great Lakes Indian Fish and Wildlife Commission to enforce state conservation laws off-reservation in the Wisconsin ceded territory.

The Tribal Council expanded its role in natural resource management in 1989 by hiring a biologist to administer the Natural Resources Department. Funding reductions forced the Tribal Council to temporarily suspend its conservation enforcement program in the fall of 1989. A technician joined the Department staff in 1990. The on-reservation conservation enforcement program will be resumed by returning an officer to the staff in March, 1991.

Cooperative activities and accomplishments include development of a walleye pond culture program that has stocked over 200,000 walleye fingerlings in nine northwest Wisconsin lakes, reseeding of wild rice, water quality monitoring, rough fish removal, fish habitat enhancement, fish population assessments, and a study of predator/prey relationships among wildlife.

The St. Croix Natural Resources Department's priority goals for the future include: (1) building a hatchery/equipment storage building with Department office space and (2) construction of additional ponds for fish rearing.

The St. Croix Tribe will also be starting construction in 1991 of a major aquaculture project related to accelerated growth of salmon with an ancillary products division and processing capabilities.

Sokaogon Chippewa Community of Wisconsin (Mole Lake Band)

Mailing address:
Route 1, Box 625, Crandon, WI 54520
Telephone: 715/478-2604
Natural Resource Programs:
Fish Culture, Parks and Recreation
Current operating budget: $4,000

The Sokaogon Chippewa Community does not currently have a natural resources department but it operates a fish culture project that obtains eggs from speared walleyes for incubation and pond rearing. The project produces 2,000 to 5,000 walleye fingerlings annually for stocking in area lakes. The tribe also operates its own campground facility and has been upgrading and expanding it each year.

Planning efforts for the next three years hope to develop a natural resource code for the Tribe.

Wisconsin Department of Natural Resources

Mailing address:
Wisconsin Department of Natural Resources
Box 7921
Madison, WI 53707
Telephone: 608/267-6897
Fax: 608/267-3579
Current operating budget:
Total Budget: $327,000,000
Fisheries Management Budget: $15,939,000

The mission of the Department is:

- To protect and enhance our Natural Resources-our air, land and water; our wildlife, fish and forests.
- To provide a clean environment and a full range of outdoor opportunities.
- To insure the right of all Wisconsin citizens to use and enjoy these resources in their work and leisure.
- And, in cooperation with all our citizens, to consider the future and those who will follow us.

Recognizing that the valuable natural resources of our state could only be protected and wisely managed through a coordinated effort, the Wisconsin Legislature created the Department of Natural Resources in 1967. In creating the Department, the Legislature brought together closely related traditional conservation functions and combined them with newly emerging environmental protection programs.

The Department coordinates the preservation, protection and regulation, of the natural environment for the benefit of the people of this state and its visitors. Included in its objectives are water and air quality maintenance, water supply regulations, solid and hazardous waste management, fish and wildlife management, forest management and protection, providing parks and recreation opportunities, lake management, wetland, shoreland and floodplain protection, and law enforcement.

A seven-member citizen Natural Resources Board appointed by the Governor provides policy direction for the programs administered by the Department. The Department is organized with a headquarters office in Madison, six district offices, 15 area offices, and over 200 other field stations and offices. Over 70% of the Department's personnel operate from field stations outside of Madison. The Department is organized into Divisions and subprograms to facilitate the accomplishment of its mission. The Department employs a permanent staff of 2,765.

Division of Resource Management

Within the Department, management of fish, wildlife, forests, state parks, and recreation properties is the responsibility of the Division of Resource Management. The Division's responsibilities include planning and directing activities to protect, manage, conserve, and wisely use the State's fish, wildlife and forest resources. The Division's goals are accomplished by establishing objectives that include protecting, maintaining and developing both game and nongame species, as well as providing necessary public access. Fisheries Management is one subprogram within the Division.

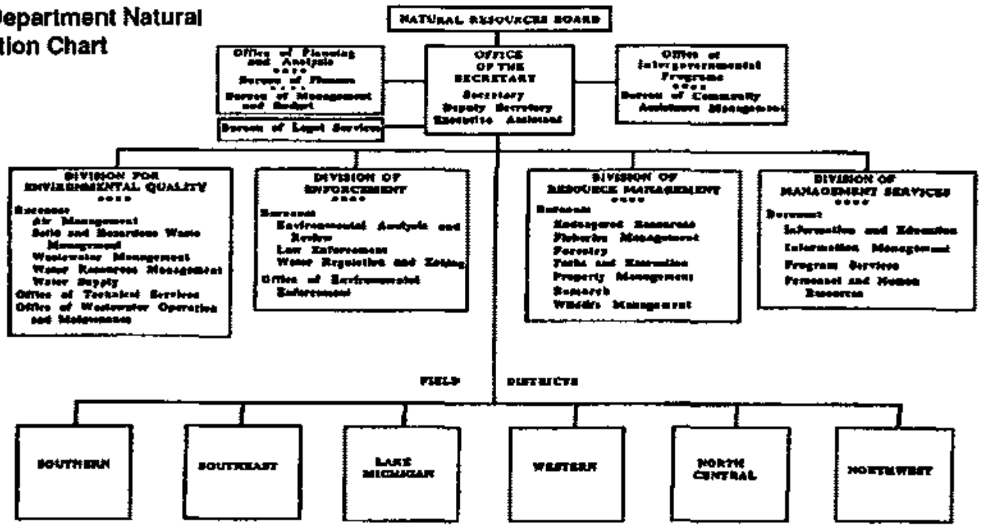
Fisheries Management Subprogram

The Fisheries Management Subprogram is responsible for protecting, maintaining, and selectively enhancing Wisconsin's fisheries and aquatic resources. The subprogram serves over 2 million anglers and protects and manages a resource that includes 15,000 inland lakes (totalling 1.2 million acres), 9,000 miles of trout streams, 8,000 miles of warmwater streams and rivers, over 6.4 million acres of the Great Lakes, and Wisconsin's portion of the Mississippi River. Professional fish managers maintain and develop over 650 separate public fishing areas totalling 130,000 acres to provide access or protect critical habitat. These combined resources provide over 36 million days of sport fishing each year and support a commercial fishing industry with a catch valued at more than $4 million annually. Independent surveys by the U.S. Fish and Wildlife Service have found that sport fishing in Wisconsin contributes more than $750 million to the State's economy each year.

Fishery Assessment Activities In Ceded Territory

Meeting Fisheries Management's specific responsibility to assess and manage the fisheries resources related to treaty fishing will require an estimated 33,000 hours of permanent time (costing over $400,000) and an additional $510,000 for temporary labor and other expenses during each of the next two years (1991-92 and 1992-93). Environmental and other fishery assessments, habitat development, hatcheries and stocking, public access development, permit review and other costs associated with the Fisheries Management Program in the ceded territory cost an additional $4,260,000 per year.

State of Wisconsin Department Natural Resources Organization Chart



Organizational Framework

Fisheries Management is highly decentralized with 94% of its total personnel assigned to district field programs. This reflects the Department's district structure and provides a high degree of local service and public interaction.

Physical Plant

Fisheries Management operates 12 coldwater and 4 warmwater hatcheries in addition to a large fleet of vehicles, boats, motors, and other equipment. Personnel are stationed in 44 offices across the state.

Table 1. Funding Sources (1991-1993 Estimated Statewide Annual Fisheries Management Budget From All State and Federal Sources of Funding)

SEG* Operations	$10,225,900
SEG* Development	55,300
Inland Trout Stamp	520,900
Great Lakes Salmon & Trout Stamp	596,600
General Tax Revenue (GPR)	399,900
Recreational Boating Fund	100,000
Boating Access-S.E. Wisconsin	100,000
Dingell-Johnson Federal Aid	3,400,000**
Other Federal Aid	540,400
Total:	**$15,939,000**

(*SEG, Segregated revenue from the sale of fishing licenses)
(**Anticipated federal funding for 1990-91 based on the 1989-90 apportionment)

Staffing

There are a total of 248.37 full-time positions (FTEs) attached to the Fishery Management Subprogram; 233 FTEs are assigned to the district field programs. Of these positions, 161 FTEs are support personnel (Natural Resource Technicians, Assistants, and maintenance personnel); 72 field positions are occupied by professional fisheries biologists (Natural Resource Specialists and Supervisors).

To meet program goals and objectives, fisheries personnel perform the following tasks:

1. Propagation at 12 coldwater and 4 warmwater hatcheries and stocking to maintain or enhance fish populations.
2. Resource assessments and surveys to identify critical habitat and fish populations for the environmental impact process and for permit reviews. Surveys also provide data on population structure, harvest, and exploitation for Native American Treaty Fishing implementation and assessment and for the regulation of sport and commercial fishing.
3. Management evaluations to determine the effectiveness of various management practices like stocking, regulations and habitat development. Evaluations provide quality control for the subprogram.
4. Maintenance and development of public fisheries areas, access sites, and habitat.
5. Public involvement in program development, public relations and public education and information services.
6. Land acquisition to provide public access and protect critical habitat.

Bureau of Indian Affairs

Mailing address:
Minneapolis Area Office
331 2nd Ave. S.
Minneapolis, MN 55402
Telephone: 612/373-1146

Great Lakes Agency Office
615 W. main St.
Ashland, WI 54806
Telephone: 715/682-4527
Fax: 715/682-8897

Natural Resource Programs:
Fish and Wildlife Management, Conservation Law Enforcement, Recreation, Forestry, Archaeology, Hydrology, Geographic Information Systems, Environmental Quality.

Current operating budget:
Approximately $18 million for Minneapolis Area natural resource programs of which over 80% is distributed to tribal governments. The Wildlife and Parks Section allocates over $13 million to Minneapolis Area tribal and inter-tribal fish and wildlife management, conservation law enforcement and recreation programs.

The Bureau of Indian Affairs is the agency primarily responsible for assisting tribes in the administration of Indian trust property and for protecting and implementing treaties, laws, and regulations that pertain to the affairs and welfare of American Indians. In its capacity as trustee and its government-to-government relationship with the tribes, the Bureau is the lead agency designated by the Secretary of the Interior to fulfill Departmental trust responsibilities, including assistance in tribal pursuit of self-determination goals. It is the mission of the Bureau to develop, apply, and preserve a firm national policy for the conservation and enhancement of tribal resources.

The Minneapolis Area Office and its respective Agency and Field Offices are responsible for implementing the Bureau's trust responsibilities for thirty reservations and four inter-tribal organizations in the midwestern States of Wisconsin, Michigan, Minnesota and Iowa.

U.S. Fish and Wildlife Service

Mailing address:
Regional office;
Federal Building, Fort Snelling
Twin Cities, MN 55111
Telephone: 612/725-3447
Fax: 612/725-3508

Fisheries Assistance office:
2800 Lake Shore Drive Ease
Ashland, WI 54806
Telephone: 715/682-6186
Fax: 715/682-6185

Natural Resource Programs:
Fish and fish egg production, fish culture techniques, fish health expertise, fishery management assistance, wildlife management assistance, sea lamprey control, habitat enhancement and law enforcement.

The U.S. Fish and Wildlife Service provides fish, services, assistance, and information to tribes, other Federal cooperators, and states under authority provided by the *Fish and Wildlife Act of 1959, as amended; **Fish and Wildlife Coordination Act, as amended; and the ***Indian Self-Determination and Education Assistance Act of 1976. In accordance with these authorities, the U.S. Fish and Wildlife Service cooperatively assists the state and tribal agencies in gathering, compiling, and assessing data on the fishery resources included in this study.

The Service has a history of providing assistance in fishery matters to agencies and much of the work is covered through cooperative agreements with military, tribal, or state partners. In Region 3, Service personnel at five national fish hatcheries, four fishery assistance offices, two sea lamprey control stations, and one fish disease control center conduct activities cooperatively with other federal, state or tribal biologists to strengthen fishery resource programs.

Current programs emphasize the development and enhancement of recreational fishing, habitat improvement, and hatchery production of fish, including the development of aquaculture. These activities are supported by 140 FTE's and $8.65 million, of which $4 million are provided by non-Service agencies.

Fish and fish eggs are provided from Service facilities to meet requests from tribes and other cooperators. National fish hatcheries produce 5.3 million lake trout to support Great Lakes restoration. Over 90 percent of the tribal fish that the Service provides are raised at the Genoa National Fish Hatchery, WI, with the remainder coming from Service lake trout hatcheries such as Iron River National Fish Hatchery, WI or through Service cooperators. Federal lake trout that are stocked in Wisconsin waters are produced at the Jordan River National Fish Hatchery, MI and Iron River National Fish Hatchery, WI. Fisheries assistance activities include work on national wildlife refuges, Department of Defense(DOD) facilities, national forests and parks and work on and off tribal reservation waters. All cooperator activities are performed at the request of the military or tribes and in conjunction with representatives from DOD, Bureau of Indian Affairs, Great Lakes Indian Fish and Wildlife commission or the tribes. Service fishery assistance biologists from Ashland Fisheries Assistance Office (FAO), WI; Winona FAO, MN; and Genoa National Fish Hatchery, WI conduct activities in Wisconsin to support tribal and state efforts. Biologists from Crab Orchard FAO, IL, and the other FAO offices perform fishery assistance activities on national wildlife refuges throughout the eight states in Region 3.

*Fish and Wildlife Act of 1959, as amended; 16 U.S.C. 742a-742j; **Fish and Wildlife Coordination Act, as amended; 16 U.S.C. 661-666c; ***Indian Self-Determination and Education Assistance Act of 1976, 25 U.S.C. 450-450n.


S.LIVINGSTON ©'92

Historical Background

"People will never look forward to posterity, who never look backward to their ancestors."
Edmund Burke 1729-1797

A definitive history of the inland fisheries of northern Wisconsin has not been written. This report can only provide a brief overview of the factors that have influenced the fishery resources of the ceded territory. The waters of northern Wisconsin are numerous and diverse, so they are difficult to characterize as a group. It is even more difficult to describe fish populations of the past because few scientific data exist.

Lakes may appear tranquil and unchanging to the casual observer, but they are always changing. Changes occur in daily and seasonal cycles tracking light and temperatures in the environment. Fish populations vary naturally from year to year in association with weather patterns and other environmental variability. Linear changes also occur as sediments and nutrients accumulate (a natural process known as eutrophication) or as lakes are affected by development in the watershed. Cultural development generally increases the rate of eutrophication.

Original State of the Resource

The starting point for this discussion is circa 1850, the era of U.S./Chippewa treaties and the initial influx of white Americans to northern Wisconsin. William Whipple Warren wrote in 1852:

That portion of the present State of Wisconsin, comprising the valleys of the Chippeway and Wisconsin rivers, and the country watered by their numerous tributaries, have been occupied by a large section of the Ojibway tribe for the past century. The beautiful inland lakes from which they head, have been for this length of time the sites of their villages.

For the Chippewa Indians, fishing activity continued almost the entire year. Johann Georg Kohl wrote in 1860: "The migrations of the fish, their regular arrival and departure, the periods of their spawning, being out of season and becoming in condition again, ... [had] a material influence on the movements of the [Chippewa] population." A government census was conducted in 1843 of the Chippewa bands signatory to the 1842 treaty. The Chippewa population in Wisconsin was 2,793 people in 18 bands, each of which was associated with a lake or river.

The lakes and fisheries of that era were shaped by natural influences and by the harvesting of fish by the Chippewa and their predecessor tribes in northern Wisconsin. No scientific data on the fish populations exist. One can reasonably infer that fish were long-lived and slow-growing with a lower turnover rate than in today's fishery (Goedde and Coble 1981). In general, the lakes "were young geologically, had uneroded shorelines, stable levels and were infertile in productivity." (Sather and Threinen 1969)

Settlement

The settlement of northern Wisconsin by white Americans following land cession treaties was first directed toward the extraction of natural resources (lumber and metallic ore). It later evolved toward agricultural, industrial, and hydro-electric development and finally moved toward the development of tourism. Settlement and economic development of the region increased the eutrophication of natural waters through erosion and nutrification; increased the harvest, growth, and recruitment of fish populations; created new fish habitat as flowages; expanded the distribution of fish species through stocking; increased the incidence of toxic contaminants in fish; and caused changes in the uses and values associated with fishing. The influences of settlement on the fisheries resource were neither all good nor all bad. For example, eutrophication increased biological productivity, but it also decreased the aesthetic appeal of lakes, caused winterkill and summerkill of fish in some waters, and favored some fish species over others. Hydroelectric facilities killed some fish by entrainment and degraded river habitat. On the other hand, valuable lake habitat was created in the flowages behind some dams.

Logging

Liquidation of the timber resources of northern Wisconsin began after the Chippewa ceded the land to the United States, reached a peak in the late 1800's, and was completed by 1920. Aquatic resources were affected by erosion, surface runoff, and decreased groundwater flow, but these effects were buffered by humus and woody debris. A committee of specialists reported to the state legislature in 1867 that "clearing away the forests diminishes the flow of water from springs, increases the suddenness and magnitude of floods and torrents, [and] washes away the soil . . ." (Lapham et al. 1867).

Fishery resources were directly affected by the transportation of pine logs via rivers and indirectly by the fires that followed the logging. Temporary dams were built to store seasonal runoff. During the spring thaw, the dams were opened to float white pine logs downstream to the mills. Log drives devastated fish habitat in the rivers. After the timber that stood near rivers had been cut, log drives were no longer practical and railroads were built to move timber from less accessible areas.

Slash fires on the cutover landscape were widespread and intense. In 1908, the worst fire year in Wisconsin history, 1,435 fires burned 1.2 million acres. Regeneration of the forest was delayed in areas where the heat was intense enough to sterilize the soil and incinerate the humus. Erosion from the charred landscape probably had significant adverse effects on aquatic habitats. Leaching from the ashes probably increased productivity and buffering capacity of the waters, at least temporarily.

Today most of northern Wisconsin is again forested. Timber harvest from public lands is managed on a sustainable basis, with consideration given to the effects on aquatic habitats. The forested landscape protects aquatic habitat by reducing erosion, increasing infiltration of water into the soil, and stabilizing groundwater flow.

Mining

Northern Wisconsin has significant deposits of metallic ore, including copper, zinc, nickel, iron, silver, gold, vanadium, titanium, and uranium. Iron ore was mined extensively following its discovery in 1885 on the Gogebic Range in Iron County. Numerous small copper mines existed throughout northern Wisconsin. Intensive mining in Minnesota and Michigan caused major water pollution problems. Wisconsin's small-scale mines had little effect on aquatic resources; however, the largest Wisconsin orebodies have not yet been exploited. Mining of gravel also affects some waters, particularly rivers, and requires regulatory vigilance.

Agriculture

Settlers expected to establish prosperous farms in northern Wisconsin after the forests were cut. Many lumberjacks owned land that they farmed in the summer. European immigrants were encouraged to settle in the cutover land. However most farms failed because of the infertile soil, short growing season, and poor economic conditions. Millions of acres were abandoned to tax forfeiture and reverted to forest in public ownership.

Today agriculture occurs in the ceded territory where conditions are favorable, though it is not common in the major lake districts. Where it occurs, agriculture affects aquatic resources through fertilizers, herbicides, erosion, feedlot runoff, and irrigation.

Cranberries have been cultivated in Wisconsin wetlands since the early 1860's and are the state's most valuable fruit crop. Since 1867, the State of Wisconsin has encouraged development of the cranberry industry by giving growers special rights to water, and by exempting growers from water quality laws. Commercial cranberry operations are suspected of having adverse impacts on fisheries because they alter aquatic habitat, interfere with water flows, and apply chemical pesticides and fertilizers. In a recent study, five pesticides were detected in surface waters that received discharge from commercial cranberry marshes. Four were present in concentrations that "may adversely impact sensitive aquatic invertebrates" (Zuelsdorff 1987). Cranberry growers are experimenting with nonchemical pest control methods and disease resistant stock in an effort to overcome environmental concerns (Sperling 1988).

Industry

During the logging era, sawmills were built downstream from the pinelands to receive logs and to supply the lumber needs of a growing nation. Sawdust and woody debris were commonly discharged into the water, covered the bottom, and degraded the habitat of fish and bottom-dwelling food organisms. In time, most of these habitats recovered, but even today, some waters are blanketed with a layer of wooden slabs that degrade the fish habitat.

In the late 1800's, money made in lumber was invested in the first paper mills in northern Wisconsin (Sandberg 1983). Virgin hemlock, and later second-growth aspen, provided the raw materials for supplying the nation's growing demand for paper. Development of the paper industry affected aquatic resources both upstream and downstream from the mills. In the Wisconsin River basin, natural lakes and impoundments were developed as reservoirs to supply water to paper mills downstream and to control floods. Effluent from the paper mills depleted oxygen in the water and devastated fish habitat. Long-term pollution problems were caused by sulfite wastes and organochlorine compounds.

However, since 1973, the biological oxygen demand in the Wisconsin River due to paper mill effluents has been reduced by 90% at a cost of 350 million dollars. Toxic discharges have been reduced to limits specified in wastewater discharge permits, and productive fisheries have been re-established in some of the areas formerly affected by the paper industry.

Tourism

The first fishing camps and resorts in northern Wisconsin were established in the 1890's. Tourism became commonplace as rails and roads became better established. In 1920, it was estimated that 300,000 non-residents vacationed in Wisconsin "because of the many beautiful lakes and streams within our borders". They spent an estimated seven million dollars (Scott 1937). President Calvin Coolidge vacationed in northern Wisconsin, largely for the angling experience. In 1968, Sawyer County had 395 establishments with facilities for tourists, 320 of them located on lakes and rivers (Sather and Threinen 1969). Fishing was the primary attraction at most resorts, but the tourism industry expanded to include hunting, skiing, wildlife and historical exhibits, riding stables, boating, canoeing, fall color tours, and special local events.

Transportation System/ Development Access

Prior to settlement by white Americans, transportation in northern Wisconsin was primarily by water, via the many rivers that transect the region, notably the St. Croix, the Chippewa, and the Wisconsin. Overland trails provided portages between waterways and between major Indian villages. In the late 1800's, an extensive network of railroads was constructed to link cities, and to transport lumber, ore, and farm products. Railroads also carried the first tourists to fishing resorts in northern Wisconsin.

With the advent of the automobile, highways were constructed throughout the region, providing easy access to fisheries and other resources. The construction of highways and bridges temporarily affected water quality and hydrology. Currently the Department of Natural Resources has an agreement with the Wisconsin Department of Transportation to cooperate in project planning and to develop practices that prevent water pollution and protect wetlands and surface water from construction site erosion.

Shoreline Development

The development of lakeshores for commercial and residential purposes is perhaps the most important historical factor in determining the current status of the fishery resource. Resorts and second homes are ubiquitous sights on lakeshores in northern Wisconsin. As these were constructed, shorelines were cleared of trees and shrubs, privies and septic systems were built, and construction proceeded to form concentric rings around popular lakes. A lack of local zoning laws prevented rational control over the impacts of development. Only small lakes on public lands and a few on private lands have escaped development.

Shoreline development has had extensive biological effects. Logs and stumps have been removed, reducing cover for fish. Property owners have fertilized lakeshore lawns and treated aquatic vegetation with 2-4,D, copper sulfate, and sodium arsenate. The filling of wetlands has adversely affected northern pike and muskellunge spawning habitat. Andrews and Threinen (1966) warned, "Conversion to sand bottom types due to sand blankets and erosion will eliminate the gravel and rubble spawning grounds of the walleye and smallmouth bass and reduce the invertebrate populations requiring hiding places and places for attachment." Shoreline development has caused failure of walleye reproduction in Minnesota (Colby et al. 1987). In recent years, many of these impacts have been addressed by laws at the national, state, and local levels.

Land Acquisition

In northern Wisconsin, acquisition of land by public agencies has provided substantial protection for aquatic resources. These lands are generally managed to protect watersheds from injurious use. During the 20th century, nearly 4 million acres in the ceded territory have come under public ownership.

Evolution of Management

Ryder (1970) summarized the evolution of management policies on glacial lakes:

Initial management consisted almost entirely of restriction by regulation on the sport and commercial fisheries. These regulations often had no biological base, were subject to political whim, and sometimes were actually injurious to the fisheries. Regulatory control in North American fisheries was contemporaneous with a fish-stocking fad that was prevalent in the late 19th and early 20th centuries...

More recently, as regulatory control of our fisheries has been subjected to careful biological scrutiny, many of the older restrictive regulations, such as creel and size limits and closed seasons, have been discarded in favor of more liberal regulations. These are based on a knowledge of lake productivity, growth, and natural mortality rates of fishes, and other parameters affecting the ultimate long-term yield of a lake.

This pattern of evolution can be traced in fishery management in Wisconsin. The first law for the protection of natural resources in Wisconsin was passed by the territorial legislature in 1839. It required that fishways be put in every dam except mill dams. In 1853, the state prohibited gillnets in streams and netting in lakes of less than 12 square miles. In 1858, the first closed season was introduced (four months for brook trout). In 1864, state game and fish laws began to be enforced against Indians. In 1878, the state prohibited methods other than hook and line for taking game fish. In 1881, the bass and walleye seasons were closed from February 1 to May 1, and the same closing was added for muskellunge in 1889. In 1887, the first state game wardens were hired. Prior to that time, local sheriffs had responsibility for enforcing fish and game laws, and "undoubtedly often wavered in the performance of their duty" (Scott 1937). In the 1890's, fish refuges were established, and set lines and ice fishing with more than one line were prohibited.

All of these restrictions were enacted by the State legislature. In 1917, the Conservation Commission was empowered to issue orders that had the effect of law to reduce the length of open seasons and to reduce bag limits when petitioned by interested groups. By 1921, minimum size limits were in effect for many fish species, from rock bass to muskellunge. The first attempt to investigate and classify Wisconsin's lakes and streams was begun in 1921. Today the importance of a scientific basis for fisheries management is well accepted, as expressed in a Minnesota DNR brochure (Breining, no date):

Half a century ago, fish management consisted of a few regulations and planting little fish in every puddle and rivulet... Experience has shown that this management by chance is often a waste of time and money. To be successful, management must be clear in its goals, scientific in its approach, and in step with the natural fish habitat.... Fisheries management is only as good as the information that accompanies it.... Because aquatic environments are complex, fish management will remain much like meteorology—an inexact science. But through research and careful monitoring of the fishery, we can conduct a fish management program that depends less on myth and hope, and more on science and clearly expressed goals....

Fishing Pressure

State fishing license sales provide one indicator of historical trends in angling pressure. In 1909, non-resident fishing licenses were first required; 10,000 were sold. By 1916, sales had increased to 27,000. Wisconsin first required resident fishing licenses in 1947 when a total of one million resident and non-resident licenses were sold. A gradual upward trend occurred until the 1980's, when total sales leveled off around 1.4 million per year.

Fisheries Legislation and Funding

The Board of Fish Commissioners, the first governmental institution charged with managing Wisconsin's fisheries, was created in 1874. A Conservation Commission was created in 1907 but it did not become a full-time governmental agency until 1915. The office of Commissioner of Conservation was created in 1923. The Commissioner was empowered to appoint employees as necessary to carry out his duties. The Conservation Commission was reorganized in 1927. The Commission and its director were charged with providing an "adequate and flexible system for the protection, development, and use of forests, fish and game, lakes, streams, plant life, flowers and other outdoor resources". In 1967, the Departments of Conservation and Resource Development were combined to create the Department of Natural Resources in its current form. The Conservation Congress, a private citizen group established in 1934, was designated to serve the Natural Resources Board in an advisory capacity in 1971. (Wisconsin Blue Book 1989)

Since 1950, the Federal government's primary role in managing Wisconsin's inland fisheries has been through the Federal Aid in Sport Fish Restoration Program, more commonly known as Dingell-Johnson (or D-J). The D-J program collects a 10% excise tax from manufacturers of fishing tackle and gear for funding sport fishery management projects. The law was amended in 1984 to increase the D-J fund with a 3% tax on electric motors and sonar devices, duties on imported boats and tackle, and a portion of Federal motor boat fuel taxes. Funds are distributed to the States and Territories under a formula based on land and water area and the number of paid license holders. The state agency must fund 25% of the cost of projects. In 1986, Wisconsin received $3,847,813 of the $109,959,300 distributed under the program (Sport Fishing Institute 1986).

In recent history, the Indian tribal governments of Wisconsin have made important contributions to fisheries management. The Lac du Flambeau tribal fish hatchery began operations in 1936 and the Bad River fish hatchery began in 1975. Tribal biologists first collected scientific data on fish populations in 1980 on Lake Superior. Since then, tribal fisheries assessment has expanded to include many waters in northern Wisconsin, especially lakes where treaty fishing has occurred.

The U.S. Fish and Wildlife Service has maintained a Fishery Assistance Office in Ashland since 1973 to stock fish and to conduct fishery assessments on Indian reservations and Federal properties. In the early 1980's, funds and staff were reduced and the office was vacant for a time. Renewed support for fishery resources by the Federal government revitalized the office in the late 1980's.

User Attitudes

Historical differences in attitudes of Indian and non-Indian cultures toward fisheries resources are partly responsible for the current animosity and misunderstanding among fishery user groups.

Chippewa Indians traditionally believe that plants and animals gave their lives to sustain human life, creating a spiritual bond between the hunter and his prey. Approaching the harvest with a proper attitude, symbolized by a gift of tobacco, was essential to sustaining the bond and ensuring future harvests. Man did not dominate this relationship; the life of the animal was given conditionally and taken with gratitude. Chippewas harvested fish and other resources for sustenance with the most efficient technology available to them.

Historically, white Americans also harvested fish in the most opportune manner. Kohl (1860) observed that Chippewas speared fish "by night and by torchlight, in the same way as many other nations in Northern Europe [such as] the Letts, Finns, and Scandinavians". Besides spearing, Kohl reported "the Ojibbeways have the same methods of fishing as we—with the net, the line, and the hook". The prevailing attitude of many early settlers was that natural resources were placed on earth for humans to use as they desired for their immediate benefit. Fish and other resources seemed inexhaustible, so little heed was given to the needs of future generations.

Attitudes toward natural resources changed over the decades. As Americans saw the destruction of unique and valuable natural resources, the idea of conservation for sustainable use took root. Wisconsin was the home of key figures in the development of the conservation ethic, including Carl Schurz, John Muir, and Aldo Leopold. President Theodore Roosevelt popularized the term "conservation" in 1907. The first conservation education program in Wisconsin was established by the Conservation Commission in 1912 and the public reaction was enthusiastic. Sportsmens' clubs experienced rapid growth in the 1920's under the umbrella of the Wisconsin Fish and Game Protective Association, first organized in 1909. The 20th Century in America has been characterized by a growing awareness by many Americans that humans depend on sustainable ecosystems and that, given the forces that man exerts, sustainable ecosystems depend on human stewardship.

The period after World War II was one of growing prosperity and increased leisure time. Americans believed that the "good life" included some time spent fishing in places like northern Wisconsin. As user participation grew, the technology of angling expanded and the sport fishing industry grew rapidly. Manufacturing companies (including many in Wisconsin) were formed to produce outboard motors, aluminum boats, fiberglass and graphite rods, monofilament line, sonar depth sounders, and a bewildering assortment of terminal tackle. Information on angling exploded in the form of outdoor magazines, books, maps, videos, and even fishing schools. Angling became a competitive sport and fishing tournaments proliferated. More recently a catch-and-release ethic emerged as anglers began to take greater personal responsibility for the future of their sport.

While angling had undergone a technological revolution, the traditional Chippewa harvest ethic toward fish re-emerged with the assertion and implementation of treaty rights. While emphasizing traditional ways, Indian people and tribal leaders also accepted technological changes in fishing methods. They began to utilize scientific principles of fisheries management as a means of working with government agencies and anglers in resource management and protection. Today Indian people and tribal governments are working with state fishery managers and other conservationists and environmentalists to build a sustainable future for fishery resources.

Fish Stocking

In the late 1800's and early 1900's, fish stocking and fish management were nearly synonymous. The Wisconsin legislature appropriated $500 for the propagation of fish at a private hatchery in 1872. "From this time on, evidently because of the depletion of the original fish supply by a larger population, Wisconsin people looked toward fish propagation as the only remedy . . ." (Scott 1937). In 1874, three fish commissioners were appointed to oversee the distribution of fish from the federal Bureau of Fisheries.

The first state hatchery was established in 1876. In 1879, carp were imported into Wisconsin by the fish commissioners. Walleye were first planted in 1883 and muskellunge in 1897. By 1900, the fish commissioners were annually planting over 100 million fry in the state. Hatcheries were built in northern Wisconsin at Woodruff (1892), Bayfield (1895), Eagle River (1915), and Spooner (1916). Fish were transported by rail car. In 1921, a new aerating system for the fish car allowed for the transportation of fish over long distances without loss.

Public support for fish stocking was high. By the early 1920's, so many sportsmen volunteered to assist in the fish stocking program that it was impossible to fill all of the requests. In the 1930's, the Conservation Commission set a goal to raise and stock one billion fish per year. Help was solicited from the Works Projects Administration (WPA) and Civilian Conservation Corps (CCC), and the goal was achieved in 1937. In 1940, 1.5 billion fish were stocked in Wisconsin. A turning point came in the early 1940's when an aquatic biologist was assigned to the Woodruff Station to make stocking recommendations based on research data that had been collected (Oehmcke 1989). Lake survey data were used to determine where to plant fish and where the chances for survival were greatest. The numbers of smallmouth bass, largemouth bass, and northern pike raised and stocked each year were drastically reduced. The discovery that planting muskellunge as sac fry was not effective prompted fish culturists to initiate a rearing pond program for that species. Some of Wisconsin's fish culture facilities were converted to raising forage fish (suckers and minnows) for the muskellunge rearing ponds.

Water Quality/ Contaminants

Lakes in forested areas without industrial development in their watersheds, even lakes without residential development on their shores, are still susceptible to pollution from airborne contaminants. Acid rain originates as oxides of sulfur and nitrogen emitted by powerplants and automobiles. It is a potential problem in soft-water lakes that have little buffering capacity. Increased acidity can make the water unfit for most aquatic life, notably fish. Studies in northern Wisconsin, where several hundred susceptible lakes are located, indicate that acidic precipitation occurs, though not to the extent that it does in waters to the south and east. The acidity of northern Wisconsin lakes has not changed appreciably and declines in fish populations due to acidity have not been observed. In 1986, the Wisconsin Legislature passed one of the most stringent acid rain control bills in the United States. It seems likely that northern Wisconsin lakes will escape the devastation that has occurred in some waters of New York and Canada.

Mercury is another airborne contaminant of concern in the aquatic environment. This metallic element damages the brain, liver, kidneys, and blood of humans.

It is released into the atmosphere from paints, coal-burning power plants, and the growing number of municipal garbage incinerators. The Wisconsin Department of Natural Resources began research on mercury in fish in 1968, and has been issuing fish consumption advisories for many northern Wisconsin lakes since 1982. Mercury occurs naturally in the rocks and soils of the region, but has increased in recent history. The U.S. Environmental Protection Agency estimated that mercury increased 3% per year in fish from northeastern Minnesota lakes since the 1930's and 5% per year since 1970 (Swain and Helwig 1989). Lake sediments now contain about 3.5 times as much mercury as they did at the time of white settlement. These trends are attributed to contamination from atmospheric sources.

Mercury combines with organic compounds to form methyl mercury, a process that occurs readily in acidic waters. Methyl mercury is taken up by aquatic organisms and passed up the food chain to top predators, like walleye and northern pike. Large, old predator fish generally have the highest levels. Methyl mercury in the human body is slowly eliminated over time if consumption ceases. Generally less than 70 days is required to eliminate half of the human body burden of mercury (National Research Council of Canada 1979).

Habitat Enhancement/ Restoration/Mitigation

Techniques for the manipulation of fish habitats in glacial lakes include regulation of water levels, construction of artificial spawning beds, artificial shelter, fishways, prevention of winterkill and summerkill, fertilization, predator control, invertebrate introductions, control of aquatic plants, and the rehabilitation of polluted waters (Ryder 1970). Many of these techniques have been applied in northern Wisconsin lakes; however, it has been found that treating the symptoms of eutrophication — cloudy water, algae blooms, and oxygen depletion — is expensive and often unsuccessful. Prevention rather than rehabilitation is the most prudent approach.

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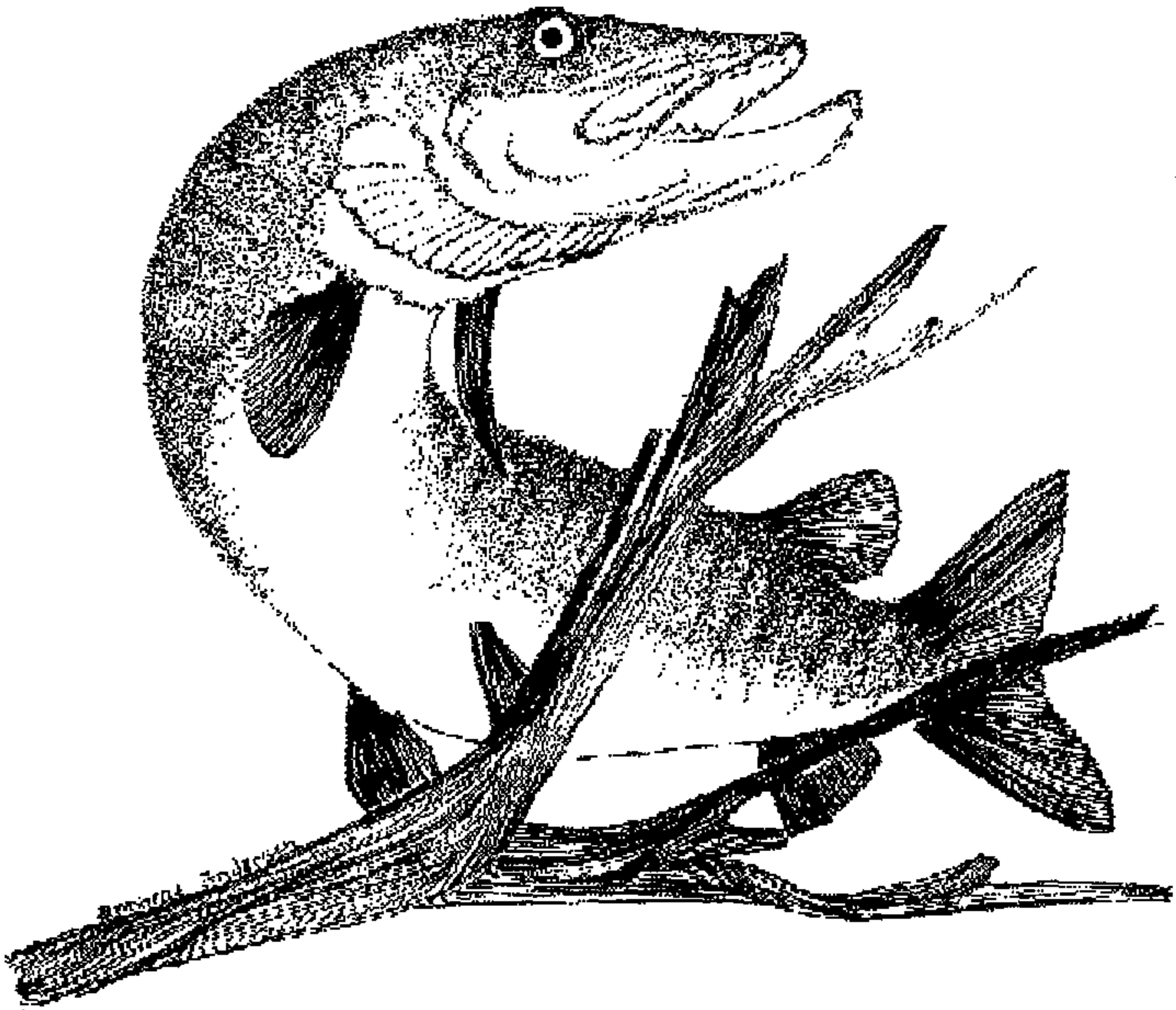


Biology of the Major Species of Concern

Introduction

Wisconsin's fishery resources have been monitored and managed to some degree for the past 100 years. The five species (muskellunge, walleye, northern pike, smallmouth bass, and largemouth bass) discussed in this report were selected because they are Wisconsin's most popular sport fishes. Inventories of the lakes and streams in Wisconsin inhabited by these species are presented in the Wisconsin Department of Natural Resources publication Fish Management Reference Book (Klingbiel, 1990) and in county-by-county surface water resource publications (eg. Surface Water Resources of Bayfield County, Johannes, 1970). Inventories of walleye and muskellunge populations that inhabit waters in Wisconsin's ceded territory are available from the Great Lakes Indian Fish and Wildlife Commission and the Wisconsin Department of Natural Resources as unpublished reports on Ceded Territory Population Estimates and Safe Harvest Levels.

Currently, all five of Wisconsin's top sport species are doing well. Walleye are abundant in most of Wisconsin's larger lakes and streams because of natural reproduction and the stocking of walleye fry and fingerlings. Muskellunge populations are maintained by natural reproduction in prime habitat and by stocking fry and fingerlings in the other waters. Northern pike, smallmouth bass, and largemouth bass populations are maintained almost exclusively by natural reproduction but populations in some of the marginal waters are supported by stocking.

A state-tribal technical working group classified 859 walleye lakes and 603 musky lakes in the ceded territory. Lake classifications were made according to the type of recruitment (natural reproduction or stocking) in the population. Each lake's walleye and/or musky population was sampled and analyzed to determine length distribution, age distribution and origin of the fish.

The results of those data were used to place each lake into one of the following recruitment code classifications.

- **NR.**, Natural reproduction only; consistent enough to result in multi-year class adult populations.
- **NR-2.**, Natural reproduction only; inconsistent, results in missing year classes.
- **C-NR.**, Natural reproduction is adequate to sustain the population even though the lake is being stocked.
- **C-.**, Natural reproduction and stocking provide more or less equal recruitment to the adult population.
- **C-ST.**, Stocking provides the primary source of recruitment but some natural reproduction occurs and may augment the adult population.
- **ST.**, Stocking provides the only source of recruitment and is consistent enough to result in a multi-year class adult population.
- **REM.**, Stocking provides the only source of recruitment but was discontinued. The stock will disappear at some time in the future.
- **O-ST.**, Stocking provides the only source of recruitment but was initiated only recently and has not yet resulted in a harvestable population of adults.

Population estimates and safe harvest levels were calculated for the lakes in the categories NR, NR-2, C-NR, ST, and C-ST.

Walleye

Walleye are so-named because of the rather large translucent lenses of their eyes. They are Wisconsin's most sought-after sport species and most popular food fish. Wisconsin is located near the center of the walleye's native range and the species is native to most of the state's larger lakes and streams, including Lake Michigan and Lake Superior (Fig. 1). The random stocking of walleye fry during the early 1900's did not expand the species' overall range in Wisconsin but it did introduce them into waters where they were not native.

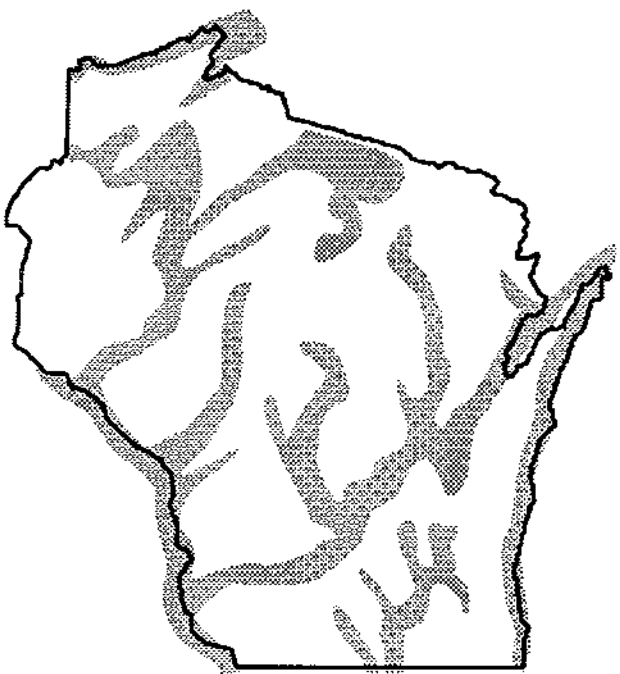


Figure 1. Original geographic range of the walleye in Wisconsin. Map from *Fishes of Wisconsin*, Becker (1983).

The non-ceded territories of Wisconsin that support large populations of walleye include Lake Winnebago, the Fox River-Wolf River systems, and the Mississippi River along the state border with Minnesota and Iowa. A large percentage of the state's walleye stocks occur in the 30 counties of the ceded territory in northern Wisconsin (Fig. 2). Walleye inhabit 859 lakes in Wisconsin's ceded territory (lake sizes vary from 22 to 15,300 acres). The total population is estimated to be 1.6 million adult fish.

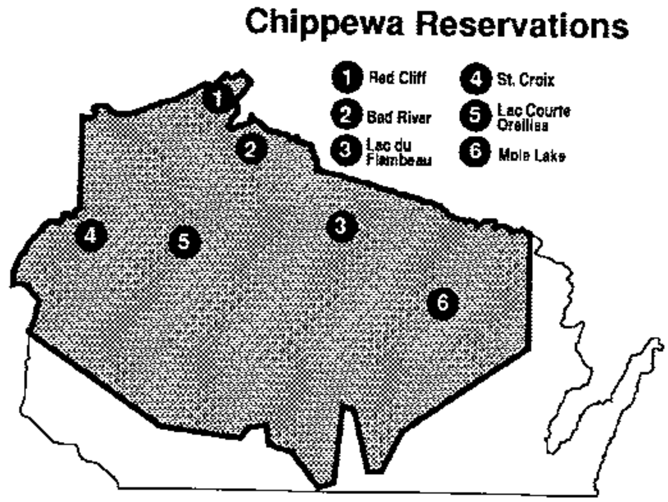


Figure 2. Map depicting the ceded territory in northern Wisconsin. Heavy line indicates approximate ceded territory boundary.

The state-tribal technical working group classified walleye lakes in the ceded territory by type of recruitment (natural reproduction or stocking) in the lake. Results from the recruitment code classification of 859 walleye lakes in northern Wisconsin are:

Code	# Lakes	%
NR.,	361	42
NR-2.,	91	11
C-NR.,	26	3
C-.,	59	7
C-ST.,	90	10
ST.,	97	11
REM.,	94	11
O-ST.,	41	5
Total	**859**	**100**

Population estimates (number of walleye per acre of water) were calculated for 172 of the 859 lakes. Estimates from 115 naturally reproducing populations varied from a low of 1.10 walleye per acre in Buskey Bay (Bayfield County) to a high of 22.10 in Nelson Lake (Sawyer County) and averaged 4.82 overall. Most of the lakes have population estimates that exceed the 3.0 fish per acre objective that biologists established as the guideline for healthy walleye populations in lakes with recruitment from natural reproduction.

Walleye do well in large bodies of water. Most quality walleye habitat is in large slow-moving rivers or in lakes that exceed 200 surface acres. Clean, moderately fertile, relatively deep waters that contain shoal areas and moderate amounts of aquatic vegetation are typically preferred by walleye. They can however survive in waters that range all the way from darkly-stained, highly acid, bog lakes to crystal clear, soft water lakes, and to turbid, highly productive, hardwater lakes.

Walleye prefer water temperatures in the 55 to 74 F range but tolerate temperatures from near freezing (34 F) to more than 80 F. Walleye spend most of their daylight hours in deep waters away from bright sunlight and move to shoal and weed bed areas after sundown. In turbid waters or on overcast days, they often remain in shallow water areas during daylight hours. In July and August, when water temperatures are highest, walleye often retreat to deep water areas and remain there until fall when water temperatures cool. They require relatively high levels of dissolved oxygen and are highly susceptible to winterkill. Winterkill occurs in some of the shallow water lakes that contain substantial amounts of aquatic vegetation.

Walleye spawn each spring soon after ice-out (April-May) when water temperatures are in the 42 to 50 F range. Lake spawners move into shallow water immediately after ice-out and deposit their eggs over rocky, wave-washed areas along the shoreline. However, in lakes with inlet rivers, the fish often migrate into the rivers to deposit their eggs over gravel bars. Spawning walleye may migrate great distances. Some Lake Winnebago fish spawn below the Montello Dam located 75 miles up the Fox River. Spawning begins with a courtship ritual that involves a female and one or more males. Males locate a ripe female and begin to rub against her sides. As the courtship activity intensifies, spawning acts begin with one or more of the males aggressively pushing or turning the female onto her side. Spawning acts are repeated every five minutes or so until the female is spent. Females leave the spawning grounds soon after they have spawned but males remain to mate with other females. Walleye scatter their eggs and milt over the spawning grounds and provide no parental care. The eggs are adhesive for an hour or two after fertilization and attach to any object they touch during that time. Eggs lose their adhesiveness after the water hardening process is complete.

Male walleye become sexually mature at 3 to 5 years, at a size range of 10 to 20 inches; females mature at 4 to 7 years, over a size range of 14 to 25 inches. Females produce from 40,000 (1.5 pound fish) to 250,000 eggs (6 pound fish) each year and egg numbers increase with fish size. Eggs hatch after 26 days of incubation at 40 F or 21 days of incubation at 50 to 55 F. Newly-hatched fry are about 0.3 inches long and, during the 3 to 5 day period of yolk absorption, their intermittent swimming motions propel them upward towards thesurface of the water. When they stop swimming, the fry drift with currents as they sink slowly back to the bottom. Fry that hatch in rivers drift downstream during their yolk absorption period. They will usually reach prime feeding areas by the time they are ready to feed. Preferred first food items for walleye fry are small zooplankton or water fleas. The success of walleye reproduction is affected by a number of potential limiting factors such as: 1) fluctuating water levels during egg incubation and fry development; 2) food availability when fry begin to feed; 3) weather conditions during the spawning season and 4) water quality on the spawning grounds.

Walleye growth in Wisconsin waters varies considerably with best growth occurring in South Green Bay, the Mississippi River and Lake Puckaway (Winnebago Co.) Table 2. Factors that cause different growth rates include: abundance of forage fish, competition with other fish species, and long spawning migrations. Females grow faster, live longer, and reach larger maximum sizes than males.

Walleye seem to consume whatever food items are available; zooplankton, insect larvae, crustaceans, and fish all contribute to their diets. In general, as walleye grow larger they consume larger food items. In most food habit studies, fish made up from 80 to 98 percent of the total volume of food, crustaceans (usually crayfish) ranked second, followed by insect larvae and zooplankton. Major prey species for walleye include: yellow perch, suckers, troutperch, freshwater drum, and minnows.

Walleye are schooling fish that do little migrating other than during their spawning runs. They are important components in the predator-prey balances of many lakes, rivers, and reservoirs that have diversified fish populations. They have been used successfully to control stunted populations of perch and panfish. Walleye may compete with largemouth bass and smallmouth bass for food and sometimes prey directly on these species. In some waters where walleye are dominant, bass populations decline.

Walleye survival rates from eggs to fall fingerlings were estimated; for every 10,000 eggs, less than 3 survive to the fall fingerling stage. Survival rates from fingerlings to age 3 varied from 3 to 18 percent (average 12 percent). Survival rates for age 3 and older walleye in Escanaba Lake varied from a low of 53 percent in 1969 to a high of 63 percent in 1980 and averaged 58 percent for the years 1979-82. Angling exploitation rates for adult walleye in 45 lakes in the ceded territory from 1980-89 were estimated at 1.8 to 58 percent and

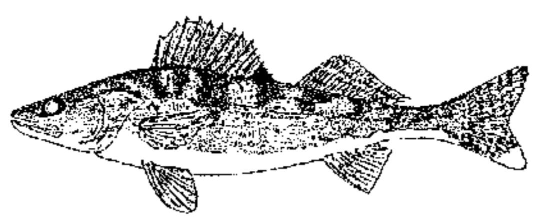
Age

Location	1	2	3	4	5	6	7	8	9	10	11	12	Source
Northwestern Wis. drainage lakes	5.7	9.4	12.3	14.6	16.6	18.6							Snow (1969
Trout L. (VilasCo.)	5.3	8.7	13.7	16.6	19.0	20.7	21.7	22.3	23.1	23.3			Schloemer and Lorch (1942)
Pike L. -Round L. (Price Co.)	5.5	8.2	10.5	12.1	13.1	14.1	15.0	15.7	16.9	17.1			Bever & Lealos (1974)
Mississippi R., Pool 7	7.7	11.4	14.0	16.8	18.6	18.9	20.7	23.8	23.9	24.8	26.1	26.5	Gebken & Wright (1972b)
Mississippi R., Pool 11	6.9	12.1	16.3	19.4	21.3	23.0	24.0	24.6	25.5	26.2	26.8		Vasey (1967)
Red R. (DunnCo.)	6.4	10.4	12.9	14.7	16.5	17.8	18.7	19.2	20.2	21.1	22.1	24.3	Colvin (1975)
Big Eau Pleine Res. (Marathon Co.	7.1	11.8	15.5	18.0	19.6								Joy (1975)
South Green Bay Males	8.9	13.1	15.7	18.5	19.4								Niemuth et al. (1959a)
Females	8.5	13.2	16.6	19.7	22.0	24.3	27.2	28.0					
L.Winnebago (Winnebago Co.) Males	5.6	10.2	12.7	14.2	15.1	15.6	16.2	16.8					Priegel (1969a)
Females	6.0	10.1	13.4	15.6	17.3	18.6	19.5	20.5					
L Puckaway (Winnebago Co.) Males	7.5	12.7	15.5	17.0	18.1	18.9	19.6	20.3	21.3				Priegel (1966b)
Females	7.8	13.6	17.3	19.6	21.1	22.4	23.6	24.7	25.5				
Pike L. (Washington Co.) Males	6.8	11.2	14.1	15.8	17.0	18.0							Mraz (1968)
Females	7.0	11.5	14.8	17.3	18.9	21.0	22.6	24.8	25.7	27.6			

Table 2. Age and growth of walleyes in Wisconsin waters. Table taken from *Fishes of Wisconsin*, Becker (1983).

averaged 16.7 percent. This is below the maximum 35 percent exploitation rate agreed upon by state and tribal biologists. Exploitation rates are usually higher on small lakes than on large lakes or rivers.

Most northern Wisconsin walleye populations are not over-exploited. Existing data, though limited, show no long term trends toward declining abundances. The Wisconsin Department of Natural Resources has monitored populations of walleye in Escanaba Lake from 1946 to the present. Angling catch rates on Escanaba Lake increased from 1949-87 and were higher (0.167 fish/hour) than for other lakes in the ceded territory (0.104 fish/hour). Angling effort decreased on Escanaba Lake from 25,000 hours per year in the 1950's to 15,000 hours per year in the 1980's. Total catches decreased from 3,000 walleye (11/acre) in the early 1950's to 2,200 walleye (7.5/acre) in the 1980's. Even though the harvest figures changed over time, walleye populations in Lake Escanaba have been relatively stable during the 40 years from 1950 to the present. Currently, average adult walleye populations in the ceded territory appear to be stable with average adult density of 4.8 walleye per acre in the lakes with natural reproduction and 2.3 walleye per acre in the lakes that are dependent on stocked fish.



Muskellunge

In northern Wisconsin, the only waters that originally possessed native stocks of muskellunge (musky) were those located in the Chippewa River Flowage above Chippewa Falls, the Flambeau River Flowage, the Wisconsin River Flowage above Hat Rapids, and the Amnicon River Flowage into Lake Superior (Fig. 3). Wide-spread indiscriminate stocking during the railcar-cream can era of the early 1900's and planned discriminate stocking from the late 1930's to the present introduced the musky into most of the waters that are capable of supporting them. Currently, muskies are found in 703 of Wisconsin's lakes and 48 of its streams (total area - 404,758 acres); more than 85 percent of those waters are located within the 30 county ceded territory (Fig. 2).

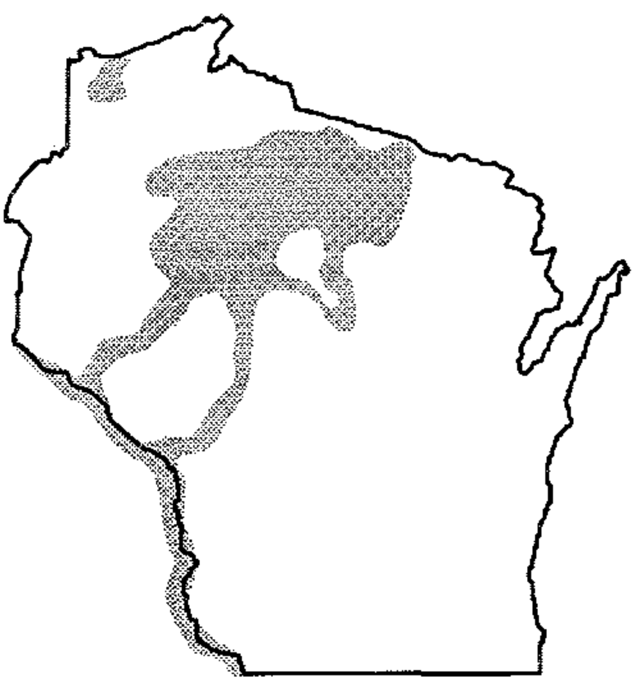


Figure 3. Original range of the muskellunge in Wisconsin. Map from *Fishes of Wisconsin*, Becker (1983).

During the 1960's, fishery managers classified Wisconsin's muskellunge waters by dividing them into three categories, based on the abundance of fish and the quality of the fishery. Class A waters are those that support good muskellunge populations and provide a highly productive fishery. There are 312 Class A lakes and streams in the state (total area - 165,972 acres); almost all of them are located within the ceded territory. Class B waters are considered those that provide good fishing but muskellunge are not as abundant as in class A waters. These include 234 lakes and streams (total area - 136,069 acres), most of which are within the ceded territory. Class C waters are those where muskellunge are present but provide only a limited fishery. This classification includes 315 lakes and streams, (total area - 102,717 acres), some of which are located in the ceded territory. Class C waters have minimal or no natural reproduction.

During the late 1980's and early 1990, a state-tribal technical working group classified musky waters in the ceded territory by type of recruitment (natural reproduction or stocking). Results from that recruitment code classifications of 603 musky lakes in northern Wisconsin are:

Code	# Lakes	%
NR.,	159	26
C-NR.,	26	4
C-.,	126	21
C-ST.,	88	15
ST.,	103	17
REM.,	91	15
O-ST.,	10	2
Total	**603**	**100**

Population estimates (number of musky per acre of water) were calculated on 38 of the 603 lakes. Estimates varied from a low of 0.11 musky per acre in Lac Courte Oreilles Lake (Sawyer County) to highs of 2.06 in Mud Lake and Callahan Lake (Sawyer County). The 38 lakes had a mean population estimate of 0.58 musky per acre.

Muskellunge typically inhabit shallow water areas with abundant weed beds. On occasion, they occupy deep waters that are relatively free of weeds. Weed beds provide cover for the predatory muskellunge and habitat for the forage stocks on which they depend for food.

Musky are solitary predators that remain within relatively small territorial home ranges during most of the year. The exceptions are during their spring spawning migrations and each fall as the water cools. Musky are relatively sedentary during the summer and winter months; movements during those periods seem to involve searches for food. They have a preferred water temperature range of 33 F to 78 F but can tolerate temperatures to 90 F for short periods of time. Even though muskies prefer clean, clear, well-oxygenated waters, they can survive in water with high levels of turbidity or low levels of dissolved oxygen better than many other species of game fish.

Muskellunge spawn each spring, usually in shallow water over matted decaying aquatic vegetation. Water temperatures during their spawning runs vary from 48 to 60 F but spawning peaks at 55 F. Spawners often return to the same spawning grounds each spring. Some male muskies mature at age 3 and all are mature at age 4. The size at first maturity ranges from 22 to 26 inches. Some females mature at age 4 and all are mature at age 5; their size at maturity ranges from 26 to 30 inches. Spawning involves a female swimming side by side with one or more males as they broadcast eggs and milt over the bottom. The eggs are deposited indiscriminately over large areas along the shoreline; no parental care is provided. Females produce from 22,000 to 180,000 or more eggs, depending on the size ofthe fish. Eggs hatch after 8 to 14 days of incubation in 54 to 62 F water. Musky fry remain on the spawning substrate until all of their yolk material has been absorbed. Immediately thereafter, the 0.5 to 0.7 inch swim-up fry become active and begin to feed on zooplankton. If other fish are present, musky fry will switch from zooplankton to fish within 4 or 5 days after swim-up.

The success of natural reproduction is dependent on a number of factors such as: 1) fluctuations in water temperatures during egg incubation; 2) fluctuations in water levels during egg incubation and fry development; 3) predation on eggs and fry by fish or predaceous invertebrates; 4) the availability of suitable food items when fry reach the swim-up stage and feeding begins; and 5) changes in water quality, such as oxygen depletion on the spawning and nursery areas. These factors probably influence the success of reproduction more than the number of eggs deposited in a given year.

Musky grow rapidly during their first three to five years but growth slows considerably thereafter. Muskellunge waters in northern Wisconsin were classified according to growth patterns of the fish. Poor growth occurs in cold, infertile, unproductive waters that produce fish, with a maximum age of 8 to 10 years and a maximum size of 24 to 28 inches. Most of the muskellunge waters in Wisconsin are classified as "average". Such waters produce 30 inch fish at age 5 with maximum ages and weights of 15 to 16 years and 50 plus pounds, respectively. Only a few waters are classified as "excellent" in northern Wisconsin and muskellunge are not native to most of those. Muskies that inhabit the "excellent" waters are usually stocked, hatchery-reared fish that do very well. They are fast growing, stocky fish that generally reach a length of 30 inches by age 4.

Muskies grow rapidly during the early summer, immediately after their spawning run, and during the early fall, when water temperatures are favorable. They feed on any available fish, including other muskellunge, but yellow perch, white suckers, and various species of minnows are the most common food items. Muskellunge tend to hide in aquatic vegetation, under submerged objects, or along drop offs and dart out to capture unsuspecting prey. Peak feeding occurs when water temperatures are in the 60 to 65 F range. Muskellunge are sight feeders so turbid waters restrict their ability to locate food. Small muskellunge are prey for other predators, including large muskellunge, northern pike, walleye, smallmouth bass, and largemouth bass. However as muskellunge grow, they become less susceptible to predation, and after age 3, their primary predators are fishermen.

Natural mortality rates for stocked musky eggs, fry, and fingerlings are very high. Johnson (1982) found that from 50 to 65 percent of stocked fingerlings die within 1 to 4 weeks after release. At times, only 5 percent of the stocked fingerlings may be alive after four weeks. Hansen (1986) conducted a study in Wisconsin to estimate the survival rates of stocked eggs, fry, and fingerlings. Only two of five lakes that were stocked with eggs produced measurable year classes. The egg to fall fingerling survival rates in those two lakes were only 0.007 percent and 0.029 percent. Fry stockings were even less successful as measurable year classes were evident in only two of six lakes and fry to fall fingerling survival rates were only 0.006 percent and 0.016 percent. Muskellunge stocked as fingerlings are more likely to survive until fall than those stocked as eggs or fry. A muskellunge life expectancy chart is presented in Table 3. The chart does not include data for the egg to sac-fry and sac-fry to fall fingerling intervals because no estimates of mortality are available for those stages of their life history. Hansen's (1986) estimates of survival for the stocked egg to sac-fry interval (0.018 percent) and sac-fry to fall fingerling stage (0.011 percent) are not realistic for native muskellunge. It would require about 50 billion eggs to produce 1000 one year old fish at those survival percentages. Evidently, naturally-spawned eggs in self sustaining populations survive better than stocked eggs. Annual mortality rates of age 2 and older muskies in Escanaba Lake were 34 percent; exploitation accounted for 84 percent of that total.

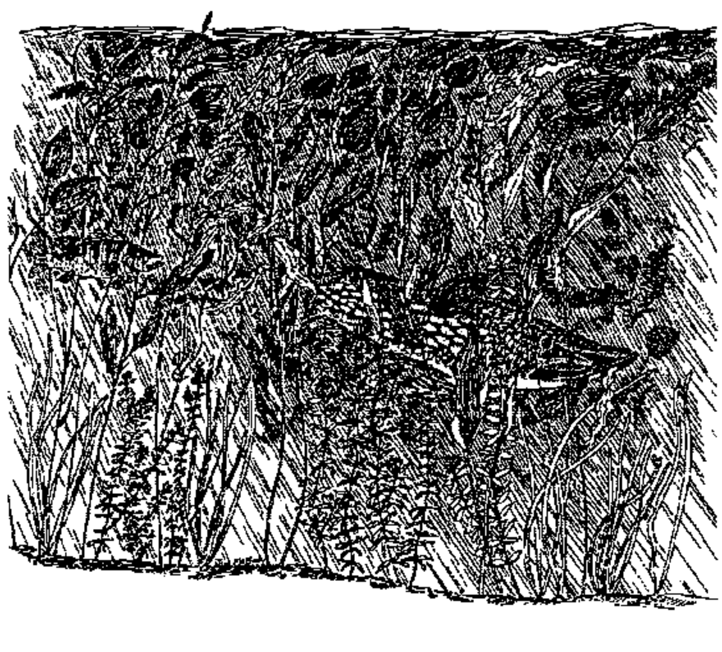
Age interval (Years)	Number alive-beginning of interval	Number succumbed-during interval	% Lost during interval	% Survival of original number
0.5 - 1	1,000	886	88.6	11.4
1 - 2	114	5	4.4	11.1
2 - 3	109	5	4.6	10.6
3 - 4	104	5	4.8	10.1
4 - 5	99	5	5.0	9.6
5 - 6	94	29	30.9	6.7
6 - 7	65	13	20.0	5.4
7 - 8	52	16	30.8	3.8
8 - 9	36	10	27.8	2.8
9 - 10	26	7	26.9	2.1
10 - 11	19	5	26.3	1.6
11 - 12	14	1	7.2	1.5
12 - 13	13	4	30.8	1.1
13 - 14	9	2	22.2	0.9
14 - 15	7	2	28.6	0.7
15 - 16	5	3	60.0	0.4
16 - 17	2	-	-	-

Table 3. Life expectancy of stocked muskellunge in Wisconsin (Johnson, 1975).

Competition between muskellunge and northern pike is a concern for fish managers. Competition probably begins soon after the two species spawn. Northern pike eggs hatch up to two weeks earlier than muskies and northern pike fry grow rapidly during their early life stages. This gives them an advantage over musky fry if they compete for food items. Many authors have noted that population changes occurred after northern pike were introduced into muskellunge waters. In almost all cases, the abundance of muskies declined and northern pike became dominant. As a result, the Wisconsin Department of Natural Resources initiated a policy to control the abundance of northern pike in good musky waters. The policy was in effect for only a short period of time and the results were never evaluated scientifically. In some waters where both muskellunge and northern pike are native, the two species seem to co-exist successfully.

In Wisconsin, anglers seek muskies more as a trophy sport fish than for food. Recent indications suggest that publicity about catch and release fisheries is affecting musky fishermen and that some legal length fish are now being released. Catch rates in Wisconsin waters during the early 1900's were very high and many of the fish caught then were in the 30 to 40 pound range. Current catch rates in Wisconsin's musky waters average between 1.0 to 2.0 fish per 100 hours of fishing. Maximum sizes are in the 30 to 40 pound range. Catch rates of muskellunge are being maintained, in part, by the state's musky propagation and stocking programs.

One other aspect of Wisconsin's muskellunge management program involves the tiger musky. Tiger muskies are muskellunge/northern pike hybrids. They occur naturally in some lakes but most are produced in hatcheries. The tiger musky program began in the 1940's and was expanded each year until 1976, when 164,926 fry and 33,341 fingerlings were stocked. Most were released in Class C waters of central and southern Wisconsin. Tiger muskies are easier and less costly to raise in hatcheries than muskellunge because they will accept artificial food whereas muskellunge require live fish for food. Use of live food increases production costs. Hybrids grow faster than muskellunge and therefore supply more rapid returns to the fishery. Disadvantages include: 1) their vulnerability to capture at sub-legal sizes (they bite year round, and are especially vulnerable to live bait); and 2) the limited ability of hybrids to reproduce. Tiger muskies are usually stocked in marginal musky waters where muskellunge do not survive very well.



Northern Pike

The northern pike is Wisconsin's second largest predator. Its voracious feeding habits cause some anglers to rate it as the top game fish in the state. Northern pike were native to all but the unglaciated southwest corner of Wisconsin; however, even in that area, they were native to the Mississippi River (Fig. 4). Historically, waters in the highlands area of northern Wisconsin were devoid of northern pike. Propagation activities during the 1960's and 1970's established them in most of those waters and over half of the 11,348 lakes in the ceded territory now contain them.

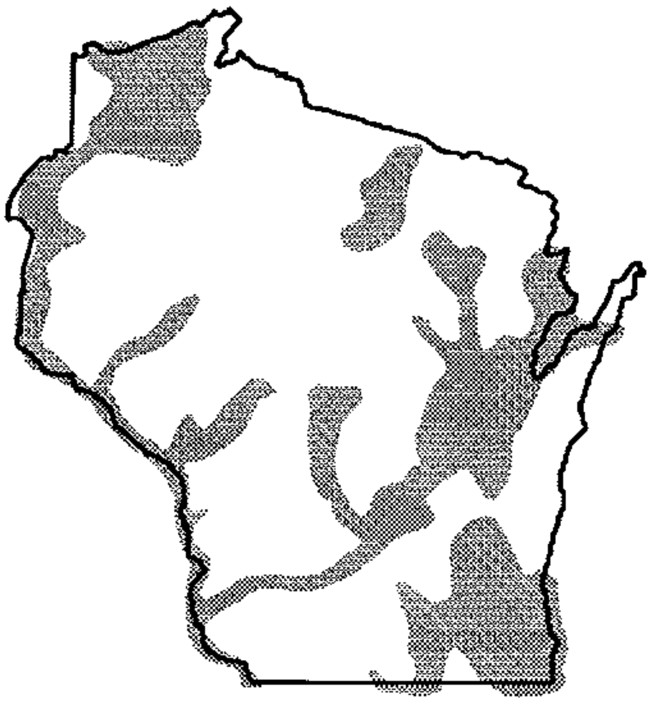


Figure 4. Original geographic range of northern pike in Wisconsin. Map from *Fishes of Wisconsin*, Becker (1983).

Northern pike do well in most of Wisconsin's ceded waters and abundances remain high without stocking. They can be susceptible to over exploitation if anglers select them as a target species or when lakeshores become developed. Population estimate data for northern pike are limited for waters in the ceded territory. However, assessment of ceded territory lakes by the Wisconsin Dept. of Natural Resources produced population data (number per acre of water) on 62 lakes. The number of catchable size northern pike per acre of water in those 62 lakes ranged from a low of 0.28 in Grindstone Lake (Sawyer County-1976) to a high of 28.58 in Little Mirror Lake (Polk County-1979) and averaged 5.20 fish per acre overall. Little Mirror Lake in Polk County and Bucks Lake in Rusk County (in some years) were the only lakes in which northern pike populations exceeded 20.0 fish per acre. Seven lakes had populations of 10.00 or more northern pike per acre and 24 had populations that exceeded 5.00 fish per acre of water.

Northern pike prefer clean, moderately cool, sluggish waters that support large beds of aquatic vegetation. They do well in medium to large lakes (50 acres and larger) and in streams that have deep water areas adjacent to shoals or sand bars. Northern pike can tolerate highly turbid waters but do not thrive in them. Even though northern pike prefer cool 55 to 70 F, well-oxygenated water, they can survive temperatures to 90+ F and dissolved oxygen levels to 3.0 ppm and less.

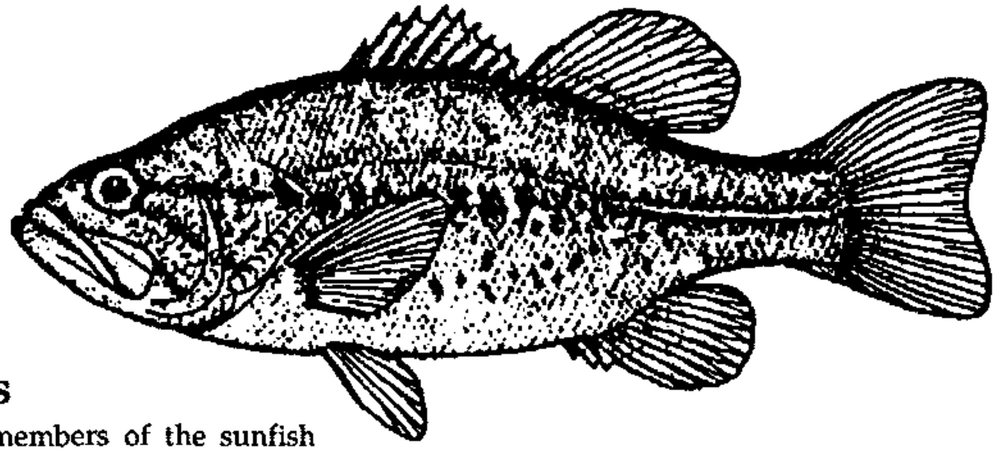
Northern pike spawn at ice-out in the spring (March-April) when water temperatures are in the 34 to 40 F range. They spawn in bays or flooded marsh areas (8 to 10 inches of water) in the lake proper, or in marshy areas associated with inlet streams. Northerns move onto their spawning sites at night and remain there for several days before they begin to spawn. Inundated grasses, sedges, or rushes are used as substrates on which they deposit their eggs. Spawning groups (a female and one or more males) swim slowly over the matted weed beds and scatter their eggs and milt. During the spawning act, males curve their bodies and slap the female with their tails causing her to expel 10 to 60 eggs. The acts are repeated every few minutes until the female is spent. Eggs are broadcast over an extended area and no parental care is provided. Female northern pike lay from 8,000 to 100,00 eggs each spring; egg numbers increase with size of the fish. The eggs are sticky and adhere to whatever they touch. Eggs that fall to the bottom are not likely to hatch due to anoxic conditions near the bottom mud. Incubation times vary from 9 to 17 days at water temperatures in the 40 to 60 F° range. Newly-hatched northern pike fry are about 0.3 inches long and absorb their yolk material in 6 to 15 days depending on the water temperature. After yolk absorption, the fry begin to feed on plankton organisms. Fry start to leave the spawning site areas when they reach 0.7 to 0.8 inches, about 16 to 20 days after swim up. The success of northern pike reproduction is affected by a number of factors such as: 1) fluctuating water levels during egg incubation and fry development; 2) predation on eggs and fry by fish or predaceous invertebrates; 3) the availability of suitable food items when fry begin to feed; and 4) changes in biological oxygen demand or dissolved oxygen levels in the spawning and nursery areas.

Northern pike growth varies considerably in Wisconsin. Growth is best during the first two years of life and decreases thereafter. In Michigan waters, northern pike fry grew to 6 inches in 82 days after they hatched. In Gilbert Lake (Washington County, Wisconsin), northern pike had reached 1.7 inches long 54 days after they hatched. In Murphy Flowage, two year old northerns were 13 to 24 inches long and, by age seven, some reached 40 inches (weight 18 to 20 pounds). Northerns from the St. Louis River were 10.9 inches (males) and 11.1 inches (females) at age 1. At age 6, they had reached 28.1 inches (males) and 30.1 inches (females). Females grow faster, live longer, and attain larger sizes than males. The average life span of northern pike in Wisconsin is about 7 years but a few large fish (25 to 30 pounds) reach 20 to 25 years. Maturity occurs at ages 1 to 3 for males (length range 12-16 inches) and at ages 2 to 4 for females (length range 14 to 20 inches).

Northern pike are opportunistic daytime feeders that exploit any seasonally abundant food source, including fish, small mammals, and small birds. Occasionally, northern pike choke to death on prey that is too large to swallow. Northerns feed by sight and have a preferred feeding temperature range of 65 to 70 F. They usually conceal themselves around structure, such as the edge of vegetation beds, stumps, logs, or drop-offs and dart out to capture unsuspecting prey. Their ferocious feeding habits are evident even when they are very young. Northern fry consume other fish, including their own kind, by the time they are 1.0 inch long. Fish are the primary food items throughout their entire life history but occasionally they consume other organisms, such as leeches, aquatic insects, and crayfish. Their most common prey species are: yellow perch, cisco, suckers, sunfish, smallmouth bass, largemouth bass, and minnows. Northerns feed almost continuously after they have spawned in the spring and after the water cools in the fall and early winter. They feed less aggressively during the hottest portions of the summer (July and August) and during the latter part of the winter (January-March).

Northern pike leave their spawning grounds immediately after they spawn; the smaller fish (1 to 5 pounds) disperse to shallow water areas (2 to 8 feet deep) with weed beds. The larger northerns (6 to 15 pounds) move into deep water (8 to 15 feet) and take up residence around structures, such as sand bars and/or beds of submergent vegetation. During the summer when water temperatures approach 80+ F, the fish will move into cooler, deep water and become less active. When water temperatures cool in the fall, they will return to shallow water and remain there until freeze-up. During the winter, northern pike can be found throughout the entire lake. Northern pike are compatible with most other fish species that inhabit Wisconsin lakes and rivers; muskellunge are an exception. Northerns are considered a threat to Wisconsin's muskellunge waters. The Island Lake Chain in Rusk County, Wisconsin, is now dominated by northern pike, but fifteen years ago, no northerns were present and muskellunge flourished. Today, muskellunge are much less abundant. Northern pike have been used as predators to control stunted populations of bluegills and yellow perch but the technique has been successful in some lakes and not in others. Total mortality on northern pike is high at all stages of their life history. Predation on the eggs and young by insects and other fish, including other northern pike, reduce their numbers by over 99 percent within the first few months. In Murphy Flowage, Wisconsin, 600 spawners produced nine million eggs, but only 18,000 fingerlings were left at summer's end, even though 52 to 99 percent of the eggs laid were fertile. The estimated survival rate of fingerling northern pike through their first summer of life was 28 percent in a Michigan Lake. Assuming a 35 percent annual survival rate thereafter, 9.8 percent of the 18,000 fingerlings would live to age 1+, 3.4 percent to age 2+, 1.2 percent to age 3+, and 0.4 percent to age 4.

Total mortality rates for age 3 and older northerns in the St. Louis River, Superior, Wisconsin, were estimated at 45 percent. Standing crops of northern pike in Wisconsin waters have been estimated at 15 to 25 pounds per acre in Murphy Flowage and at 40 to 50 pounds per acre at Cox Hollow Lake. However, the population in Cox Hollow Lake is extremely large. Generally, predatory fish, such as northern pike, maintain low densities in their natural environment. Carlander (1955) summarized data from around the country and reported a mean standing crop of eight pounds of northern pike per acre of water. Because northern pike feed year around, are a highly prized sport fish, and are relatively easy to catch, their populations in Wisconsin, especially in the southeastern corner, are somewhat depressed. Shoreline development by lakeshore owners has had an adverse effect on northern pike. Many of the marshes and flooded lowland areas that northerns used as spawning sites no longer exist. The weed beds that northern pike use as cover and feeding grounds have also been destroyed or permanently altered.



Largemouth Bass

Largemouth bass are members of the sunfish family. They were probably native to all of Wisconsin except the unglaciated driftless area in the southwestern corner of the state (Fig. 5). Wisconsin is close to the northern limit of their range and their presence in many waters in the ceded territory probably resulted from introductions. Although early records of the status of largemouth bass in northern Wisconsin are not very complete, they were found in 61 of 65 lakes sampled from 1975 to 1977 and in 29 of the 40 lakes in Waukesha County that were sampled in 1963.

Largemouth bass do well in medium to large rivers, lakes, ponds, sloughs, and backwaters that have shallow areas with lots of aquatic vegetation. Currently, largemouth bass are one of Wisconsin's most abundant and widely distributed sport species. There are abundant populations in some waters in almost every county in the state. The Wisconsin Department of Natural Resources assessed the populations of largemouth bass in 32 of the ceded territory lakes. The number of catchable largemouth bass per acre of water ranged from a low of 0.20 in Bass Lake (Washburn County) to a high of 65.44 in Spruce Lake (Vilas County) and averaged 9.33 fish per acre overall. Spruce Lake was the only lake with a population of largemouth bass that exceeded 50 fish per acre, and Rusk Lake (Douglas County) was the only lake with a population in the 25 to 50 fish per acre range. Seven lakes had populations that exceeded 10 largemouth bass per acre of water.

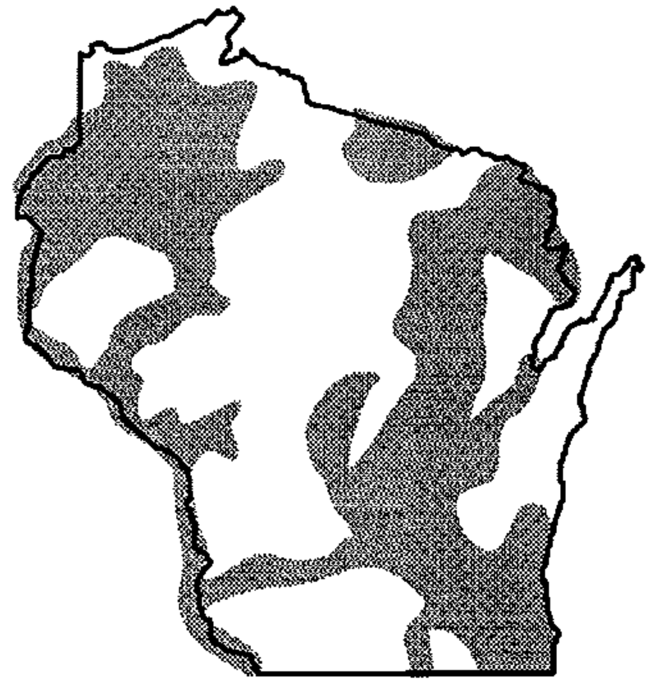


Figure 5. Original geographic range of the largemouth bass in Wisconsin. Map from *Fishes of Wisconsin*, Becker (1983).

Largemouth bass prefer shallow weedy areas (up to six feet deep) with clear to slightly turbid, highly productive water. Their optimum temperature range is from 81 to 86 F with an upper lethal limit of 96 F. At temperatures below 50 F, they become lethargic and tend to stop feeding. Largemouth bass cannot tolerate low oxygen levels and become victims of winterkill in some of the weedy, shallow water habitats where biological oxygen demands become high during the winter.

Spawning occurs from late April through July when water temperatures are in the 60 to 65 F range. In northern Wisconsin, largemouth bass spawn about two weeks later than those in southern Wisconsin. Spawning begins with males selecting nesting sites in one to five feet of water. They construct saucer-shaped nests by using their fins to sweep out a depression up to 6 inches deep. Female largemouth bass lay from 2,000 to 20,000 eggs. Males will accept more than one female in their nests and females may contribute eggs to several nests during a spawning season. The fertilized eggs are adhesive and adhere to objects in the nest. Males defend the nests against intruders. Largemouth bass nests usually contain 5,000 or more eggs; an average of about 3,000 fry came off each nest in Punch Lake (Vilas County).

Egg incubation ranges from 3 to 7 days, depending on the water temperature. Newly-hatched fry are less than 0.3 inches long and are transparent. They remain in the nest until their yolk material has been absorbed (usually 6 or 7 days); then rise from the nest as a school that is light green in color. The fry may remain together for up to 30 days. During this entire time, the school will be guarded by the male. Nursery areas for largemouth bass are shallow water weed beds located along the shoreline. Reproductive success is affected by a number of factors including: 1) favorable temperatures during egg incubation and fry development; 2) lack of flooding and storms (high winds destroy nests) during incubation; and 3) an adequate supply of food items when the fry begin to feed.

Growth rates of largemouth bass in Wisconsin waters vary greatly, depending on ambient water temperatures and types of food items eaten. They are most active at about 80 F and quit feeding at 50 F or less. Largemouth bass grow more rapidly during their first two years of life than at any time thereafter. At age one, total lengths of largemouth bass in Wisconsin waters vary from 2.8 inches in northern Wisconsin lakes to 4.5 inches in Lake Mendota (Dane County). By age three, those in northern Wisconsin lakes were 9.7 inches long; those in Lake Mendota had reached 12.6 inches. Factors that influence growth are water temperatures, availability of food items, and population densities.

Females tend to be longer and heavier than males in all age groups, especially after age two. Most largemouth bass in northern Wisconsin do not live beyond age 5 or 6 but a few reach 10 to 12 years of age, 18 to 20 inches in length, and weigh 8 to 11 pounds. The ages at sexual maturity are 3 to 4 years for both sexes at a size range from 8 to 12 inches.

The first food items eaten by young largemouth bass are zooplankton. When the fry reach 2 to 3 inches, they begin to consume insects, insect larvae, and fish. As the fish grow, they consume less plankton, more crayfish, and more fish. Prey species of largemouth bass include: bluegills, yellow perch, crappies, minnows, bullheads, madtoms, and other bass. Dragonfly nymphs were the most common insect consumed. Largemouth bass are sight feeders and feeding activity peaks occur in the early morning and again at dusk.

Largemouth bass fry have strong schooling tendencies and even the adults will congregate in small groups along the edges of weed beds in shallow water. During daytime, they are usually in 3 to 9 feet of water, often hiding under lily pads or in the shade of overhanging trees. In the evening, largemouth bass move into shallow water to feed. After dark, they return to deep water to rest on or near the bottom. Adult bass move into deep water and are relatively inactive during the winter. In the spring, they migrate into bays where the water is warmer. Largemouth bass are compatible with most warmwater species of fish. However, their abundance often declined when walleye were introduced into their habitat. When both largemouth and smallmouth bass are present in the same waters, the two species usually occupy different niches in the habitat but largemouth bass will often dominate. Carp can depress populations of bass by altering the habitat. They stir up the bottom, increase turbidity, and uproot the weed beds that bass require.

Natural mortality rates of largemouth bass are high during the fry and fingerling stages, but relatively low (5.2 percent at Ridge Lake and 12 percent at Brown Lake) for age two and older fish. Angling harvests, however, present a different picture. In Ridge Lake, 23 to 40 percent of the catchable stock was harvested each year. In Brown Lake, anglers harvested four pounds of bass per acre in 1953; about 12 percent of the total catchable stock.

The standing crop of largemouth bass in Brown Lake, a bass-bluegill lake in southern Wisconsin, averaged between 27 and 33 pounds per acre. Standing crops of about thirty pounds per acre are considered normal for the glacial lakes in Wisconsin.

Smallmouth Bass

Smallmouth bass are members of the sunfish family; their native range is limited to the North American continent. In Wisconsin, Greene (1935) was unable to determine their original range because they were so widely distributed during the cream can/ railcar era of the late 1800's and early 1900's. However, the presence of smallmouth bass above waterfalls in localities where they were never stocked indicates that they probably dispersed over most of Wisconsin during the early post glacial period (Fig. 6). Smallmouth bass prefer moderate to large rivers but they also do well in lakes that have gravel bottom areas. Currently, they are found in 214 streams (total 3,514 miles) throughout the state and in numerous lakes in the watersheds of those streams. The southwestern corner of Wisconsin and the Green Bay/Fox River area support the highest abundances of smallmouth bass outside of the ceded territory. Smallmouth are abundant in the central part of the ceded territory of Wisconsin. The Wisconsin Department of Natural Resources assessed the populations of smallmouth bass in 13 lakes located within the ceded territory. Populations (number per acre of water) varied from a low of 0.30 in Lac Courte Oreilles Lake (Sawyer County), to a high of 14.95 in Nebish Lake (Vilas County), and averaged 3.01 catchable smallmouth bass per acre overall. Nebish Lake was the only one with a population that exceeded 10 fish per acre. Clear Lake in Oneida County has the second highest population at 4.50 fish per acre.

Smallmouth bass thrive in slow to moderately swift rivers but moving water is not essential. They prefer warm, clear, well-oxygenated water over rocky or gravel bottoms. Smallmouth bass require shallow water areas, rocky ledges, patches of vegetation along the shorelines, and some relatively deep water areas in their habitat. They prefer water that is slightly turbid, moderately productive, and in the 70 to 80 F temperature range. Dissolved oxygen levels below 1.0 ppm are lethal. At 50 F and below, smallmouth bass become lethargic and do not feed.

Spawning occurs from mid-May through late June when water temperatures are in the 55 to 70 F range. As spawning approaches, the males select sites and construct nests. Nest building occurs in the early morning. Males assume a vertical position in the water and sweep the bottom vigorously with their tails. This clears the mud, sand, and small stones from an area about twice the length of the fish. The male waits for a female to arrive and attempts to nudge and push her into the nest. In the spawning act, the male and female turn on their sides and expel eggs and milt simultaneously. Individual spawning acts occur every few minutes and it may take from two to three hours

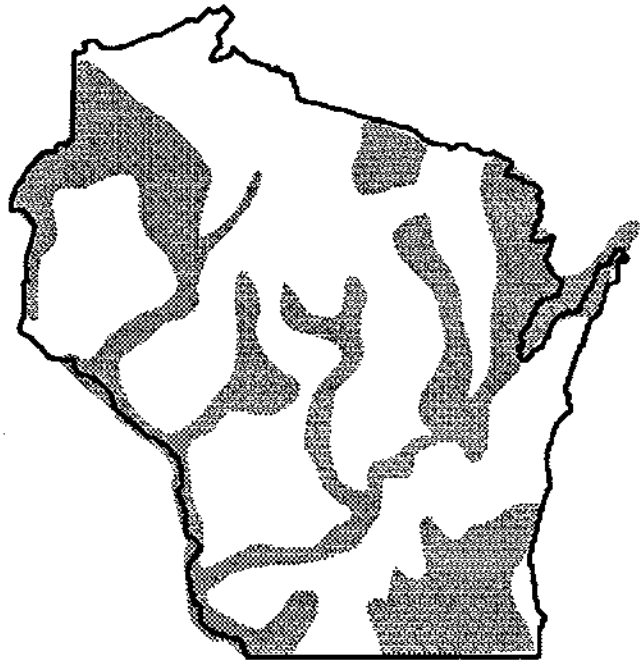


Figure 6. Original geographic range of the smallmouth bass in Wisconsin. Map from *Fishes of Wisconsin*, Becker (1983).

for a female to expel all of her eggs. The eggs are sticky and adhere to rocks in the nest. After the female deposits 2,000 to 10,000 eggs (depending on the size of the fish), she will leave the nest. Usually the male will follow her for a short distance but then return to care for the eggs. Some males are able to coax more than one female into the nest and some females may spawn in more than one nest before they are spent. Incubation times range from 3 days at 75 F to 10 days at 55 F. Smallmouth bass nests contain up to 10,000 eggs and usually 2,000 to 3,000 fry hatch and emerge. Smallmouth bass mortality is high during the first few days after the fry leave the nest. Natural mortality eliminated most of the young fish in a population before they reached ten inches in length.

The fry are about 0.3 inches long when they hatch and rise up out of the nest as a tight black school 6 to 15 days after hatching. The male stays with the brood for 2 to 9 days but abandons them as the school of fry begins to disperse. Nursery areas for smallmouth bass are generally in shallow weedy beds along the shoreline. As soon as the fry absorb their yolk material (0.5 to 0.7 inches long), they begin to feed on small zooplankton. Reproductive success is affected by a number of factors including: 1) favorable temperatures during the spawning and post spawning periods; 2) lack of flooding and high winds during the nesting stage (severe wave action will destroy nests); and 3) the presence of structures (logs, brush, large rocks) in their nesting areas.

Growth rates of smallmouth bass in Wisconsin waters vary greatly. In southern Wisconsin (Grant, Richard, and Lafayette Counties), young-of-the-year averaged 1.0 inches in June, 2.0 inches in July, and 2.8 inches in September. Smallmouth bass average 3 to 4 inches at age one, 6 to 7 inches at age two, 8 to 9 inches at age three, and 10 plus inches at age four. Most smallmouth bass do not survive past age 5, but a few reach 8 to 11 years of age, 18 to 20 inches in total length, and weigh 6 to 9 pounds. The ages at maturity for smallmouth bass are: males 3 to 5 years and a size range of 8 to 12 inches; and females 4 to 7 years and a size range of 9 to 13 inches.

Smallmouth bass fry begin to feed on zooplankton soon after they leave the nest. Small insects and small fish have been found in the stomachs of 1.8 inch bass and small crayfish and fish in the stomachs of 3.1 inch smallmouth bass. Fish species consumed were: perch, sunfish, minnows, darters, sculpins, suckers, catfish, sticklebacks, and other bass. In Clear Lake (Oneida County), smallmouth bass had mostly crayfish in their stomachs, whereas, in the Plover River (Portage County) they consumed mostly fish. Insects made up small parts of the diets in both areas. Adult smallmouth bass spend their daylight hours in deep pools, under river banks, or around logs and stumps. At dusk, they become active and move into their feeding areas. At night, they rest on the bottom until dawn when they move into shallow water in search of food. They feed aggressively, often chasing food organisms so far inshore that their backs are out of the water. During the winter, smallmouth bass move into deep water and become semi-dormant. In the summer, river bass take shelter in the lee of rocks, in cavities under objects, or along ledges. They seem to avoid living in beds of submerged vegetation but utilize them as feeding grounds.

Smallmouth bass are tolerant of most other river and lake species. However, when both smallmouth and largemouth bass are present in the same waters, they select different niches in the habitat. In Livingston Branch (Iowa County), the standing crop of smallmouth bass was very high (280 to 450 lbs/acre). In the Red Cedar River (Dunn County) and in the Plover River (Portage County), standing crops were in the 80 to 110 lbs per acre range.

Female smallmouth bass cannot be stripped of their eggs but will readily spawn when placed into small hatchery ponds. Major concerns in smallmouth bass management are habitat protection and pollution abatement. Habitat degradation caused by lake shore development, riverine hydropower plant construction, and increased pollution by industrial development have adversely affected some of the state's prime smallmouth bass waters. However, the fish continue to thrive in northern Wisconsin with a minimum amount of stocking.

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Resource Utilization by State-Licensed Anglers

The State of Wisconsin allows only hook-and-line angling by state-licensed anglers for walleye, muskellunge, northern pike, smallmouth bass and largemouth bass in inland waters of the ceded territory. Hand dipnetting and seining are also allowed for cisco in most ceded territory waters. Treaty fishing by Chippewa tribal members is not licensed by the state. Wisconsin currently sells about 1.4 million individual licenses annually and this number has generally paralleled state population growth since licenses were first required of all fishermen in the late 1940's (Figure 7). Wisconsin also licenses fishing guides. Statewide, the number has increased steadily since 1979 (Figure 8) and, in 1989, Wisconsin licensed 1,560 guides.

Although it is impossible to determine how many of the state-licensed anglers or guides fish in the ceded territory, good estimates are available of the total fishing effort on ceded territory lakes. There are 11,348 lakes covering 533,086 acres in the ceded territory. From 1980 to 1989, state-licensed anglers annually fished 32.4 million hours on these waters (60.8 hours/acre).

Walleye are found in 859 ceded territory lakes that cover 355,183 acres. Effort on these lakes during the state walleye fishing season averaged 15.7 million hours per year (48.5 hours/acre) but not all of this effort is directed at walleye. Muskellunge are found in 603 lakes that cover 277,432 acres. Angling effort on these lakes during the muskellunge open season averaged 8.2 million hours annually (29.7 hours/acre). Again, not all of the effort was directed at muskellunge.

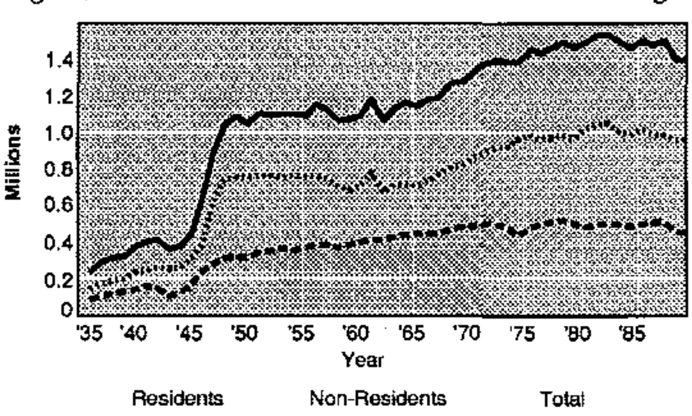

Figure 7. Total statewide sales of fishing licenses by the State of Wisconsin to residents and non-residents, 1936-1989. Does not include license sales which are primarily used on the Great Lakes.

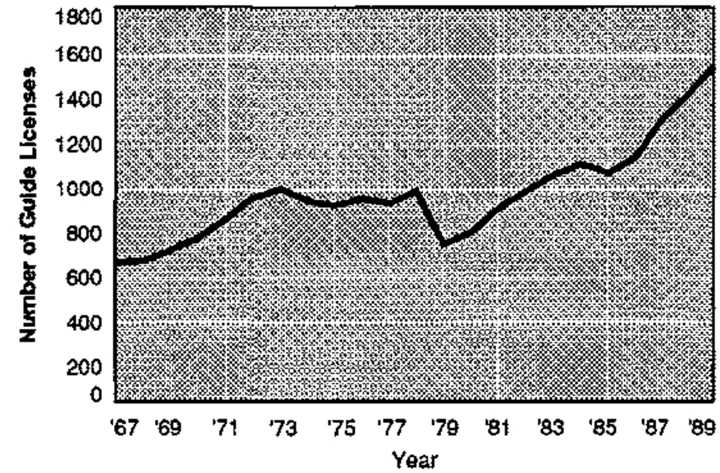

Figure 8. Total statewide number of licenses issued to guides by the State of Wisconsin, 1967-1989.

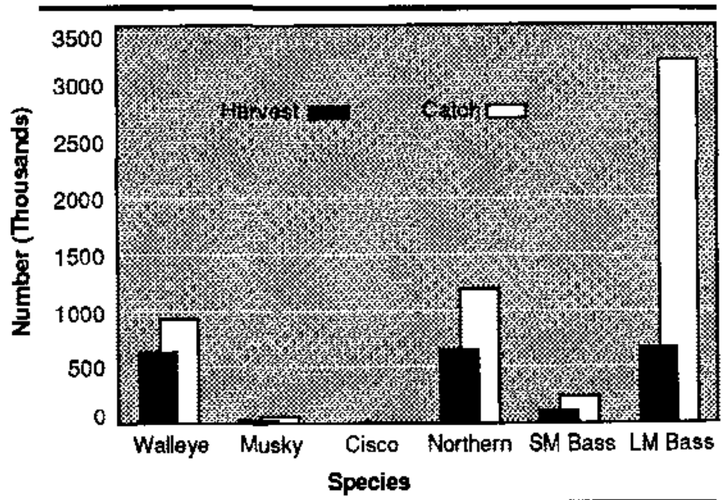

Figure 9. Estimated annual sport angling harvest and catch (including fish caught and released) of walleye, muskellunge, cisco, northern pike, smallmouth bass and largemouth bass in the ceded territory of Wisconsin, 1980-89.

Estimates of annual state-licensed angling harvest and catch (includes both harvested and released fish) in the ceded territory during 1980-89 are based on 90 separate creel surveys run on 64 different lakes. Results have been statistically expanded to cover all ceded territory lakes based on the assumption that the sampled lakes are representative. Total annual harvest by state licensed anglers averaged 623,525 walleye; 9,454 muskellunge; 623,831 northern pike; 96,928 smallmouth bass; and 661,105 largemouth bass (Figure 9). Total annual catch (including released fish) of each species was 46 percent to 513 percent higher than the harvest, indicating a substantial number of gamefish are being released by anglers. Fish may be released because they are smaller than legal size limits, anglers have already filled their daily bag limit, or anglers are practicing "catch-and-release" fishing. Estimated catch and harvest of cisco was negligible.

While total harvest estimates are interesting, catch and harvest per unit area estimates provide a better basis for comparing various fisheries and population statistics. Total annual harvest by state licensed anglers on a per acre basis averaged 1.76 walleye/acre; 0.03 muskellunge/acre; 1.17 northern/acre; 0.18 smallmouth bass/acre; and 1.24 largemouth bass/acre (Figure 10). Catch (including released fish) was much higher than harvest and the cisco catch and harvest was negligible.

Efficiency of sport angling is relatively modest. Anglers fishing specifically for a particular species ("specific angler") needed 9.4 hours to catch a walleye; 196.1 hours per muskellunge; 8.1 hours per northern pike; 3.4 hours per smallmouth bass; and 4.8 hours per largemouth bass (Figure 11). It took much longer for anglers not fishing for any particular species ("general angler") to harvest a fish. If fish that were released are included, it took much less time for both specific and general anglers to simply catch a fish (Figure 12).

The size ranges of fish harvested by anglers from 1980 to 1989 varied according to species. The most common size of fish harvested by anglers was: walleye-13" (Figure 13), muskellunge-33" (Figure 14), northern pike-18" (Figure 15), smallmouth bass-10" (Figure 16), and largemouth bass-13" (Figure 17). Size distributions of fish that were caught and released are generally not available. The proportion of the angling harvest that might be considered "trophy size" was also modest for all species except muskellunge. While 25 percent of muskellunge harvested were 40" or larger, only 0.02 percent of walleyes were over 30", 2.2 percent of northern pike were over 30", 0.2 percent of smallmouth bass were over 20", and 0.4 percent of largemouth bass were over 20".

It is not possible to routinely monitor incidental or "hooking" mortality of fish that are caught and released by anglers. However, many sound scientific studies have shown that such mortality is minimal for walleye, muskellunge, northern pike, largemouth bass and smallmouth bass if the fish are released immediately after capture. A recent study in Minnesota, however, showed that incidental mortality can be very high if walleyes are caught and held in livewells for extended periods before release, as is done in fishing tournaments. Similar results have not been reported for other tournament species such as largemouth bass The State of Wisconsin does not license, monitor or encourage fishing tournaments. During scientific investigations of fish populations and in projecting future impacts of fishing regulation changes, the State of Wisconsin typically assumes a "worst-case" value of 15 percent for hooking mortality.

State-licensed fishing also occurs on the reservations. Data related to such fisheries are presented in Tables 4 and 5.

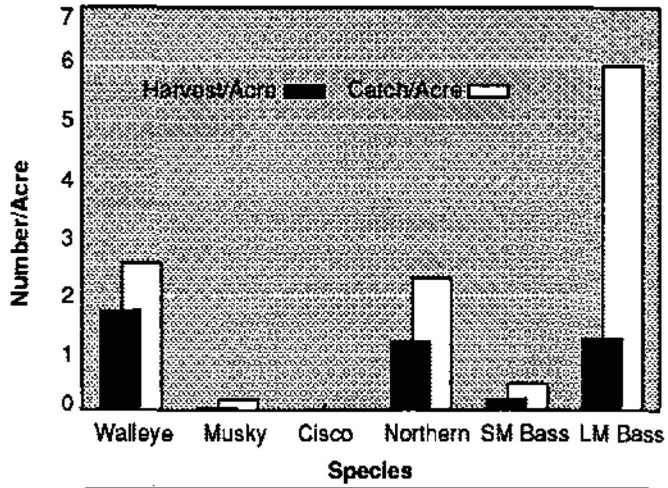

Figure 10. Estimated annual sport angling harvest and catch (including fish caught and released) per acre of walleye, muskellunge, cisco, northern pike, smallmouth bass and largemouth bass in the ceded territory of Wisconsin, 1980-89. Walleye and muskellunge values are based only of waters containing those species, while values for the other species are based on all waters.

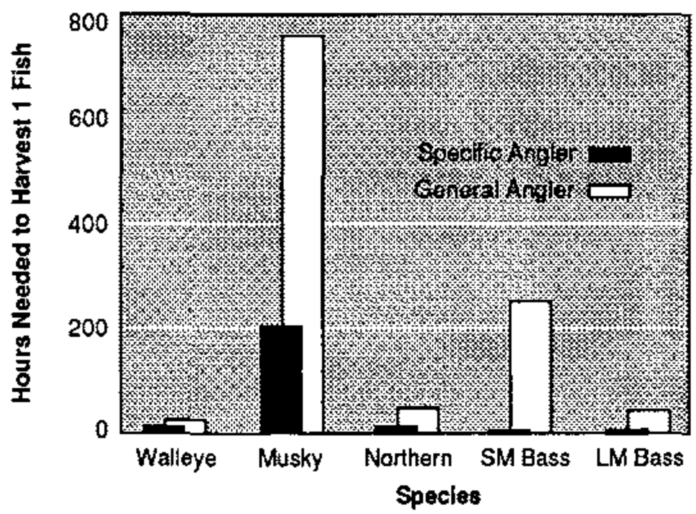

Figure 11. Hours needed by sport anglers specifically fishing for a species ("specific angler") and all sport anglers ("general angler") to to harvest one fish in the ceded territory of Wisconsin, 1980-89.

Table 4. Creel census data collected on nine lakes from the Lac du Flambeau Chain and from the White Sand Lake between July 29 and September 30, 1990 (64 days).

	Flambeau Chain	White Sand
Number of fisherman on lakes	13,644	3,302
Angler hours/day	213	52
Catch/hours fished	0.24	0.12
Total fish captured	3,274	400
By species	36% bluegill 11% northern pike 8% walleye 5% black crappie 2% yellow perch	57% yellow perch
Number of fishermen interviewed	750	288
Number of out-of-state non-resident licenses	358	139
Number of resident non-tribal licenses	297	137
Number of non-triibal Lac du Flambeau residents	53	12
Number of tribal residents from reservation	31	0
Number of off-reservation tribal licenses	11	0

Table 5. Creel survey of Lake Chippewa (Sawyer County, Wisconsin). Data collected by the Wisconsin Department of Natural Resources, may-October, 1990. (Unpublished).

Species	Total hours of angling	Catch/hour of angling	Average size (inches)
Walleye	242,635	0.26	13.8
Northern Pike	24,107	0.15	21.9
Muskellunge	250,259	0.02	38.7
Smallmouth Bass	11,028	0.24	12.8
Largemouth Bass	16,023	0.21	13.9
Bluegill	64,589	1.94	6.7
Pumpkinseed	3,429	0.70	6.2
Black Crappie	186,563	1.71	9.6
Yellow Perch	31,262	0.82	8.7
Rock Bass	2,022	0.37	-
Black Bullhead	1,090	0.25	9.9

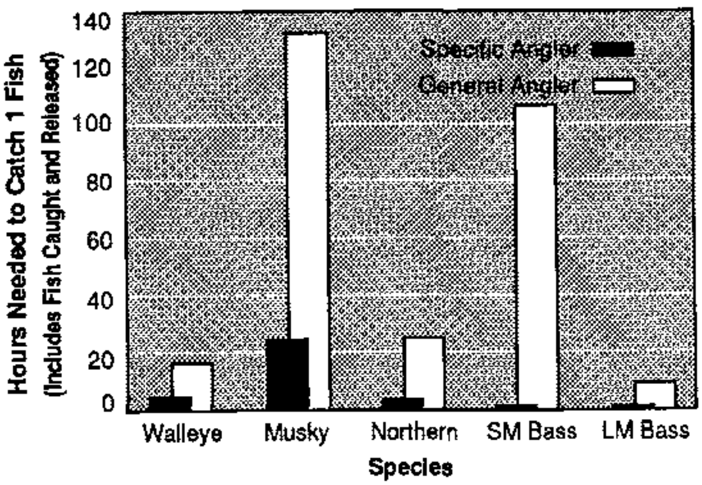

Figure 12. Hours needed by sport anglers specifically fishing for a species ("specific angler") and all sport anglers ("general angler") to to catch (including fish caught and released) one fish in the ceded territory of Wisconsin, 1980-89.

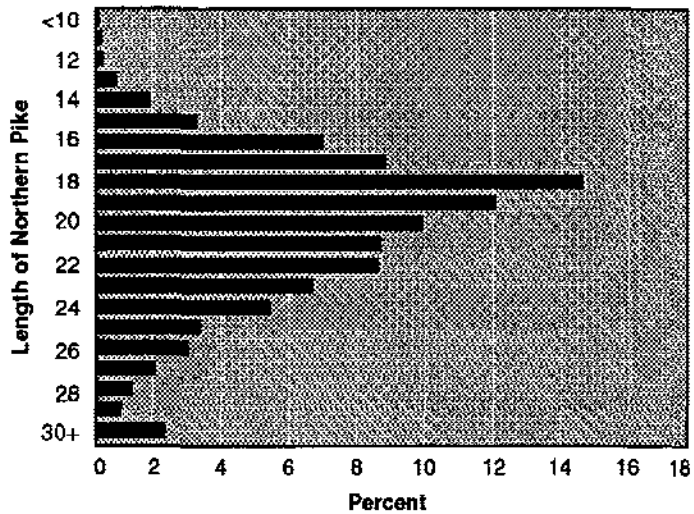

Figure 15. Length distribution (inch classes, e.g. 10=10.0" - 10.9") of northern pike harvested by sport anglers in the ceded

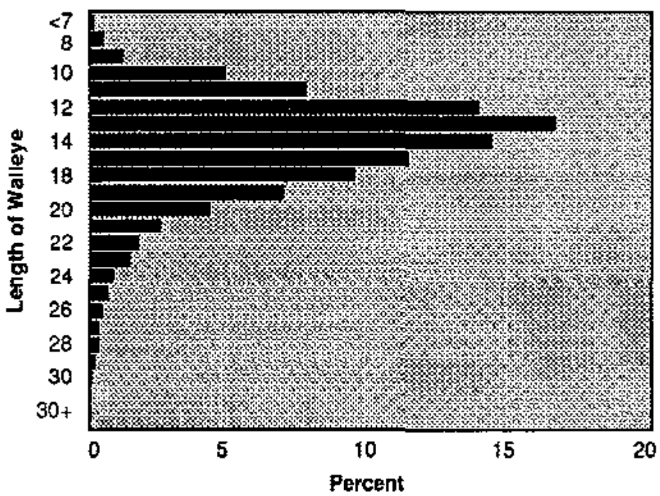

Figure 13. Length distribution (inch classes, e.g. 10=10.0" - 10.9") of walleyes harvested by sport anglers in the ceded territory of Wisconsin, 1980-89.

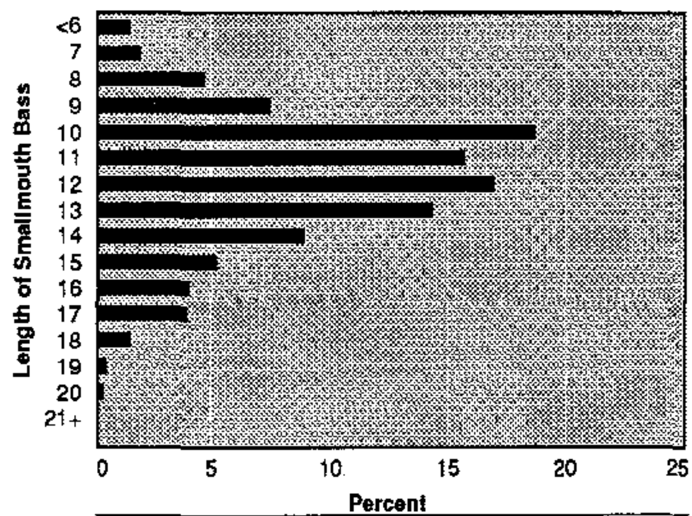

Figure 16. Length distribution (inch classes, e.g. 10=10.0" - 10.9") of smallmouth bass harvested by sport anglers in the ceded territory

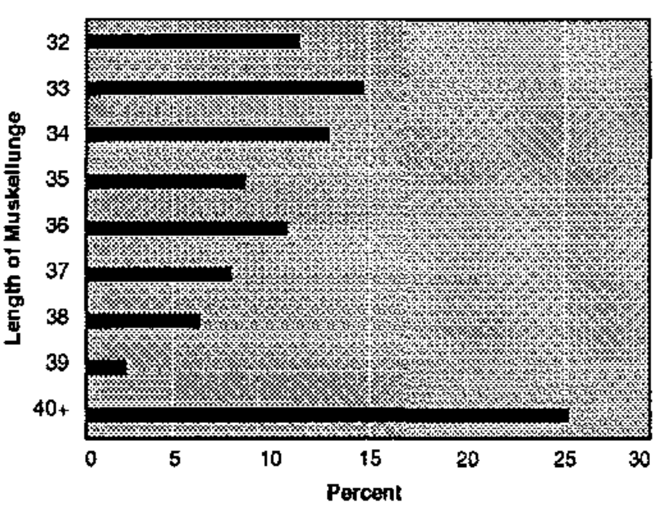

Figure 14. Length distribution (inch classes, e.g. 10=10.0" - 10.9") of muskellunge 32+" (current legal size) harvested by sport anglers in the ceded territory of Wisconsin, 1980-89.

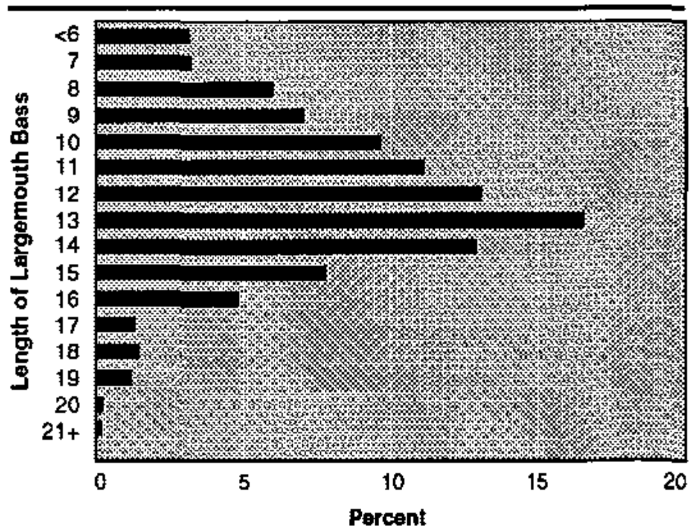

Figure 17. Length distribution (inch classes, e.g. 10=10.0" - 10.9") of largemouth bass harvested by sport anglers in the ceded territory

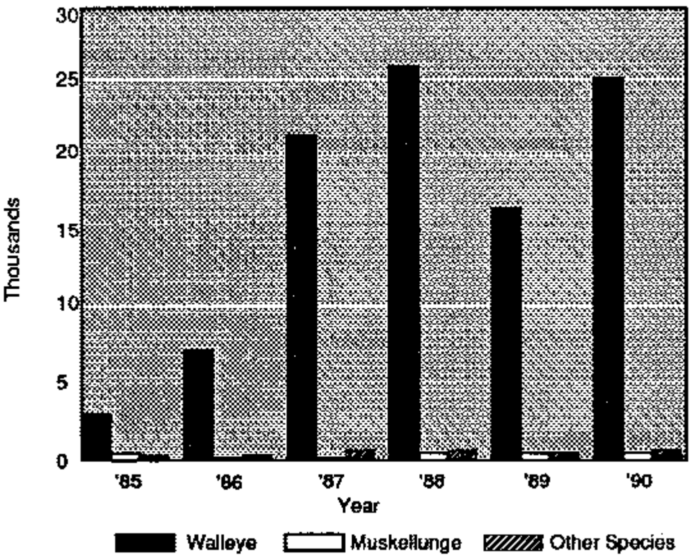

Figure 18. Number of fish harvested by spring spearing, 1985-1990.

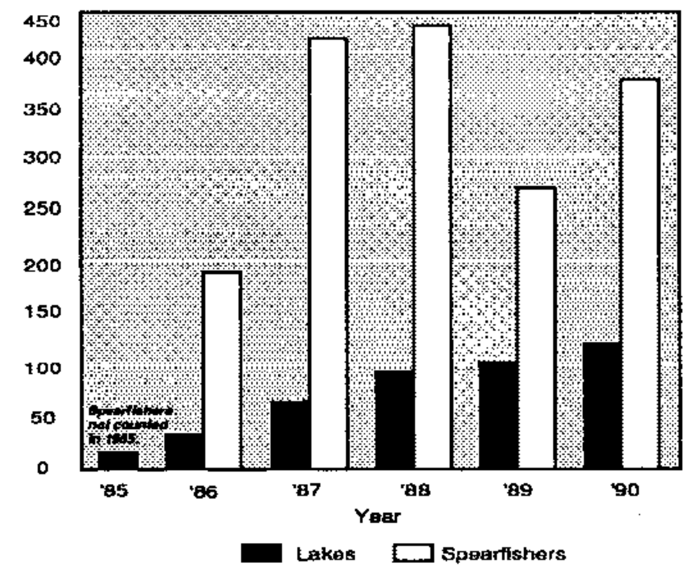

Figure 19. Number of lakes and spearfishers, 1985-1990.

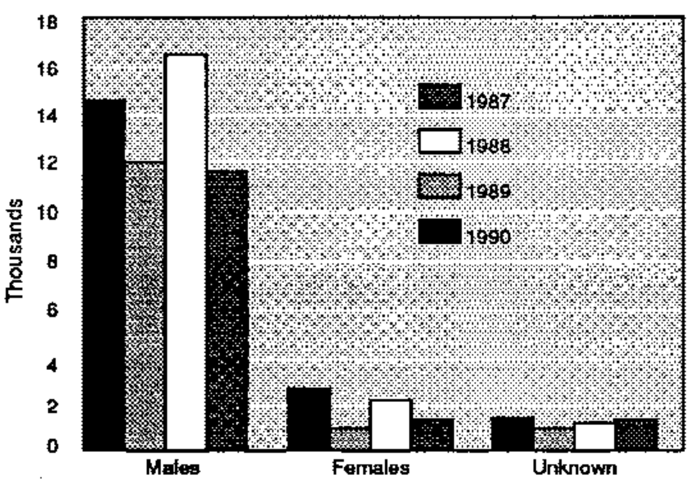

Figure 20. Sex compostion of walleye harvested by spearfishing, 1987-1990.

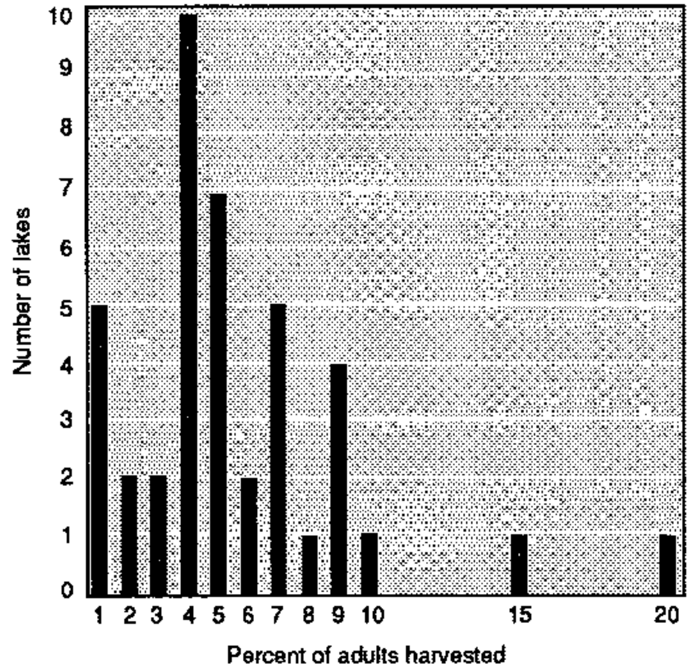

Figure 21. Spring spearing exploitation rates on walleye, 1989-1990.

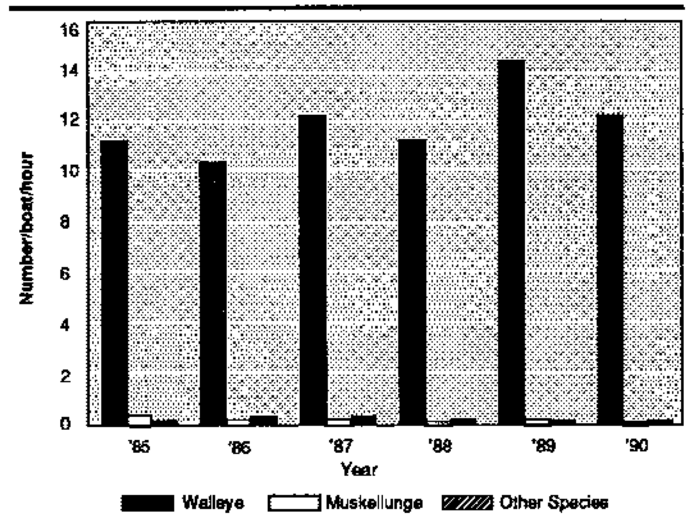

Figure 22. Catch rate (number per boat/hour in spring spearing, 1985-1990.

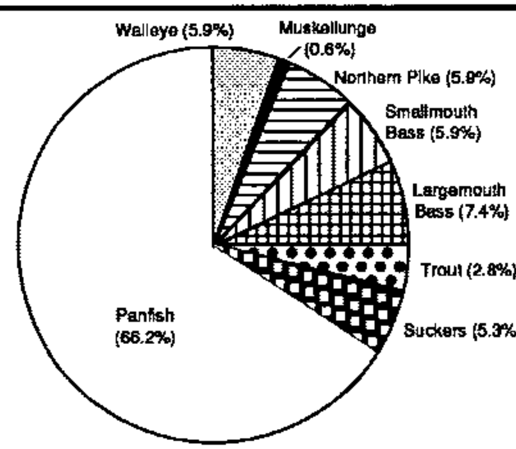

Figure 23. Fish species harvested by tribal anglers in 1989.

Tribal Harvest Activities

Open water spearing

Chippewa Indians have used spears to harvest fish for many generations. During the last century, when the exercise of off-reservation treaty rights was denied, members of several bands continued to spear in waters on reservations. Tribal members use boats or canoes and battery-powered lights to spear walleye, muskellunge, and other species during open water, especially during the spring. About 98 percent of the harvest consists of walleye. During the spring, Bad River tribal members spear walleye at the Bad River Falls as they migrate from Lake Superior. A few sturgeon and other species are also taken each year. Spearers stand along the bank or wade into the rapids holding spears that are about 6 feet long. These are much shorter than the spears used in lake spearing (up to 15 feet long). Camps are set up near the river, and spearers, relatives, and friends often remain there for several days.

Lac Courte Oreilles tribal members spear walleye, and occasionally muskellunge, during spring from boats in lakes that are entirely or partially on their reservation. Fishermen also spear from boats in the West Fork of the Chippewa River. Spearers attach car headlights to a variety of hand-held objects and hold the device so that the light shines underwater. Although motors are commonly used to travel to spearing areas, spearers generally row while they search for fish. Lac Courte Oreilles members also take muskellunge and walleye in the fall using similar methods. At Lac du Flambeau, tribal members spear on many large and small reservation lakes during spring. Walleye are the targeted species, but some muskellunge are taken. Lights are typically attached to some type of headgear and wired to a car battery. While a partner maneuvers the boat along the shoreline, the spearer stands in the bow of the boat and scans the water looking for the reflection from the eyes of a walleye. Lac du Flambeau tribal members generally use motors while spearing walleye and stalking muskellunge. The same methods are also used during the fall. St. Croix tribal members spear during the spring in the reservation portion of lakes adjoining tribal land. All species of gamefish are taken, plus occasional panfish and suckers. Tribal members generally row, paddle, or pole boats or canoes while spearing. The Mole Lake Band has no waters on the reservation that are appropriate for spearing gamefish. Tribal members spear suckers on the reservation in Swamp Creek during the spring. Tribal members have speared gamefish and suckers in off-reservation waters for many years, but risked arrest by state wardens prior to the recognition of treaty rights.

Members of the Red Cliff Band fish mostly in Lake Superior using gillnets, but they have harvested fish with spears from inland lakes since 1988.

Winter spearing

Lac Courte Oreilles tribal members are the most numerous winter spearers. They spear muskellunge and a few walleye and northern pike through the ice on the Chippewa Flowage and other reservation border lakes from darkhouses (shacks covered with felt). Some spearers use hand-carved wooden decoys to attract fish to the hole in the ice; others "jig" for trout in spring ponds and use them as bait. Muskellunge are very sluggish during winter, and attracting them to the spear hole is a long, tedious process. Lac du Flambeau fishermen spear muskellunge through the ice from 3 to 4 foot high "wigwams" constructed of branches and covered with cloth material. A blanket is placed on the snow in front of the wigwam door, and the spearer lies on it with his head and shoulders inside the wigwam. A hand-carved wooden decoy is used to attract muskellunge and occasionally walleye. Conversations with spearers and on-reservation surveys indicate that the number of spearers and the winter harvest by Lac du Flambeau members are much less than at Lac Courte Oreilles. Creel surveys of winter spearing by Lac Courte Oreilles members on the Chippewa Flowage were conducted during the winters of 1983-87. During the winter of 1986-87, an estimated 208 muskellunge were speared from Chief and Tyner Lakes. The maximum number of darkhouses (35) was similar to that observed in 1984-85 (37). During 1984-85, an additional 25 darkhouses were observed on 3 other areas of the Flowage and on 2 border lakes. Using the total number of darkhouses (62) and assuming that 1 or 2 individuals occupy a darkhouse over the course of a season, then the total number of spearers was between 62 and 124. Total winter harvest from the three lakes was between 250 and 350 muskellunge.

Fishing with nets

Bad River tribal members take walleye with gill nets in the Bad River between the river mouth and the Bad River Falls during the spring. Gill nets are also set in Lake Superior near the mouth of the Bad River. Walleye are harvested along with a variety of other species. Several sturgeon are taken by netting the river each spring. The Bad River Band and Red Cliff Band also licenses commercial and subsistence netting on Lake Superior, mostly for species other than walleye.

In the recent past, a few gill nets were fished by Lac du Flambeau members fishing for walleye. However, in 1985, on-reservation netting of sportfish was prohibited by tribal referendum. The practice of netting cisco (Coregonus artedii) during the summer and fall continues under a tribal permit system.

Other fishing practices

Members of all the Bands use tip-ups and jig for fish during the winter and use hook-and-line when still-fishing or trolling during open-water seasons. Tribal members of the Lac du Flambeau Band fish through the ice with lines that have a single hook and leave them unattended overnight. This fishing method is used most during early winter when the ice is thin. Lines are checked and rebaited every morning and sometimes again in the evening.

Tribal fishing effort and harvest

Most of the off-reservation fish harvest regulated under interim agreements (1985-1988) and under permanent rules (1989-1990) has been taken with spears during the spring. The spring harvest and all spearing and netting in open-water have been completely monitored.

Most fish harvested during spring spearing seasons have been walleye (Table 6, Figure 18). During the first off-reservation season in 1985, 2,914 fish were taken and 95% were walleye. During the next 5 seasons, the number of fish harvested ranged from 7,077 (1986) to 26,477 (1988); 97 to 98 percent of these fish were walleye. The harvest of walleye has increased since 1985 because interest and familiarity with off-reservation spearing has grown and because changes in the rules have given spearers more opportunity and greater flexibility. The number of muskellunge harvested from 1985 to 1990 ranged from 55 to 303 (Table 6, Figure 18). The number of lakes on which spearing occurred has increased over the past six seasons from 13 to 119 (Table 6, Figure 19). Spearing effort during this period ranged from 243 to 2,241 boat-hours (Table 6). The number of tribal members that engaged in spearing during the spring has been recorded since 1986. During this 5 year period, the number of spearers ranged from 194 to 426 (Table 6).

Walleye harvested by spearing in the spring are mostly males (Figure 20). Over the past four seasons 82 percent of the walleye harvested in the spring have been identified as male and 10 percent as female. The remainder were not sexable; most of them are probably spent females. The average size of walleye speared in the spring has been 15.9 inches. Eight percent were longer than 20 inches and 1% over 25 inches in length.

The number of walleye harvested by spear in 1989 and 1990 was nearly always less than 10 percent of the adult population, and usually 5 percent or less (Figure 21). These percentages, called "exploitation rates", are based on comparisons of the spear harvest and surveys of the adult walleye populations on 41 lakes. Biologists consider 35 percent to be the maximum sustainable exploitation rate for walleye in Wisconsin.

The catch rate of fish by spearing is measured as the number of fish taken per "boat-hour". The averge catch rate of walleye has generally ranged between 10 and 15 per boat-hour (Figure 22). Catch rates of other species have been much lower, less than one per boat-hour.

Fall spearing and summer netting in off-reservation waters occurred during the 1989 season only. During the fall, a total of 100 walleye and 3 northern pike were speared on two lakes. During the summer, a total of 2400 feet of 3-inch (stretch mesh) gill nets were set in 3 lakes on 4 dates. The catch from the 3 lakes was 176 cisco and 47 and 47 walleye.

The off-reservation use of unattended lines set overnight during winter appears to have stabilized. Thirty tribal members obtained tags for use in marking unattended lines in 1984-85, 22 in 1985-86, 36 in 1986-87, 26 in 1987-88, 24 in 1988-89, and 23 in 1989-90. Data on harvest and effort were obtained through a self-reporting system. Response rates during the first four seasons were 33 percent, 54 percent, 55 percent, and 77 percent. Despite inherent biases associated with a self-reporting system, the off-reservation harvest by unattended lines appears to be insignificant. No muskellunge were harvested off-reservation by unattended lines during the winters of 1984 to 1990.

Tribal hook-and-line anglers were surveyed by questionnaire to estimate the magnitude of their activity during the 1989 season (Figure 23). Open-water fishing permits for off-reservation waters were issued to 200 members by 4 tribes. The Bad River and Lac Courte Oreilles Bands did not issue angling permits. Usable responses were received from 77 tribal anglers. The reported harvest included 462 walleye, 44 muskellunge, 466 northern pike, 464 smallmouth bass, 581 largemouth bass, 223 trout, 5,183 panfish, and 412 suckers. St. Croix and Mole Lake tribal members were the most active off-reservation anglers, probably because their reservations are small and offer little fishing opportunity.

	Number of Lakes	Number of Spearers	Fishing Effort (boat-hr)	Harvest		
				Walleye	Musky	Others
1985	13	N/A	243	2,716	86	67
1986	30	194	668	6,940	55	82
1987	67	419	1,717	21,321	196	408
1988	93	426	2,241	25,969	158	350
1989	102	271	1,085	16,054	118	221
1990	119	381	2,008	25,346	303	485

Table 6. Fishing effort and harvest in the Chippewa spring spear fishery in Wisconsin, 1985-90.

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CURRENT MANAGEMENT PROGRAMS

Introduction

For many gamefish, the harvest demand exceeds what the resource can provide on a sustained basis. Exploitation of the fisheries is increasing due to a growing population of sport fishermen, a greater diversity of user groups, increased efficiency of gear, and greater access. Land use practices and chemical pollution continue to alter and degrade water quality and fish habitat. Consequently, management of both the resource and its use is necessary to insure the long term viability of fish populations.

The demand for fishery resources and the need for management is increasing at a time when staffing and funding of resource agencies are declining. The effectiveness of future management programs will depend heavily on the ability of resource managers to accurately inform and advise the public about wise use of the resource. This will require substantial documentation of resource problems and encouragement of the public to participate in making changes in policies and regulations. Resource agencies will be required to manage the resources to meet the needs of a diverse number of user groups and will play an important role in mediating equitable allocation decisions.

The Wisconsin Department of Natural Resources's long range strategic plan, Fish Wisconsin 2000, proposes strategies intended to guide Wisconsin's Fishery Management Program through the year 2000. The issues addressed reflect similar concerns raised by other agencies responsible for managing fishery resources throughout North America and directly acknowledges the Department's goal of implementing the treaty-protected rights of the Lake Superior Chippewa Indians. These concerns focus on the long term viability and use of fish populations threatened by environmental degradation and over-harvest.

Interagency Coordination/Cooperation

"What the parties in this case have done to give practical effect to plaintiff judicially recognized Treaty Rights is a remarkable story," stated Judge Barbara Crabb in her opinion dealing with the issue of fish spearing under treaties in Wisconsin. Judge Crabb added that, *"It is remarkable in its own right; it is even more so when contrasted with the very different reaction by the State of Washington to the judicially recognized fishing rights of the Indians in that state."*

Since the 1983 Voigt Decision reaffirmed the hunting, fishing, and gathering rights of the Wisconsin Chippewa Indians on lands ceded to the U.S. Government in the treaties of 1837 and 1842, the State of Wisconsin and the six tribes involved have entered into 39 interim agreements that enabled the member tribes to exercise their rights while other parts of the issue were undergoing litigation. Interim agreements were reached with regard to the harvesting of wild rice, small game hunting and trapping, open water and ice fishing, spearfishing, deer hunting, and the gathering of bark and firewood on ceded lands.

"Both the tribes and the officials of the State of Wisconsin responsible for implementing the tribes' treaty rights can take pride in their accomplishments of the last six years," Judge Crabb said in issuing her 1989 decision on spearfishing. *"They deserve widespread recognition and appreciation for their efforts."*

The Wisconsin Department of Natural Resources created the Office of Tribal Cooperative Management to work with all 11 Indian tribes in Wisconsin. The Office began operation on February 26, 1990, and it reports directly to the Office of the Secretary of the Department.

The Office of Tribal Cooperative Management coordinates all Department activities relating to Wisconsin Indian tribes and works with programs administered by the following Departmental bureaus: fisheries, wildlife, forestry, law enforcement, endangered resources, air, water, solid and hazardous waste, information and education, community assistance and legal services. Each bureau will retain its statutory responsibilities, but the Office will guide internal coordination within the Department and external communications with Indian tribes to meet the Department's legal and administrative obligations. It is the aim of the Office of Tribal Cooperative Management to be involved in developing other new cooperative resource management projects with Wisconsin Indian tribes by providing a direct contact point for local units of government and the private sector and by coordinating negotiation activities with the Department of Justice and the Governor's office. By establishing this Office, the Department planned to provide the Department with the internal organizational structure needed to fully implement Federal Court decisions and to maintain a close working relationship with the Great Lakes Indian Fish and Wildlife Commission and the Great Lakes Intertribal Council.

In mid-1990, the Wisconsin Department of Natural Resources and the Great Lakes Indian Fish and Wildlife Fish and Wildlife Commission entered into a Memorandum of Understanding to implement five cooperative wildlife management projects. The five projects included the following: 1) Northern Wisconsin Predator Interaction Study; 2) Sharp-tailed Grouse Restoration Project; 3) Wild Rice Seeding and Management; 4) Amsterdam Slough Wildlife Area Run-Off Ponds; and 5) Natural Areas Management and Improvement. These projects were established to fulfill requirements of Senate Bill 542 and to foster greater in-the-field cooperation between staffs of the Great Lakes Indian Fish and Wildlife Commission and the Wisconsin Department of Natural Resource.

In May of 1990, the Secretary of the Department and the Executive Administrator of the Great Lakes Indian Fish and Wildlife Commission, conducted a joint press conference at Wausau, Wisconsin to announce agreement on joint efforts in four areas. One was in wildlife management relating to activities already underway. The other three concerned fisheries management, law enforcement, and cultural awareness. Both leaders expressed the need to continue to build on an already evident record of cooperative efforts to mutually protect and enhance the resources of northern Wisconsin.

The Wisconsin Department of Natural Resources and the Great Lakes Indian Fish and Wildlife Commission have embarked on a highly interactive program of conservation law enforcement. For several years, state fisheries biologists and Great Lakes Indian Fish and Wildlife Commission biologists have been working jointly in a group called the Technical Working Group. This body has worked to assess ceded territory fish resources, to develop an understanding of the biology of the fishery, and to control treaty harvest numbers of walleyes and muskellunge.

Finally, in an effort to achieve greater understanding and cooperation with Native American peoples, about 45 Department employees, including Secretary Besadny and other administrators, participated in a cultural awareness training program at the Red Cliff and Bad River Indian Reservations in February of 1991. The session was sponsored by the Department's Office of Tribal Cooperative Management and the Great Lakes Indian Fish and Wildlife Commission. The cultural awareness course was a pilot session preliminary to offering it to all Department personnel and included an overview of tribal customs, history, tribal governments, and their current programs. It also offered those attending an opportunity to experience Chippewa Indian customs and ceremonies.

Tribal representatives have been added to standing committees of the Wisconsin Department Department of Natural Resources dealing with wildlife, fisheries and endangered resources issues.

Resource Planning

Increased demands for the fishery resource and the diversity of user groups have necessitated a more systems-based approach to management. This approach attempts to integrate the various social, political, and biological factors that affect the management of fishery resources. The planning process provides a framework for this integration. Management goals, strategies, and alternatives are formulated through this process. The scope of planning ranges from the management of a single species in one lake to the development of long range regional resource plans. Time frames for planning may be one year or may encompass as many as 10 or more years. Provisions for evaluating and updating plans are mandatory. They maintain flexibility of the plans for responding to the needs of the users and to changes in the resource, and provide evaluations of how effective the plans are in achieving goals and objectives.

Resource Planning by the Wisconsin Department of Natural Resources

The Comprehensive Management System of the Wisconsin Department of Natural Resources is comprised of plans that step broader program objectives down to individual projects. The Strategic Plan has two major components, the Strategic Agenda (Fish Wisconsin 2000) and a Long-range Plan. Fish Wisconsin 2000 presents a statement of mission responsibilities, defines management philosophy, identifies issues that are critical to future management, and provides general guidelines in the form of broad strategies and goals. The Long-range Plan includes six year objectives, problem statements, and strategies for individual fish species or groups of species. Objectives of the Long-range Plan are updated every two years prior to the writing and ranking of operational projects.

The operational plan describes how the Strategic and Long-range Plans will be implemented. It develops projects that describe needs and objectives of what is proposed and what will be produced. Projects are written by the individuals responsible for conducting the work. The projects are then reviewed and ranked against a written set of criteria and priorities based on the Strategic and Long-range Plans. The set of approved and funded projects constitutes the operational plan for a biennium. Approved projects are assigned to the work unit responsible for completing the work.

The Control and Evaluation System provides fiscal control, project monitoring, and program evaluation. The fiscal control system tracks all costs and time by project. As part of program evaluation, managers and staff are required to write quarterly reports describing the progress and accomplishments of all projects. Evaluation also requires a quarterly audit of the district staff and of all district programs.

Public involvement in the development and revision of plans is a necessary continuing component of the overall planning process. Public involvement in the Department planning process is integrated in the following ways:

1. The Natural Resources Board - a group, represented by members of the public appointed by the Governor, that reviews and approves plans.
2. The Conservation Congress - a citizens advisory group that reviews and provides input into plans. (The Conservation Congress elects citizen representatives from each of Wisconsin's 72 counties).
3. Numerous citizen groups, sports organizations, and cooperating agencies at local and statewide levels are invited to comment on management plans.
4. Additional public involvement through hearings and reviews is required before any controversial strategies are implemented.
5. Plans are published and widely distributed for public inspection and comment.

Resource Planning by the Great Lakes Indian Fish and Wildlife Commission

The Great Lakes Indian Fish and Wildlife Commission is directed by the leaders of local tribal governments (Commissioners) who establish the policies and priorities of the organization. Management activities carried out by the Commission in the ceded territory are primarily directed to fulfilling the requirements set by recent Federal Court rulings and stipulations agreed upon by the Tribes and the State of Wisconsin. These stipulations and rulings concern assessment of populations, establishment of tribal regulations to protect natural resources, enforcement of off-reservation conservation codes, and monitoring of tribal harvests.

The Commission has established five long term goals based upon the organization's formal charter, including:

1. To improve the general welfare of Indian people in the Great Lakes Region.
2. To facilitate and coordinate inter-tribal communication in the Great Lakes Region concerning matters pertaining to the exercise of treaty rights.
3. To assist tribal governments in the protection, preservation, conservation, and management of tribal fish, wildlife, and plant resources in the Great Lakes Region.
4. To expand and improve technical assistance and services to member tribes.
5. To educate tribal membership, tribal leadership, and the general public in issues and events related to the other goals stated herein.

Resource Planning by Local Tribal Agencies

Several local tribal governments have developed integrated resource management plans. These plans provide overall guidance to the resource programs and serve as the framework for stepdown resource plans (ie. fish, timber, and wildlife management plans, etc.). Tribal governments solicit the assistance and comments of federal and state resource agencies and tribal and non-tribal local organizations in the development of their plans.

Fish Population Data Collection and Analysis

Introduction

Fisheries assessment data provide the foundation for evaluating the status of fish populations and are basic to the management of these populations. Information on distribution, abundance, life requirements, community interactions, and degree of exploitation of fish populations along with data on the types, availability, condition, and use of the habitat are needed. In addition, sound management relies on continual monitoring and evaluation of the effectiveness of management actions and regulations. Through this process, problems can be identified and strategies revised to formulate better alternatives or solutions.

Surveys are planned and organized according to their purpose; guidance is provided by the stepdown structure of the planning process. The methods used to obtain needed information vary in how data will be collected and determine the intensity of the collection effort needed to achieve specific objectives. These data are used to obtain baseline information for statewide resource inventories, resource comparisons, and classification updating.

Fisheries inventory and monitoring information is collected by biologists from several different agencies. Data collected from the numerous annual fisheries assessment projects are used to monitor current conditions and continue to add information to the lake and stream inventory database. However, much more fisheries information is necessary for long term protection of the fishery resources in the ceded territory.

Many guidelines for assessment work are available in the professional fisheries literature and in resource agency handbooks, technical reports, and research reports. Cohesiveness among the agencies is maintained through technical committees, working groups, and professional societies, such as the American Fisheries Society. Guidelines may be revised, or new ones adopted, as new methods or findings by the scientific community are accepted.

Fish Population Assessment Methods

An appraisal of the status of any fishery resource begins with population assessment work. Such investigations provide the biological foundation for developing management actions and regulations. In general, assessment surveys attempt to provide information concerning the species present, their abundance, size structure within the population, number that are of harvestable size, number of spawning adults, reproductive success, and stability of recruitment from one year to the next. Data are also collected on forage fish abundance, abundance of competitor species, fish growth; age structure of the population, number of year classes in the spawning population, mortality rates, and the potential sustainable harvest.

Biologists sampling aquatic environments are hampered in that they are unable to see the subjects of their investigation. They are required to take random samples to appraise what is occurring in the ecosystem. Population data collected in this manner are subject to considerable variation between what is perceived and what may actually be occurring. In most cases, variability can be reduced by increasing the sampling effort but more funds and personnel are required.

Abundance of Fish

The assessment of fish populations is determined from the measurement of abundance, size composition of the catch (length frequency), age and growth information, and mortality rates. Relative abundance is expressed as the number of fish caught per unit of effort (CPE) and is usually adjusted for the type of gear used to collect the fish. If highly intensive fisheries exist (ie. the tribal spear fishery/sport fishery), mark and recapture population estimates can be used to provide a more exact determination of abundance (expressed as fish per surface acre). Mark and recapture studies are much more expensive ($2,000 to $4,000 per lake, depending on the size of the lake) than surveys that utilize relative abundance data.

Population estimates are based on mark and recapture studies in which fish are collected, marked (tags, fin clips), and then returned to the lake for subsequent recapture. Estimates of the population are based on the ratio of marked fish to unmarked fish in the recapture sample. In order to obtain a highly accurate estimate, a large proportion of the population must be marked (normally 10 to 30 percent). Population estimates for species that are present in low abundance require much greater sampling effort to mark an adequate number of fish. If the number marked is low, estimates will be subject to greater variability.

Population estimates have been done for a variety of species. The majority of estimates have targeted walleye because this species is important to both tribal and sport fisheries. Population estimates are a key component in any attempts to establish safe harvest levels for managing the mixed fishery of the ceded territory.

Age, Growth and Recruitment

Age and growth information is generally collected during assessment surveys. Knowledge of the age composition is essential to the proper utilization of a fishery resource. Age information generally is used to determine fish growth, recruitment, their age at maturity, and their mortality rates. Age is most commonly determined by length frequency analysis and by the interpretation of annular growth rings on scales and bony structures (such as dorsal spines on walleye).

Rates of growth are useful in determining competition, the productivity of the habitat, how fast fish reach catchable size, and the potential harvest a lake can sustain. Growth is influenced by many factors. The most common determinants include the abundance and size of available food, competition for the food resource, temperature, dissolved oxygen levels, other water quality factors and the abundance, size, age, and sexual maturity of the fish. Fish in slow growing populations take longer to reach harvestable size and are more susceptible to over-harvest.

Age and growth information, coupled with information on abundance, are heavily relied on when resource management decisions are made. Combinations of these data can be used to determine the sustainable harvest, to assess variations in the abundance of different year classes of fish, for evaluating recruitment and past reproductive success, and for estimating the abundance of spawners by individual year classes. The latter is often used as a criterion for insuring the presence of a healthy spawning population (a stable spawning population is one that has many individuals of varying age).

Mortality

Mortality rates indicate the rates at which individual groups of fish in the population are dying. Mortality is often broken up into its major components; natural (those dying from natural causes) and fishing, sometimes referred to as exploitation rate or those fish taken through harvest. The combination of these components is referred to as total mortality.

Walleye in Wisconsin may sustain annual rates of total mortality of 50 percent or more. Figure 24 illustrates how a 50 percent total mortality rate would affect a population, assuming that there is constant recruitment of 1000 yearling fish each year. For every 1000 fingerlings, there would be approximately 125 four year old fish, 8 eight year old fish, and few or no 12 year old fish in the population. Populations subjected to a 30 percent annual mortality rate, assuming recruitment of 1000 yearling fish per year, would include 343 four year old fish, 82 eight year old fish, 20 twelve year old fish, 5 sixteen year old fish, and some fish up to a maximum age over 20 years.

The exploitation rate (fishing mortality) is the percentage of fish removed by angling or other harvest methods during the year. This rate must not exceed the harvestable surplus (number of fish that can be taken without affecting population stability in a given body of water) brought about by recruitment and growth. For lakes in the ceded territory, the maximum allowable rate of exploitation for adult walleye is 35 percent; for muskellunge it is 27 percent. These figures are interim rates and are currently being assessed by tribal and state biologists. Exploitation rates can usually be determined if both harvest data (creel census information) and population estimate data are collected. The exploitation rate equals the proportion of the population estimate that is taken in the harvest. Angling exploitation rates for walleye were determined for 45 lakes in the ceded territory during 1980 to 1989. These rates ranged from 1.8 to 58 percent and averaged 16.7 percent. Smaller lakes had higher rates of exploitation and averaged 31.5 percent for 9 lakes of less than 500 surface acres. Exploitation rates by spearing for walleye from 1986 to 1988, regulated by interim State/Tribal agreements, exceeded 20 percent on two lakes but most were less than 10 percent. In 1989, when spearing was regulated under permanent rules, exploitation rates averaged 3 percent and did not exceed 8 percent on any given lake. Some information on exploitation rates for northern pike, smallmouth bass, and largemouth bass in Wisconsin is available but more research is required to determine what rates of exploitation these populations can withstand.

Harvest Monitoring Methods

Population assessment presents information on the status, abundance, and health of fish populations. Harvest monitoring provides information that characterizes the fishery; the numbers and species of fish that are being harvested, the effort expended, quality of fishing, and provides information on user preferences. Measurement of the harvest is a vital component of the management of intensive fisheries. It is generally costly, because of the high level of effort needed to collect the information.

Tribal open water spearing and netting is regulated by the quota system and is completely monitored. The spearing harvest usually occurs during a short time period in the spring when fish are spawning; this facilitates a complete survey. Angling harvest surveys must occur over a period of nine to ten months and require a systematic process of sampling to derive an estimate of the harvest. A complete creel census of all angling would be virtually impossible. All fish captured in the tribal fishery are recorded by creel clerks, so analyses of these data are not subject to some of the variables associated with estimating the sportfish harvest.

The Wisconsin Department of Natural Resources has been conducting standardized angler creel surveys since 1980 on selected lakes in the ceded territory. Starting in 1990, the Department's Bureau of Fish Management has greatly expanded the angling monitoring program on shared fishery lakes of the ceded territory. The census period typically spans the period from opening day in the spring to the close of the season in March.

Fish Population Management Practices

Introduction

Management recommendations are developed and implemented following the collection and analysis of data. Recommendations may be directly translated into regulations through the proper administrative channels, may request a more detailed analysis for future management and/or research investigations, or may urge initiation of a specific management action. Management actions may include stocking, forage or rough fish population manipulation and control, and habitat restoration and enhancement. Regulations are typically instituted to reduce mortality of fish through direct and indirect methods. Direct regulation limits the number harvested through quotas. Indirect regulation limits daily bag, seasons, sizes of fish harvested, and efficiency of gear used for harvest; under the assumption that these will protect the fish populations without requiring total monitoring of the harvest.

Forage and Rough Fish Control

Forage fish (ie., those species preyed upon by predator species such as muskellunge, northern pike, walleye, and bass) include yellow perch, bluegill, other panfish, minnows and shiners. Rough fish species are those that are less preferred for harvest and that, because of their rapid growth, quickly become unavailable to predator species. Over-abundant populations of rough fish and panfish compete with more desirable species for food and space. They sometimes feed on eggs and fry of sportfish species. Carp and bullheads may also have deleterious effects on the habitat by uprooting aquatic plants and increasing turbidity in the water.

Over-abundant populations of small panfish and rough fish species exist in many waters. This usually results from over-exploitation of predator fish, poor productivity of the lake (causing slow growth rates), excessive vegetation that protects these fish from predation, or a combination of these factors. Over-exploitation reduces the natural control provided by predators that normally maintains balance in the fish community. As predator numbers decline, panfish species usually respond by increasing in abundance, competition for food then slows growth and few reach catchable size. In lakes that are periodically subject to winterkill, the more desirable predator species suffer higher mortality because they cannot tolerate low dissolved oxygen concentrations. Most winterkill lakes in northern Wisconsin naturally revert to a minnow and bullhead community after a winterkill. These species are more tolerant to winterkill conditions and will have greater survival, further setting off the imbalance in the community.

Drastic measures may be required to restore balance and to shift the productivity from a community characterized by many small, slow-growing fish dominated by few species to one with a diversity of species that exhibit good growth. Chemical treatments using rotenone or antimycin have been used in the past for both partial and total removals of fish populations. The use of chemicals is declining and, for larger lakes, the cost of treatment is extremely expensive. Manual removal of undesirable fish populations is time consuming, labor intensive, and usually ineffective. At least 80 percent to 90 percent of the biomass must be removed if there is to be any lasting effect. In some cases, commercial fishermen are contracted to remove rough fish species. However, the supply of fish generally exceeds the market demand and, for many affected waters, there is no interest on the part of the commercial fishermen. In other waters, commercial fishing for rough fish may conflict with other uses or objectives. Fish barriers have been used to prevent the migration of rough fish species into lakes. In lakes where water levels can be controlled, drawdowns can be used successfully to expose over-abundant prey species to predators. Control of excessive vegetation can accomplish similar results and is accomplished by winter drawdowns, mechanical removal, and chemical control. Vegetation control by any method, must consider other management objectives, including those for waterfowl, wild rice, etc.

Predator stocking, primarily of bass and walleye, is used as a control method for over-abundant panfish populations, however, the success of this practice is widely variable. Stocking is usually followed by restrictive harvest regulations to allow the predator population to become established and to maintain their presence. In any case, a combination of control methods used on a continuing basis and coupled with predator stocking is the most effective way to restore a balanced community structure.

Stocking

Stocking is perhaps the most widely recognized management practice but the least understood. Stocking is used to supplement populations that have poor reproduction; to increase the diversity of species caught; to maintain stability of the catch rates or quality of the fishery; to control over-abundant prey and rough fish populations; to repopulate lakes that have been renovated or where pollution and winterkill have affected abundance; to protect native stocks by buffering their harvest with hatchery fish; and to maintain fisheries in the face of heavy exploitation.

Stocking does not always produce desirable results; in some cases, it can be detrimental to existing fish populations. In other cases, stocked fish simply do not have adequate survival to justify the costs of production. Preventative measures, such as protecting spawning habitat, can greatly reduce the need and cost of stocking. Habitat improvement (ie. nesting cover, spawning reefs and marshes, etc.) and control of undesirable fish populations can provide additional benefits by reducing the need for hatchery production. As budgets are reduced and demands on the resource increase, the future of quality fishing will largely depend on the need to maintain good habitat, and on the acceptance of restrictive bag and size limits, rather than the number of fish that can be stocked.

Considerations and guidelines by individual species, along with production and costs associated with stocking, are presented in the following sections.

Walleye Stocking

Most walleye waters in the state do not require stocking. These lakes generally have already established naturally reproducing populations of walleye with good growth and adequate abundance. The introduction of walleyes into good bass lakes of northern Wisconsin is discouraged by fish managers. An abundance of walleye usually results in much lower population densities of bass. In some cases, walleye can be stocked in bass waters, but only if reproduction of walleye is limited. Winterkill lakes are not normally stocked with walleye if they have serious mortalities more frequently than twice in a ten year period. Walleye do not tolerate low oxygen conditions found during severe winters in winterkill lakes and consequently suffer heavy mortality.

In an average year, Wisconsin produces 3.2 million walleye. During 1989, 147 of the 350 lakes in the stocking program received fish. Currently, the state produces walleye at the Spooner and Woodruff hatcheries; both were built in the early part of the century. Although the State facilities operate at full capacity, the production of walleye consistently falls short of meeting the local fish manager stocking requests by 1 million or more fish per year. Furthermore, stocked lakes typically have lower densities than lakes where natural reproduction occurs.

On May 2, 1989, the Wisconsin Department of Natural Resources initiated a feasibility study for increasing hatchery production of walleye. The objectives were to increase the number of walleye stocked by 2.5 million or more per year, to stock more walleye per lake, to stock more lakes, and to evaluate the cost effectiveness of a newly-proposed, accelerated growth production program to provide 6 to 8 inch fish for stocking. Recommendations from the feasibility study included renovation of the Spooner and Woodruff hatcheries, construction of a walleye-rearing facility in Marathon County, pursuit of contracts with commercial aquaculturists, and development of cooperative agreements with local organizations. Implementation and continuation of this initiative will incur the following expenses: development costs - $4.2 million; operating costs - $167,000; and capital equipment costs - $210,000.

Table 7. 1989 Tribal walleye production in the ceded territory.

	# of Fry	# of Fingerlings
Bad River	5,920,000	4,200
Lac du Flambeau	17,000,000	715,000
Lac Courte Oreilles	700,000	523
St. Croix		15,986
Mole lake	500,000	200
Total:	**24,120,000**	**735,909**

Tribal resource programs in the ceded territory have expanded their production of walleye fry and fingerlings in the last decade. Hatcheries exist at the Lac du Flambeau and the Bad River Indian Reservations. A new hatchery is under construction at Lac Courte Oreilles Indian Reservation and should be operational by 1992. Lakes located on tribal lands and leased from private individuals are being used to rear walleye. Several of these tribal rearing programs are in cooperation with the State or local organizations. In some cases, eggs from walleye taken in the spear fishery have been successfully hatched and used for these operations. Tribal walleye production is shown in Table 7. All of those fish were stocked in lakes and rivers accessible to state licensed anglers. Objectives of tribal hatchery programs are to increase production and stocking of fingerling size walleye, primarily on reservation waters.

The federal hatchery system operated by the U.S. Fish and Wildlife Service produces a number of species throughout the United States. During 1989, a total of 16.6 million walleye fry was provided to tribal resource agencies and to the State of Wisconsin. All of these fish were stocked in waters accessible to the public. The National Fish Hatchery system was considerably reduced by federal budget cuts during the 1980's. As a result, federal facilities adequate for producing walleye fingerlings no longer exist in the Midwest.

Costs of producing walleye vary considerably. High rates of production can be achieved in hatcheries but they involve major development costs and high operating expense. The utilization of small natural lakes or leasing private ponds for rearing units is less expensive but, because survival rates are highly variable, they are not dependable for consistent and predictable production.

Walleye fry are relatively cheap to produce and survival is normally 65 percent from egg to fry. The cost of fry production was estimated by the Wisconsin Fish Propagation Expenditure Analysis at approximately $0.60 per 1000 fry in 1981. Walleye have an average survival of 30 to 35 percent from egg to a 2-inch size under intensive hatchery management. Costs per fingerling produced range between $0.05 to $0.08 each. Wisconsin Bureau of Fish Management personnel began an experimental program to accelerate the growth of walleye for stocking in 1989. Survival rates of these fish to adult size may be much higher than survival rates of fish stocked as 2-inch fingerlings. The cost of raising walleye to the 6 to 10 inch size is estimated to be $1.36 to $1.40 each.

Fry are initially stocked into new or reclaimed waters and winterkill lakes at rates generally not exceeding 3000 per surface acre of water. The Wisconsin Bureau of Fish Management normally stocks walleye fry at a rate of 1000 per surface acre. If poor survival of stocked fry is apparent in the follow-up evaluation survey, fingerling walleye are stocked at rates not exceeding 50 per surface acre and no more than 100,000 per individual lake. These limitations are based on the production capability of the State Hatchery System.

Maintenance stocking is used to support walleye populations in lakes with only limited or no reproduction if adequate growth potential exists. These plantings are made on a continuous basis by stocking fingerlings every other year. Alternate year stocking also allows easy evaluation of survival, based on age and abundance data. Cost effectiveness is maximized by stocking the smallest fingerlings that will still provide adequate survival rates. Maintenance stocking must be evaluated and shown to be effective before the program is continued. If, after two years of fingerling stocking, walleye show poor survival, stocking is normally discontinued.

Stocking priorities established in the Wisconsin Fish Management Handbook include the following order of priority:

1. Rehabilitation stocking
2. Walleye stocking, evaluation projects
3. Maintenance stocking where past success is evident and angling pressure is at least 150 hours/acre/year.
4. Maintenance stocking where past success is evident and fishing pressure is less than 150 hours/acre/year.
5. Maintenance stocking that has not been evaluated and initial introductions.
6. Others.

Muskellunge Stocking

Most muskellunge populations do not have adequate reproduction to provide satisfactory angling at current levels of fishing pressure. They have been introduced into many waters but few lakes have shown significant reproduction. Maintenance stocking is required for a majority of these lakes to sustain the fishery. The range of muskellunge in the State has been expanded through stocking but this has reduced the number of hatchery fish available per unit of water.

The Wisconsin Department of Natural Resources produced 723,000 fry and 150,000 fingerlings during 1989. Tribal programs produced 200,000 fry (Lac Courte Oreilles) and 1,000 eight-inch fish (Lac du Flambeau) during 1989. Muskellunge fry production costs reported by the Department were $6.93 per 1,000 fry. Fingerling muskellunge (8 inch size) are much more expensive to produce than smaller fish because of the expense of providing live minnows and suckers to feed them. The State estimated an average cost of $2.32 per fish for the 115,652 fingerlings produced during 1981. Hybrid muskellunge (northern pike x muskellunge) production costs were much lower ($0.75 per fish) because hybrids accept artificial foods, greatly reducing the cost.

Stocking priorities established by the Wisconsin Fish Management Handbook list the following order of priority:

1. Rehabilitation.
2. Stocking evaluations.
3. Waters on alternate year maintenance stocking programs and waters on annual maintenance stocking programs that were not stocked during the previous year because of lack of fish.
4. Waters on annual maintenance stocking program.
5. Initial introductions.
6. Others.

Purebred muskellunge are normally stocked into lakes larger than 3000 acres. Hybrid muskellunge are stocked into smaller lakes (300 to 3000 acres) because they are easier to raise. Hybrids are not stocked into native muskellunge populations because they may have a detrimental effect on reproduction and may increase fishing pressure on the native fish. Very few lakes in the ceded territory are stocked with hybrids. Muskellunge can be stocked into some winterkill lakes but, because of the cost and the limited supply, only in those lakes where there is a chance that significant mortality will occur in only 1 in 15 or more years.

Fry are usually only stocked in lakes that have been rehabilitated or in new lakes where mortality through predation will be low. The size of fingerling stocked depends on the expected survival, based on past evaluation studies and surveys. Most fingerling muskellunge are stocked at a size of 8 inches. The density of existing predators, such as northern pike, largemouth bass, and walleye, is a primary factor in selection of the size of muskellunge fingerling to be stocked. Snow (1968) reported that mortality ranged from 20 percent to 80 percent for fingerling muskellunge during the first three weeks after stocking. Fry are stocked at a rate not exceeding 500 per acre or a maximum of 100,000 per lake. Two to four inch fingerlings are stocked at 2 to 4 per acre and no more than 5000 per lake. Fingerlings greater than 6 inches are stocked at rates of no more than 2 fish per acre and no more than 2,500 fish per lake.

Northern Pike Stocking

Naturally reproducing populations of northern pike are found throughout Wisconsin. Approximately 15 percent of the lakes that contain northern pike require occasional stocking but very few lakes are actually stocked. Stocking is needed in waters where reproduction is limited and angler demand is high. Losses of spawning marshes and flooded lowlands adjacent to lakes have resulted in reduced northern pike reproduction in many lakes. The majority of waters stocked with fingerlings are stocked on a maintenance basis. Northern pike are not stocked into muskellunge waters because they are considered a major competitor to musky populations. Stocking northern pike at high densities into already established reproducing populations has been shown to have a number of adverse effects including: competition with and displacement of native northern pike; increased natural mortality; and reduced angling success. The survival of stocked northern pike fingerlings is greatest in lakes that offer good growth potential and poor northern pike reproduction. About 20 percent of stocked yearling northern pike (7 to 10 inches) are eventually harvested by anglers.

Long range production goals of the Wisconsin Department of Natural Resources indicate that there is a deficit of 24,000 fingerlings greater than 6 inches to meet stocking quotas. Total production would have to include 35 million fry, 2000 fingerlings less than 6 inches, and 27,000 greater than 6 inches. During 1989, the U.S. Fish and Wildlife Service provided 8 million northern pike eggs and 6.3 million fry to the State of Wisconsin. Production of larger fingerling northern pike is inconsistent and expensive. In most years, about 20 percent of the fingerling stocking quotas are met. Production can be stabilized by using artificial food but pellet-reared fish often exhibit poorer survival than fish that were fed minnows. Northern pike stocking priorities include:

1. Stocking evaluation projects and rehabilitation.
2. Initial introductions.
3. Maintenance stocking where evaluations have shown success from prior stockings.

Rehabilitation stocking is accomplished by stocking fry followed by fingerlings. In some cases, adults capable of reproducing are stocked. Stocking of winterkill lakes is restricted to those waters where fish are not likely to suffer serious mortality in more than 3 out of 10 years. Maintenance stocking is done in waters where poor natural reproduction is low and acceptable growth rates are evident. Initial introductions include fry stocking followed by stocking of fingerlings for the next year and the following year, if needed. Northern pike fry are stocked at a rate of 1,000 per acre, fingerlings at no more than 5 per acre or 2,500 per lake. Catchable size northern pike (16 inches or longer) are stocked at rates of no more than 2 fish per acre or 2,500 per lake.

Smallmouth Bass Stocking

Reproduction of smallmouth bass is adversely affected by the presence of slow growing panfish populations and abundant game fish populations. Other factors that affect reproduction include heavy runoff during spring and early summer, cool spring temperatures, inadequate spawning substrates, and the availability of nesting cover.

Current hatchery production is limited to only a few thousand fingerlings produced by Wisconsin state fish hatcheries and occasional numbers of fish provided by the Federal hatcheries. The federal hatcheries were unable to provide smallmouth bass during 1989. In the past, the Wisconsin Department of Natural Resources received approximately 60,000 smallmouth bass fingerlings annually from the federal system. The long-range State production goal is to be able to annually provide 140,000 fingerlings per year.

Fingerling stocking should only be done when significant benefits can be expected. Stocking results have generally been poor with survival depending on the abundance of panfish and gamefish in the lakes stocked and the size of smallmouth bass stocked. Initial introductions and stocking following rehabilitation, except for winterkill lakes, are given highest priority for stocking. Relatively few fish have been available for maintenance stocking. Fry and small fingerlings (less than 4 inches) are stocked at rates of no more than 100 per acre or 10,000 per lake.

Largemouth Bass Stocking

Largemouth bass are prolific spawners and seldom require stocking if habitat conditions are suitable and other gamefish populations are not excessively abundant. Natural reproduction can be considerably enhanced by reducing abundant populations of slow growing panfish. Stocking of small fingerlings into established fish populations is rarely successful. Large fingerlings exhibit better survival but they are currently only available by transferring fish from other bodies of water.

Production of largemouth bass by state fish hatcheries during 1989 was 778,000 fingerlings. Additional fingerling bass were provided by federal fish hatcheries (175,000 largemouth bass fry). Long-range goals of the State of Wisconsin for largemouth bass are to provide 120,000 fish less than 1.5 inches, 640,000 from 1.5 to 4 inches, and 32,000 4 inches or larger. Stocking rates and priorities for stocking of largemouth bass are similar to those of smallmouth bass.

Current Stocking Related Research

The Wisconsin Department of Natural Resources has several ongoing research projects related to natural reproduction, stocking, and hatchery production. These include the following investigations.

1. Survival of pellet-fed northern pike after stocking.
2. Behavior and survival of stocked radio-tagged muskellunge fingerlings.
3. Effects of increased smallmouth bass nesting cover on the density of young-of-the-year smallmouth bass.
4. Improvement of muskellunge fingerling culture and stocking.
5. Evaluation of the Leech Lake strain of muskellunge in Wisconsin waters.
6. Survival of stocked yearling muskellunge.
7. Delayed release of pen-held muskellunge fingerlings.
8. Development and evaluation of techniques for improving the natural reproduction of muskellunge.
9. Success of walleye fry and fingerlings stocked in Lake Mendota.

A proposed future research project will investigate how to improve walleye fingerling culture and how to improve the success of stocking programs.

Tribal programs have initiated management related research concerning culture and stocking of walleye, muskellunge, and lake sturgeon. The Great Lakes Indian Fish and Wildlife Commission has conducted a study on use of artificial turf incubators for culturing muskellunge fry. The Commission is also cooperating with Lac Courte Oreilles, Mole Lake, St. Croix, and Bad River Tribal Resource Agencies in the development of natural ponds for rearing walleye. Other investigations and cooperative projects include the utilization of eggs from speared walleye for hatchery production and lake sturgeon culture.

Harvest Regulation Techniques

Fish populations can sustain only a certain amount of harvest. This potential harvest is inherent to productivity of the water, the growing season, and complex interactions between the physical, chemical, and biological characteristics of the ecosystem. Practices used to enhance production and to increase harvest are costly, limited by technology, and have only a limited effect. The present trend of increasing user demands on the resource continues to exceed the supply, as evidenced by the presence of regulations designed to protect the resource against overharvest.

The effectiveness of regulations is dependent on many factors. Social and political pressures affect development of regulations, may moderate their implementation, and may reduce the flexibility to change them. The lack of adequate data on which to base development and evaluation of regulations has often led to even more restrictive regulations to ensure protection of the resource. In the past, statewide attempts have been made to reduce the complexity of angling regulations. However, every fish community has its own inherent problems and attempts to limit the complexity of regulations may not be acceptable for some individual fish populations or lakes.

Specific regulations for individual lakes are becoming increasingly common across the country. These regulations require a much more informed role on the part of the anglers in using and managing the harvest from lakes and streams. If anglers refuse to accept the regulations, the effectiveness of the regulations is severely curtailed. Surveys to determine compliance, angler attitudes and preferences are useful tools for evaluation of the acceptability and effectiveness of a regulation. Education and enforcement are additional factors that can be used to enhance compliance with regulations; education is the preferred alternative.

Regulations are generally designed to modify the exploitation of a population or a particular segment of that population. The most common methods include direct regulation by quotas and indirect regulation through bag limits, seasons, size limits, and gear restrictions.

Bag limits and Quotas

Bag limits are commonly used to restrict harvest and to help spread the harvest among users. Bag limits indirectly control harvest by limiting the number of fish that an individual angler can keep but there is no direct control over the total harvest. Quotas are based on a predetermined number of fish that can be harvested. This number protects the fish populations from the effects of over-harvest and provides direct control over the fishery if it is adequately monitored.

In fish populations that exhibit slow growth, restrictive bag limits can accentuate stunting of a fish population, especially if productivity of the water is low. If bag limits are to be successful, they must be set low enough to reduce the catch to a specified level. A summary of 1980 to 1987 creel data for walleye angling in the ceded territory reported that few fishermen (9 percent of all successful fishermen) caught their legal bag limits of 5 fish (Figure 25). However, this relatively small proportion of the angling population accounted for the harvest of 25 percent of the total number of fish caught (Figure 26). It was concluded that reducing the bag limit from 5 to 3 fish would cut the overall harvest by 13.7 percent and that reducing it from 5 to 2 fish would cut the harvest by 26.9 percent. However, these reductions could be offset by increases in the percentage of anglers who catch fish.

Seasons

Seasons are set to restrict harvest during certain periods of the year. They are generally established to protect fish when they are particularly vulnerable to over-harvest. Harvests of walleye during the spawning season cam be regulated by quota management and protected from over-harvest by adequate enforcement and accountability. If adeequate protection and management is in place, little is gained by restricting the harvest during the spawning season that could not just as well be gained by reducing the catch of adult fish during the rest of the year.

The Wisconsin Department of Natural Resources examined alternatives to bag limit reductions, including the use of closed seasons. Elimination of ice fishing would result in a 13 percent harvest reduction, while a later seasonal opening would reduce the total catch by 29 percent. It was concluded that closed seasons would unfairly affect some anglers but not others. Daily bag limit reductions affect only the relatively few anglers who catch large numbers of fish. Even so, this regulation recommendation has proved unpopular, largely due to perceived lossed of fishing opportunities.

Size Limits

The objectives of placing size limits on fish that may be kept by fishermen are to maximize yields, prevent over-harvest, maintain favorable growth and reproduction, and to sustain quality fishing. Intensive education and / or enforcement efforts may be required during early stages of implementation of length limit regulations. Consideration must also be given to hooking mortality, public acceptance, and compliance. Minimum size limits require that all fish below a specified length be returned to the water. The goal is that by reducing the harvest of small fish it would provide opportunity to harvest more larger fish.

Minimum size limits are used to insure that adequate numbers of fish reach adult size to spawn at least one time. In implementing regulations of this type, it is assumed that fish in the population exhibit good growth, have a low reproductive rate, low natural mortality, and high angling mortality. In slow growing populations, a minimal size limit or reduced harvest would increase competition and cause even slower growth and higher mortality from natural causes. No benefit would result. Overall yields of catchable size fish would decrease instead of increase. After an 18 inch minimum size limit was placed on a population of slow growing northern pike in Bucks Lake, Wisconsin the total catch declined by 29 percent and the catch of northern pike over 18 inches decreased by 56 percent.

The Wisconsin Department of Natural Resources implemented statewide minimum size limits on bass in 1989 and walleye in 1990. Because size limits are not appropriate on all waters, the Wisconsin Department of Natural Resources issued the following reasons for exemption: "In order for a water to be exempted, at least one of the following criteria must exist:

1. Angler exploitation is less than 15 percent of the population larger than the originally applicable size limit.
2. Total adult mortality is less than 30 percent.
3. Fish that are of a length from the normal size limit to 3 inches more are in PCB or pesticide groups 2 or 3 or mercury groups 3 or 4.
4. Male walleye grow so slowly that they take more than 4 years to become 13 inches or larger; or smallmouth bass take more than 5 years to become 12 inches in the northern zone, and 6 years to become 14 inches in the southern zone."

Figure 25. Percent of ceded territory anglers who caught 0-5 walleye during 1980-87 (based on interviews with 28,901 anglers).

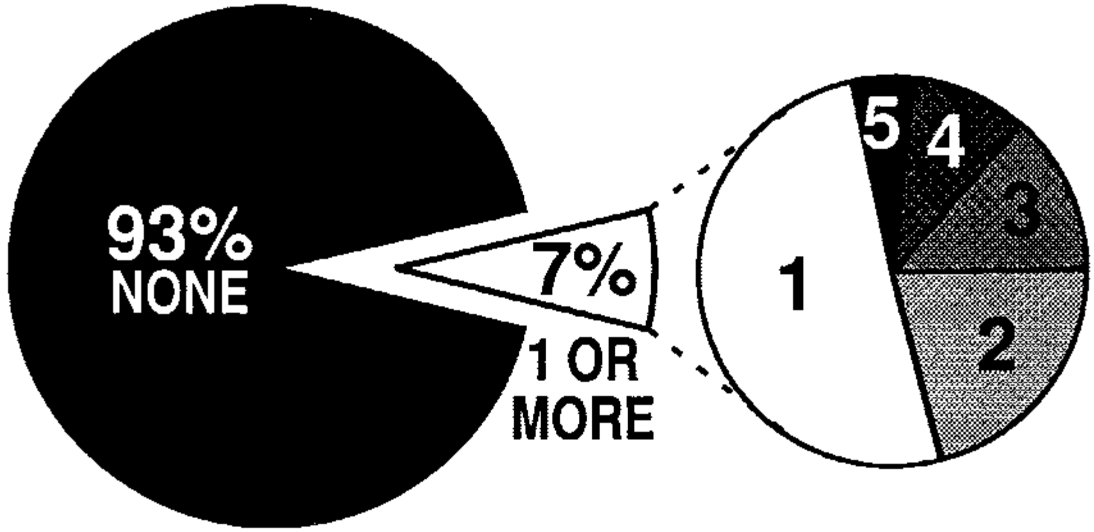
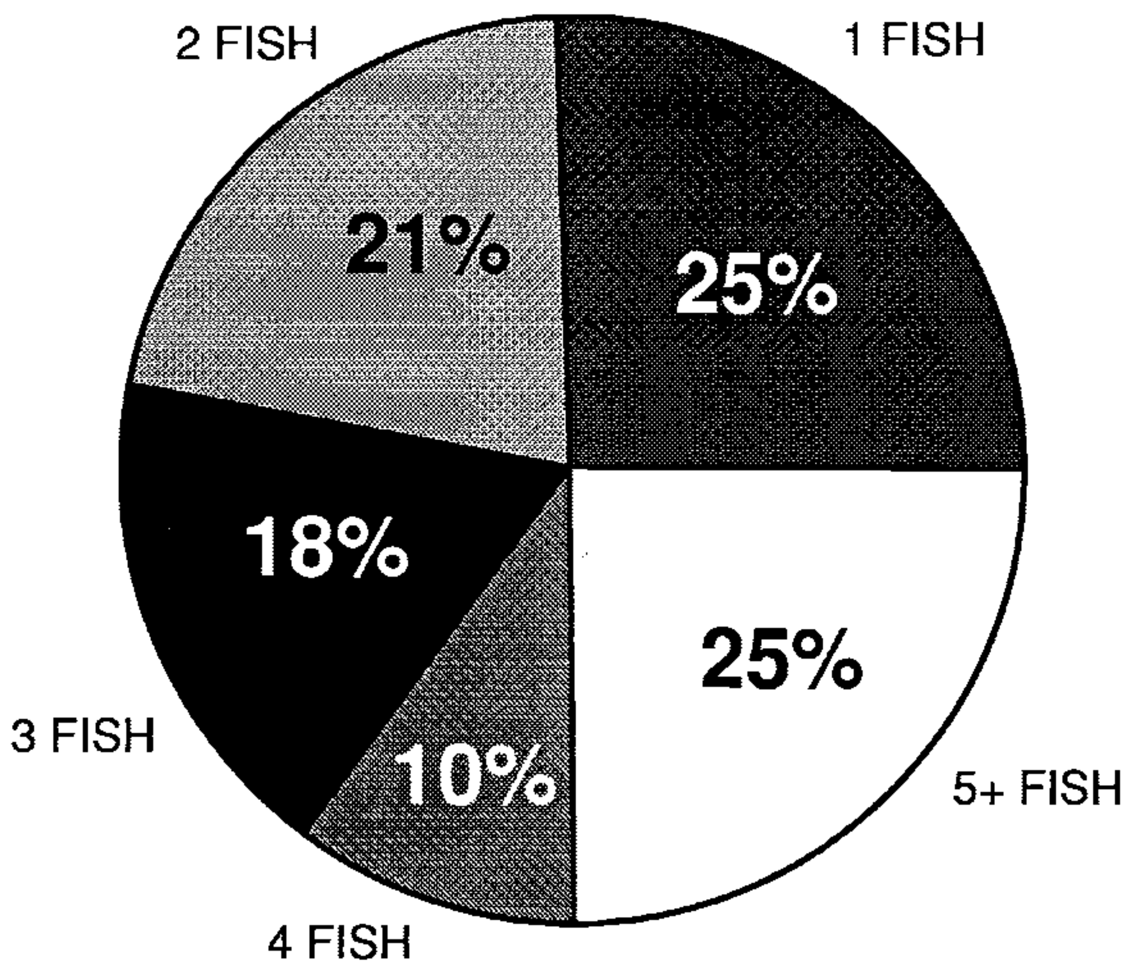


Figure 26. Percent of ceded territory angler-harvested walleye caught by anglers with bags of 1-5 fish (based on interviews with 28,901 anglers).



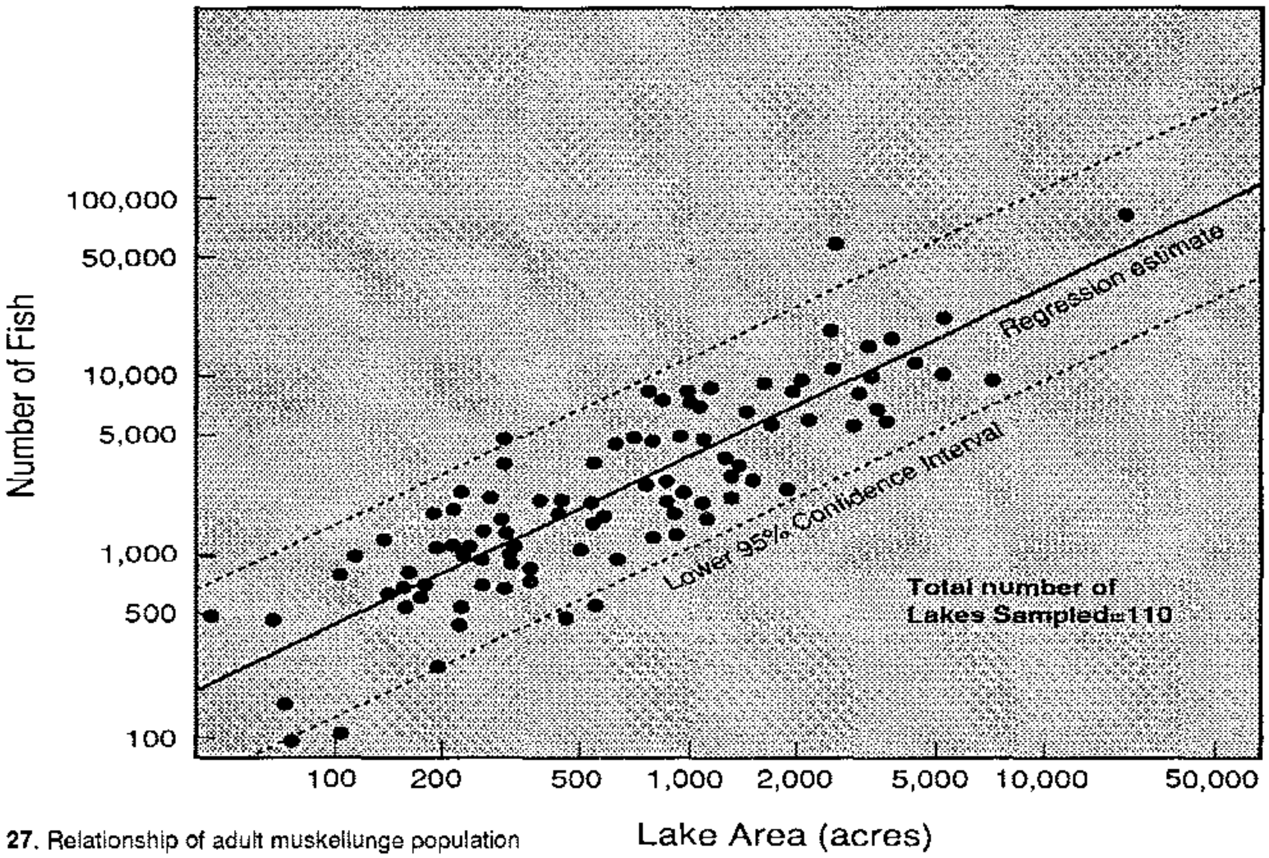


Figure 27. Relationship of adult muskellunge population size to lake area, for lakes with good natural reproduction.

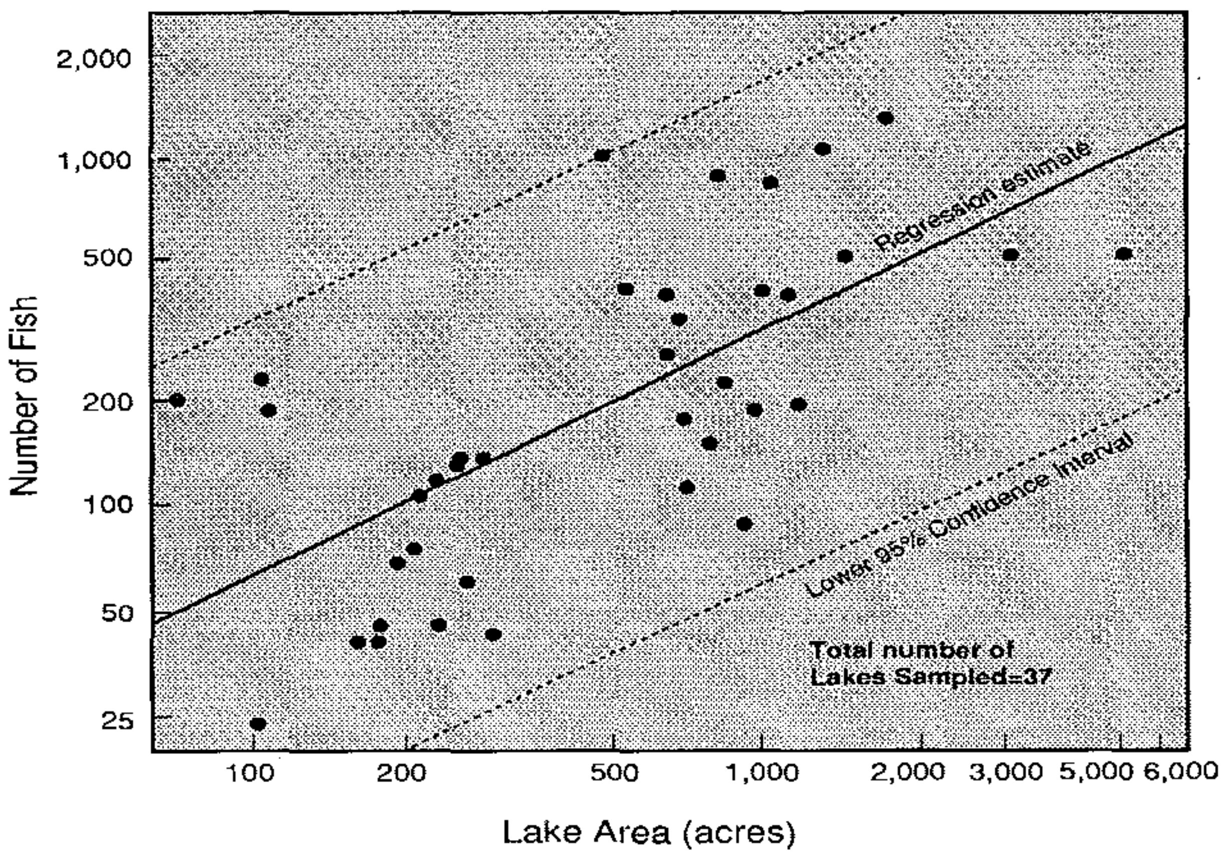


Figure 28. Relationship of adult walleye population size to lake area.

Slot size limits protect fish within a specified size range and are used to maintain the growth of predators, as well as to maintain the predator-prey balance in the community. It has been widely accepted for the management of largemouth bass populations that have good natural reproduction but slow growth. Harvesting fish below the lower limit of the slot enhances the growth of smaller fish by reducing competition. Fish within the slot size limit are protected to maintain the needed density of predators to control forage fish populations. Slot limits have only recently been applied to walleye populations and may be extremely beneficial in moderating problems associated with over-abundant panfish populations, and in increasing catch rates while still allowing the harvest of some large fish. More experimental management studies are needed on the use of slot length limits on walleye in order to gain a better understanding of how such regulations can be best applied in fishery management of Wisconsin waters.

Maximum size limits require that all fish caught that are longer than a specified length be returned to the water. Such limits are especially useful in protecting spawning populations that receive heavy exploitation. In many cases, it is combined with a minimum size limit used to assure recruitment. Maximum size limits have been also applied in regulations of the tribal walleye spearfishery. Spearing during the spawning season for walleye is regarded as a highly efficient means of harvesting, particularly for larger fish. Adult walleye are congregated in shallows during this time of year and are more vulnerable. Current maximum size regulations for the spear fishery allow the harvest of only one fish in the 20 to 24 inch size range and 1 fish of any size as part of an individual fisherman's daily bag limit.

Gear Restrictions

Restrictive regulations regarding the number and types of gear allowed are used to reduce the harvest, to limit the incidental catch, and to reduce mortality. In sport fisheries, regulations restricting gear cover the types of lures or baits, number of hooks used, size of hooks and exclusion of trolling. The State of Wisconsin has limited the use of spears and nets for fish harvest since the turn of the century because of their high efficiency in capturing fish.

Current Regulation-Oriented Research

On-going research related to the evaluation of regulations being conducted by the Wisconsin Department of Natural Resources, includes the following studies:

1. Evaluation of a slot size limit for a brown trout fishery.
2. Development of a catch and release fishery for brook trout at McGee Lake.
3. Evaluation of an open panfish and closed predator fishery.
4. Effects of a 10 inch minimum length limit on smallmouth bass in the sport fishery of Nebish Lake.
5. Impact of special harvest regulations on the sport fishery of largemouth bass in Spruce Lake.
6. Effects of a slot limit on the smallmouth bass population.
7. Effects of a 16 inch length limit and daily bag limit of 2 on the smallmouth bass population and harvest from Pallette Lake.

Studies proposed by the State Fisheries Division include an evaluation of a 40 inch minimum limit on muskellunge, the response of walleye populations to increased exploitation in Escanaba Lake, and evaluation of statewide walleye and bass length limits.

Management Of Fisheries in The Ceded Territory

Introduction

Current management of the tribal/sport mixed fishery in the ceded territory has evolved from a series of court decisions and cooperative efforts of biologists from both the Great Lakes Indian Fish and Wildlife Commission and the Wisconsin Department of Natural Resources. Tribal harvest quotas are set within the "safe harvest levels" established when Federal Judge Barbara Crabb combined portions of the State plan and portions of the tribal plan to regulate the treaty fishery. Judge Crabb ruled that the Tribes should enact management plans that provide for the regulation of their members in accordance with biologically sound principles necessary for conservation of the species being harvested. She further stated, that if Chippewa Bands did not self-regulate the harvest, then the State would gain regulatory authority over the exercise of off-reservation rights. The Chippewa Bands, through the Great Lakes Indian Fish and Wildlife Commission, developed a tribal regulatory system that conformed with conservation-based-rules proposed by the State of Wisconsin. The regulatory system was implemented prior to the 1989 fishing season. Enforcement and harvest monitoring aspects of the plan are conducted by the Biological Services and Enforcement Divisions of the Commission.

Walleye and Muskellunge Management

Treaty fishing annually occurs on 100 to 120 of the 859 walleye lakes in the ceded territory. Tribal harvest primarily occurs during the spawning season. Angler harvest during the spawning season is restricted on most lakes but is permitted on the following lakes within the ceded territory: Alice, Cornell, Dells Pond, Escanaba, Grandfather, Grandmother, Hat Rapids, Mohawksin, Old Abe, Wausau, and Wissota. If angling were permitted on additional lakes during the spawning season, it would require more intensive monitoring and a reduction of bag limits following the spawning season. The key to understanding management is that, beyond the number required to maintain the population, only a certain number of fish are available each year for harvest. If fish are highly vulnerable, the number that can be harvested safely is achieved in a relatively short period of time.

The tribal harvest is conservative and completely monitored. It is subject to maximum size limits on walleye to prevent the over-harvest of larger fish. Setting of a tribal quota may trigger a reduction in angler bag limits in accordance with State regulations. Lakes with tribal harvest are studied and monitored more than lakes without tribal quotas.

Harvest Regulations

Tribal harvests by open water spearing and gill netting of muskellunge and walleye are regulated by quotas declared by the Chippewa Tribes. Tribal harvest intentions must be presented to the State by March 15 of each year for each lake within the ceded territory that will be subject to harvest by spearing. The State then adjusts its angling regulations to minimize the chance of overharvest. Daily permits are issued to each tribal fisherman and the number of permits is limited by the quota. Chippewa monitoring crews record fish lengths and count all fish that are captured, immediately after the tribal fisherman quits fishing. During 1989 and 1990, the declared tribal quotas were exceeded on only 2 lakes of the 221 lakes that were speared. The number exceeded the quotas by a total of 22 fish. Citations were issued to spearers for the over-bag violations. However, the safe harvest levels were not exceeded.

Protection of larger sized fish is accommodated by maximum size limits and conservative harvest levels. Maximum size limits for walleye allow the harvest of one fish between 20 and 24 inches and one of any size for each permit. Muskellunge maximum size limits restrict the harvest to the first fish of any size and at least half of the rest of the catch of muskellunge must be 32 inches or larger.

The use of gill nets in the tribal fishery is limited to lakes of 1,000 acres or more. The Court decision stated that the lack of information about gill net catches, the potential for incidental catches of muskellunge and other non-target species, and the damage that might result from over-fishing on small lakes would pose an unacceptably high level of risk to fish populations in lakes less than 1,000 acres in size. Spearing is not subject to the latter considerations and is allowed on all lakes where quotas are set. The Court also determined that any lake subjected to two consecutive years of intensive tribal harvest would be closed to tribal harvest in the third year.

State-licensed anglers are restricted by season limitations, bag and possession limits, the number of lines that can be used, and size limits. Anglers are not required to report their catch on-site immediately following fishing or to register the fish they harvested, with the exception of sturgeon. The number of anglers on any given lake is restricted only by access and angling is not limited under annual quotas.

Safe Harvest Levels

The safe harvest level approved by the Federal Court is a quota that, if taken, has a 1 in 40 chance of exceeding the total allowable catch. The total allowable catch is the maximum number of fish that can be harvested during the year without damaging stability of the population for succeeding years. Analyses of angler exploitation rates indicate that total allowable catches for walleye can be set at 35 percent of the population estimate and at 27 percent of the population estimates for muskellunge. Use of a total allowable catch for setting quotas implies that biologists know what the population size is. However, these are estimates subject to the uncertainties of sampling so a "safety factor" must be applied to reduce the likelihood that over-harvest may occur. The sport fishery is not regulated by quotas and therefore safety factors are not applied.

The safety factor used in calculating the safe harvest level varies depending upon when the population estimate was determined (current year, previous year, or two year old) and upon its accuracy based on the sampling process used in determination of the estimate. Current year estimates are the most recent and therefore eliminate uncertainty associated with a time lag between calculation of the estimate and harvest. However, because data for current year estimates are not analyzed until after the majority of tribal spearing harvest (spawning season) occurs, they can only be used to update the current year's safe harvest level.

The safety factor for a current year population estimate is equal to the difference between the lower limit of the 95 percent confidence interval of the population estimate and the actual estimate. The confidence limit is a statistical expression of the accuracy of the estimate. As the accuracy of an estimate increases, the difference between it and the lower limit of the confidence interval will decrease. Using the lower confidence limit greatly reduces chances that over-estimation of the population is likely to occur. In Table 8, the safe harvest level (D) is determined by multiplying the population estimate (A) (after it has been discounted by the safety factor B) by (C) the appropriate exploitation rate (35 percent for walleye, 27 percent for musky). From the example, a population estimate of 2,000 walleye would be discounted by a safety factor of 75 percent and then multiplied by an exploitation rate of 35 percent to provide a safe harvest level of 525 walleye for the current year.

Tribal quotas have generally been set at 60 percent or less of the "safe harvest level". From the example given for Lake A, a tribal harvest of 60 percent of the 525 walleye (315 fish) would be allowed for 1991. Safety factors for current year walleye estimates made immediately before harvest have averaged at 75 percent, some have been as high as 92%.

The accuracy of older population estimates is subject to greater variability. For one and two year old population estimates, the Wisconsin Department of Natural Resources has developed "average safety factors" based on historical changes in walleye populations in Escanaba Lake over 30 years. Muskellunge "safety factors" were based on data from Lac Courte Oreilles Lake (Table 9). Using the data from the example of Lake A (last population estimate in 1991) if no new population estimate was to be made before 1993, safe harvest levels would be determined as shown in Table 10.

Most lakes do not have current population estimates. If the population estimate is older than two years, it is not considered reliable. An alternative method developed by the Wisconsin D.N.R. and the Great Lakes Indian Fish and Wildlife Commission has been accepted for determining "safe harvest levels" when no recent estimates from mark-recapture studies are available. It relies on the statistical relationship (a regression model) between population size and lake area and was developed using mark and recapture data from lakes throughout the ceded territory. Separate population estimation models have been developed for walleye lakes where natural reproduction occurs and for walleye lakes that require stocking to maintain their populations. For 1991, the regression for lakes with natural reproduction has been further refined to provide 1) separate estimates of walleye populations for lakes with good natural reproduction and abundant adult populations (Figure 27) for lakes with variable natural reproduction and a lower abundance of adult populations. The regression for estimating muskellunge populations (Figure 28) has not been adjusted by reproduction classification. The majority of muskellunge populations in the ceded territory are maintained by stocking and there are not enough population estimates available for further stratification of the regression. A total of 38 population estimates was used to develop the muskellunge regression model.

Regression estimates provide a quick method for determining population estimates for any lake, but generally have a lower level of accuracy. By using the regression estimate, walleye populations in 1,000 acre lakes can vary from 1,200 to 13,100 with a mean of 3,900. If the total allowable catch was calculated directly from the regression estimate, it could exceed the number of fish present in some lakes (eg. P.E. = 3,900 x .35 = 1,365 fish). Safety factors for the regression models vary with lake size but average 28 percent on stocked walleye lakes and 30 percent on lakes with naturally reproducing walleye. Safety factors and population estimates can be updated by agreements between the Wisconsin Department of Natural Resources and Tribal biologists as needed in the future.

Table 8. Lake A, 1991, Safe harvest level.

	Current year population estimate	Lower limit (Safety factor) 95% C.L.:	Exploitation rate	Safe harvest level
	(A) x	(B) x	(C) x	(D)
Walleye	2000	75%	35%	525
	2,000 x 75%= 1,500		1,500 x 35%=525	
Muskellunge	200	60%	27%	32
	200 x 60%= 120120x 27%=32			

Table 9. Safety factors used in the calculation of "safe harvest levels" from one and two year old population estimates for walleye and muskellunge.

	Safety factor based on one year old pop. est.	Safety factor based on two year old pop. est.
Walleye	35%	30%
Muskellunge	45%	39%

Table 10. Determination of safe harvest levels for Lake A, 1991-1993.

Year	Population estimate	Safety factor	Exploitation rate	Safe harvest level
	(A) x	(B) x	(C) x	(D)
Walleye				
1991	2,000	75%	35%	525
1992	-	35%	35%	245
1993	-	30%	35%	210
Muskellunge				
1991	200	60%	25%	32

Table 11. Modifications in daily bag limit and minimum harvest size limit in response to tribal harvest.

Reduced daily bag limits for walleye angling % of Safe harvest to be speared, trapped or netted.			
Daily bag limit	Current pop. est.	Population est. made 1-2 yrs ago	Population est. made 3 yrs. ago or more or regression model
4	1-7	1-4	1-20
3	8-18	15-39	21-54
2	19-36	40-76	55-84
1	37-68	77-94	85-94
0	69+	95+	95+

Angler Bag Limit Reductions

Safety factors imposed on the tribal fishery provide considerable protection against over-harvest. However, some lakes are already approaching the maximum sustainable harvest levels due to angling exploitation. The average exploitation rate for lakes of less than 500 acres is nearly 35 percent (the maximum sustainable level of harvest). The combined harvest, thus will routinely exceed the total allowable catch on these lakes unless harvest reductions are imposed on the angling fishery. A regulation to reduce the bag limit was implemented by the State during 1989 to protect walleye populations in the mixed fishery from over-harvest. The intent of this regulation is to reduce angler harvest to accommodate declared levels of treaty harvest. This should "fix" combined exploitation at the levels found prior to implementation of treaty fishing rights. This regulation reduces angler bag limits of walleye to 1, 2, 3, or 4 fish dependent upon the tribal harvest declarations for the lake and the method used for estimating the population when the safe harvest levels were determined (Table 11). For example, if the safe harvest level for a lake was determined from the regression model, its bag limit would be reduced to 3 fish if the Chippewa take from 21 percent to 54 percent of the safe harvest for that lake. Muskellunge minimum size limits for angler harvest are triggered when the Chippewa harvest goal for a single water is 60 percent or more of the safe harvest level. See Table 12.

The impact of the walleye bag limit reduction regulation on the overall fishery during 1989 would have subjected 254 of the lakes selected for spearing and netting by the Tribes to angler bag limits of less than 3 fish. During 1990, the State of Wisconsin did not follow the bag limit reduction regulation on lakes where limits would have been reduced to less than 3 fish. Instead, a proposal to prohibit possession of walleye on those lakes during the period from November 1 to the end of February was considered. Implementation of this proposal would have retracted a previous decision not to close seasons on the basis that it was unfair to ice fishermen. The proposal was subsequently rejected after analysis of recent harvest monitoring data (based on random sampling) revealed that combined exploitation levels would not exceed the maximum 35 percent exploitation rate during the 1990 to 1991 season.

Table 12. Increased minimum size limits for muskellunge angling.

Percent of safe harvest to be speared, trapped or netted by tribes	Minimum size limit (inches)
60-94%	45
95% or more	55

Figure 24. Number of surviving fish of various ages in a population subjected to a total annual mortality rate of 50% if the annual recruitment is 1,000 fingerlings per year.

Age	Number
1	1,000
2	500
3	250
4	125
5	62
6	31
7	16
8	8
9	4
10	2
11	1

Table 13. Quota trigger levels for species other than walleye and muskellunge in the ceded territory.

Species	Quota trigger level
Largemouth Bass	0.020 fish/acre or 5 fish per lake, whichever is greater
Northern Pike	0.013 fish/acre or 5 fish per lake, whichever is greater
White Bass	1 fish/acre
Channel Catfish	0.1 fish/acre or 10 fish per lake, whichever is greater
Cisco	1.4 fish/acre
Bullhead (all species, singly or in aggregate)	1 fish/acre
Smallmouth Bass	0.007 fish/acre or 5 fish per lake, whichever is greater
Rock Bass, Pumpkinseed, Bluegill, Crappie (in aggregate) and Yellow Perch	0.5 fish/acre of any species or 50 fish in aggregate, whichever is greater

evaluations may lead to more liberalized regulations in the future. However, fisheries managers are not optimistic about finding simple solutions. New information on the effects of the 15 inch minimum size limit on walleye and the reduction in harvest associated with it may reduce the need for bag limit restrictions on some lakes. The incorporation of recruitment rates of fish into the adult population during the season could also moderate the need for restrictive harvest regulations on some lakes. A better understanding is needed of the overall effects of fishing on walleye populations and the causes of fluctuations in abundance and recruitment of walleye populations through time on lakes with and without quotas.

Several tribes have recognized the impact that bag limit reductions have had on some waters and have reduced their declared levels of harvest or have chosen lakes that would allow angler bag limits of 3 or more fish. They have also attempted to refine the number of lakes that they declare for fishing to get closer to the actual numbers allowed for harvest. During 1989, 254 walleye lakes were declared by the tribes but only 102 were speared. This meant that there were 152 lakes where bag limit reductions proved unnecessary. During 1990, 178 lakes were selected and 119 were speared, leaving 59 lakes that were not fished.

Management of Other Fish Species

The State and tribes have agreed on regulations to manage all other fish species. This agreement largely follows the regulations set up for walleye and muskellunge, provides for advance notice of tribal intent to harvest, provides on-site monitoring of tribal spearing and gill netting, establishes quotas and safe harvest levels, and sets provisions for the use of lower efficiency fishing gear (ie. trap nets, set lines, rod and reel).

Methods for the development of tribal quotas are similar to those used for walleye and muskellunge, requiring an estimate of the population, discounting by a safety factor, and then multiplied by the predetermined exploitation rate for each species. Tribal harvests of species other than walleye and muskellunge are normally incidental and relatively few fish are taken. As a result, a system that triggers the need for a quota was established. Whenever the tribal harvest by open water spearing and netting for a particular species on a particular body of water reaches the indicated triggering level

(Table 13), the tribal harvest of that species shall cease for the remainder of the harvest year. During the next three succeeding years, tribal harvests of that species on that waterbody and all other waterbodies (the same size or smaller) selected by the band that exceeded the trigger shall be governed by a quota.

Population estimation models and exploitation rates that will protect against over-harvest need to be developed by tribal and state biologists (Technical Working Group). Trigger levels and methods for determining safe harvest levels can be modified and updated by the Technical Working Group as they deem necessary.

Additional regulations on treaty fishing include:

1. The use of gill nets on any lake where the annual tribal quota for any fish species has been taken shall be prohibited for the remainder of the harvest year.
2. For Lake Superior tributaries, individual tribal member bag limits are restricted to 10 trout and salmon per day in aggregate (only two may be rainbow trout), subject to the same season closures as state-licensed anglers.
3. The lake trout harvest is restricted to two fish per day with a 26" minimum size limit.
4. Inland harvests of brown, brook and rainbow trout are subject to a daily bag limit of 5 fish of any size in aggregate.
5. Sturgeon harvesting is restricted to one fish per person per year with a minimum size of 45 inches. The open season is from June 1 to March 1, except during spring spearing, when one fish per lake by all bands may be taken. In lakes with adequate populations of sturgeon, there will be no size or seasonal restrictions. However, the harvest on such lakes shall be governed by a tribal quota equal to 5% of the estimated number of 45 inch or larger fish in the population.

Other restrictions stipulated by the Court decision involve the use, sale, and transfer of baitfish and specific regulations for Trout Lake (Vilas County) and the Brule River (Douglas County).

Future Monitoring and Assessment Plans

Continuing population assessments and harvest monitoring are vital components in managing the ceded territory fishery. Accurate population estimates and harvest surveys are needed for the determination of safe harvest levels, for updating and refining estimation models, monitoring harvest, determining the combined effects of the mixed fishery on the fish populations, and regulating the harvest. Additional basic information on species, other than walleye and muskellunge, is required in order to adequately manage the mixed fishery.

Fish populations constantly change in response to fishing pressure, interactions with other fish populations and within their own population, and changes in their habitat.

Because of funding and personnel limitations, management must often categorize the characteristics of populations in order to develop a more universal approach to management. This approach uses statistical procedures and provides an understanding of the populations based on averages and deviation from the average. It does not tell what is happening with each individual population. Ultimately our best estimates, on which the use and protection of the fisheries are based, are only as good as the amount and quality of data used in the calculations.

Management of the mixed fishery of the ceded territory is in a youthful stage. Management decisions have been demanded by the public and the courts, but managers have been allowed only minimal time for to collect, analyze and evaluate data, and provide input.

A total of 11,348 lakes are found in the ceded territory. Of these lakes, 8,980 are less than 25 acres and cover only 9 percent of the total lake area. The Wisconsin Department of Natural Resources lists 859 lakes that have walleye. Treaty fishing annually occurs on 100 to 120 of the 859 walleye lakes. During the eight year period of 1980 through 1987, fifty creel census surveys were completed on 34 lakes. This amounts to an overall sampling rate of 50 out of 6,872 possible surveys (8 years and 859 lakes) or 0.7 percent of the total. However, the actual number of shared fishery lakes that are the target of current intensive management activities is around 125. Most of the creel surveys were done on those lakes. For this set of lakes, nearly 5% of the relevant time periods have been sampled. The latter analysis should not suggest that sampling adequacy is only based on a certain percentage of the relevant time periods sampled. A random sampling design is just as important in that it enables statistical extrapolation of the data to determine overall characteristics of the fish populations and of the fishery in the ceded territory.

The Wisconsin Department of Natural Resources's Bureau of Fish Management has greatly increased its assessment efforts beginning in 1990. Population estimates and angler harvest surveys will be completed on 20 percent of the 125 speared lakes and on an additional 10 unspeared lakes. The lakes to be sampled were randomly selected so that survey results can be statistically expanded to unsampled lakes. During the next 5 years, all 125 lakes will be sampled randomly at least one time. The sampling schedule insures that each speared lake will be surveyed at least once during a walleye generation. A total of 150 population estimates has been completed by State of Wisconsin, Great Lakes Indian Fish and Wildlife Commission, and U.S. Fish and Wildlife Service personnel since 1988. In addition, over 250 population assessments of juvenile walleye abundance have been completed by the agencies.

Total costs for the State's treaty assessment program will exceed \$1.2 million per year. The Great Lakes Indian Fish and Wildlife Commission plans to supplement the State effort by conducting population estimate sampling on an additional 25 to 30 lakes per year. In addition, 100 lakes will also be surveyed each year to monitor juvenile walleye and muskellunge abundance and to collect abundance information on other species.

The current Commission budget for the ceded territory fishery assessment program is \$262,502. The Commission has requested an additional \$146,701 from Congress for 1991. If Congress accepts this request, the total Commission budget for fishery assessment would be \$409,203. The Commission will continue to monitor all tribal harvests at an annual cost of \$44,000 (not including enforcement costs).

The U.S. Fish and Wildlife Service has been operating under a contract with the Great Lakes Indian Fish and Wildlife Commission to provide assistance with population assessment activities. The level of this activity will be governed by the availability of funds from the Commission. During 1989 and 1990, a combined total of \$10,000 was provided to the Service for these activities. Currently, the U.S. Fish and Wildlife Service receives no appropriation to pay for fisheries assistance activities in the ceded territory.

The cost of managing the ceded territory fishery represents only a small percentage of the value of benefits derived from the fishery. Fishing is a critical economicand cultural factor in northern Wisconsin. The value of the ceded territory fishery to the State's economy, in 1985, was estimated at \$240 million. Total imput to the local economy is far greater. The value of treaty fishing to the Chippewa society and culture is immeasurable.

Habitat Management and Assessment

Protection and improvement of aquatic habitats are of the utmost importance in sustaining the fish populations of Wisconsin. Many changes in the habitat ultimately reduce the productivity and carrying capacity of the affected waters. Some factors, such as heavy metal and pesticide pollution, not only degrade the quality of the habitat and affect fish reproduction and survival, they may also render the fish unsuitable for human consumption.

The Wisconsin Department of Natural Resources has the primary responsibility for habitat management and protection but these should be a primary concern of all resource agencies. Environmental assessment, protection, and enforcement programs involve several Federal agencies including, but not limited to, the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Geological Survey, U.S. Forest Service, and the National Park Service. Tribal resource agencies greatly expanded their programs during the 1980's and have developed capabilities to monitor and protect habitat on reservation lands. During this same time period, the Great Lakes Indian Fish and Wildlife Commission initiated investigations regarding mercury contamination of fish in waters of the ceded territory. The Commission is a strong advocate for the protection of habitat and water quality.

The Wisconsin Department of Natural Resources has instituted measures to protect, restore, enhance, or maintain habitat. These measures are accomplished through pollution control, water regulation, inland lake renewal, zoning, and public and private habitat improvement programs.

Jurisdiction for habitat protection through water regulatory control is provided by Federal Regulations, Wisconsin State Statutes and the Administrative Code. Fish management personnel are involved in the permit and environmental review process to ensure that adequate consideration is given to the fisheries resources. The State land acquisition program and zoning of shorelines and floodplains by local governments protect critical habitat areas and provide public access. Cooperation between the agencies is maintained to assure that watersheds are protected from point and non-point source pollution.

Many of the Wisconsin's waters have suffered declines in habitat quality through neglect and abuse, but most waters are capable of being restored to their former levels of productivity by proper habitat improvement techniques. Biologists maintain a continuing surveillance for changes during assessment and inventory surveys. Bank stabilization and protection by fencing are used to abate siltation problems in rivers and streams caused by erosion. In many waters, lack of adequate cover is a primary factor that limits the abundance of fish species. Restoration can be enhanced by installing structures to create artificial shelters, such as log cribs, brush piles, etc. Losses of spawning habitat through siltation can be restored by placing rock riprapping along the banks to control erosion and to provide clean spawning substrate in streams and by the creation of spawning reefs in lakes. The productivity of lakes may be enhanced by fertilization or liming if nutrients are a limiting factor. Aeration and de-stratification of lakes have also been used to increase the productivity or enhance dissolved oxygen concentrations in lakes. The control of rough fish, such as carp and bullheads, will often reduce turbidity and provide more suitable conditions for the growth of aquatic vegetation.

Loss of spawning habitat is a primary management concern for species, such as sturgeon, muskellunge, smallmouth bass, walleye, and particularly northern pike. Northern pike spawning marshes have been considerably degraded by shoreline development and by dredging and filling operations. Gravel substrates that are preferred by spawning walleye and smallmouth bass have been covered during the creation of sand beaches for recreation. In rivers, sand and silt deposition associated with poor land use practices, creation of navigation channels, and the development of impoundments have covered prime spawning areas. Impoundments created for hydropower development are probably responsible for declines in sturgeon populations in the ceded territory but some projects have increased habitat for walleye and muskellunge. Wisconsin's commitment to habitat management is reflected in its Fishery Research Program that includes 50 ongoing research projects; approximately 25 percent of these are related to habitat improvement.

The Wisconsin Department of Natural Resources has an active contaminant monitoring program in which the Bureaus of Fish Management, Information and Education, and Water Resources Management have joint roles. Sportfish consumption advisories have been issued jointly by the Fisheries Division and the Health and Social Services Department since 1976. Advisories were published in the Wisconsin fishing regulations pamphlet until 1986. Since then, advisories have been published as separate handouts. They are available by writing to Fish Advisory, Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, WI 53707.

Sources of mercury contamination in Wisconsin waters include geological materials, pulp mill wastes, and airborne material discharged from coal burning power plants. As of 1989, fish from 500 lakes in Wisconsin (3 percent to 4 percent of all lakes) have been tested for possible mercury contamination. Fish from 156 waters contained various levels of mercury contamination. However, the samples were not collected randomly so the data are not representative of the frequency of occurrence in all lakes. Many of the samples were collected from areas where contamination was known to occur.

Health advisory warnings are also issued by the State for PCBs and pesticide residues. Contamination by PCBs and pesticides largely results from industrial wastes and agricultural runoff. The Fish Health Advisory of 1989, included warnings about human consumption of fish from Lake Superior, Lake Michigan, Green Lake, and many rivers, including the Mississippi and Wisconsin Rivers.

Access Management of Wisconsin Waters

Management of access to Wisconsin waters is a vital component of the fisheries management program. Much of the increased future demand for recreational use could be provided by creating additional access sites and by improving current ones. Improved access can help "spread out" existing fishing effort and lower harvest demands on individual waters. Indiscriminate access development without concurrent harvest regulation represents a threat to new waters. Most of the following information is from an internal Department of Natural Resources report prepared by Ron Poff, entitled "Access Management in Wisconsin".

Wisconsin has a long standing tradition of providing public access to its lakes and streams. The tradition stems from the Northwest Ordinance that provides the philosophy to assure that citizens have an opportunity to use the waters of the state. The Wisconsin State Constitution reaffirms this right "...the river Mississippi and the navigable waters leading into the Mississippi and St. Lawrence, and the carrying places between the same, shall be common highways and forever free...". A recent opinion from the Attorney General stated that "Natural, navigable waters of this state are...impressed with the public trust, and all citizens enjoy access to and full use of these waters on an equal footing." Of the

Figure 29. State-wide access summary.

Lake size (acres)	Number	Percent with access
<200	12,985	40
200-500	408	69
>500	272	80

state-wide total of 13,665 lakes, approximately 42 percent have public access (Figure 29).

In the ceded territory, there are 595 walleye lakes and 423 muskellunge lakes that have public access.

Access is considered inadequate at more than 50% of the lakes that currently have access sites. This is due to one more of the following situations: poor boat launching ramps, inadequate parking space, lack of attendant facilities, overcrowding, and poor maintenance. Rivers in Wisconsin need significant access development to provide for boaters and canoers. For lakes that presently have no public access, either there is no public land or the sites have not yet been developed. The state owns approximately 20 percent of all access sites; the rest are owned and managed by county and local governments.

Access site acquisitions, development, renovation, and maintenance have been identified as a high priority in the Department of Natural Resources's Comprehensive Planning System (Fish Wisconsin 2000). In the recent "Fisheries Management 1991-93 Priorities" statement, access acquisition and improvement was specified as one of nine priorities and identified as a strategy in three other priorities.

Overall goals are to provide access to all lakes and access at 5 mile intervals on all rivers. Priorities established by the planning guidance include:

1. Provide access to waters that are inaccessible, particularly in areas where current opportunities are limited. Projects will target waters with the potential for important fisheries.
2. In reviews of federal re-licenses for hydropower facilities, acquisition of access to rivers and impoundments will be addressed.
3. Improve existing access quality through development, maintenance, and renovation; including greater accessibility for the hearing, learning, visually, and mobility impaired.
4. Minimize maintenance and development costs by working with local governments.
5. Work with citizens in designing access sites.
6. Enhance the development of non-boating access sites to accommodate the growing number of persons who cannot or do not wish to use watercraft for fishing.

Funding for the access development program is provided from several state, federal, and local programs; the combined budget for fiscal year 1990 was nearly 5.0 million dollars. In a single year, 30 to 60 projects are in progress. Access development at 115 sites has been completed since 1987.

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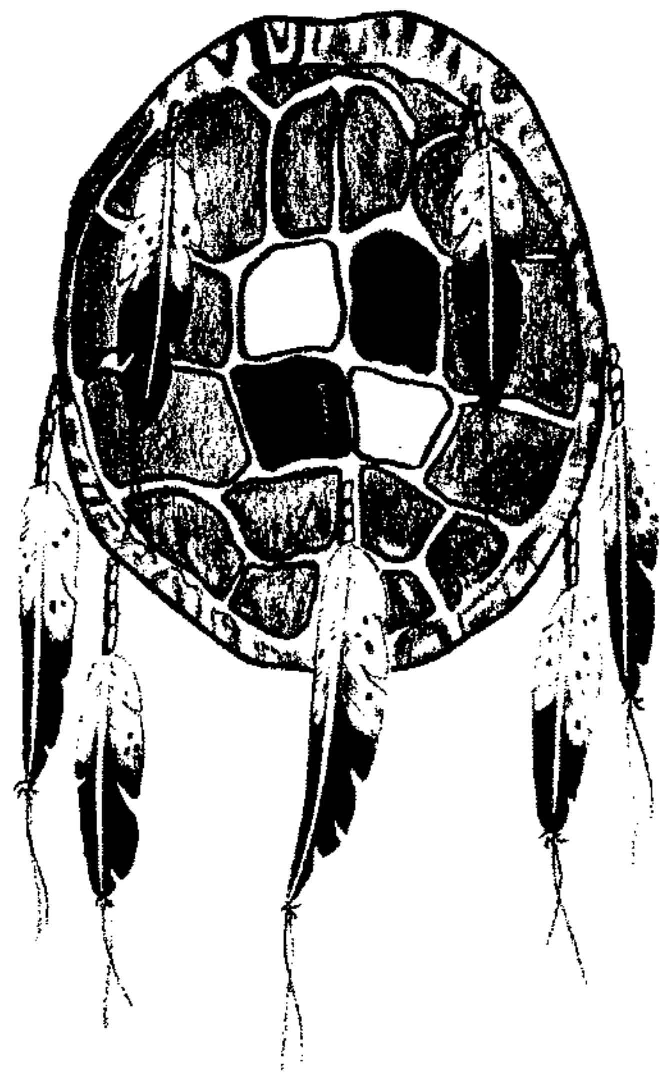


Enforcement

Generally, tribal conservation laws govern Chippewa tribal members exercising off-reservation fishing rights and State conservation laws govern non-Indians while fishing in the ceded territory. When tribal conservation laws apply to tribal members, parallel State laws do not.

Violations of tribal conservation laws are prosecuted in tribal court. In some instances, a tribal member may face prosecution in both tribal and state courts because laws from both jurisdictions apply simultaneously. State criminal laws apply to tribal members while exercising treaty rights. Certain Federal conservation laws apply to everyone and an individual may face federal prosecution as well as simultaneous prosecution under tribal or state law.

On-reservation tribal fishing generally is governed by tribal law and, in some instances, by federal law. On-reservation fishing by non-members generally is governed by state or federal law.

This myriad of laws is enforced by officers of the Wisconsin Department of Natural Resources, the Great Lakes Indian Fish and Wildlife Commission, Tribal Resource Agencies, the Bureau of Indian Affairs, and the U.S. Fish and Wildlife Service. When authorized, these agencies may exercise their enforcement powers over Indians and non-Indians alike. If a law applies to a certain situation and the warden involved has the authority to enforce that law, the warden may issue a citation regardless of who the violator is.

Department of Natural Resources wardens enforce Wisconsin state conservation laws and tribal off-reservation conservation codes. In addition, Department wardens have general law enforcement authority under state law and may enforce state criminal laws. Department wardens are stationed throughout the ceded territory.

Wardens from the Great Lakes Indian Fish and Wildlife Commission enforce tribal off-reservation and, in some instances, on-reservation conservation codes. Some Commission wardens have been deputized by the DNR to enforce state conservation laws when they detect a violation while on duty or when requested by the Department of Natural Resources. When exercising authority under Department credentials, Commission wardens must follow Department policies and procedures. Also, some Commission wardens have been deputized by County Sheriff Departments and may exercise general law enforcement authority when called upon. At least two Commission wardens are stationed at each Chippewa reservation at peak tribal harvest times, additional wardens may be placed on duty.

Tribal wardens enforce tribal on-reservation and off-reservation conservation codes. Some tribal wardens also carry credentials from the Bureau of Indian Affairs and may assist in the enforcement of certain federal conservation laws on the reservation. Tribal wardens also may be empowered to enforce other tribal laws on the reservation if the tribal council chooses. Each Chippewa tribe has at least one tribal warden; some tribes have four or more wardens.

Federal wardens generally enforce only federal laws. Sometimes, they may enforce tribal or state laws as well, if properly authorized by the government involved. Federal law generally applies to everyone equally, regardless of tribal membership. However, in some instances, tribal treaty rights or tribal religious rights may override a particular federal law.

Bureau of Indian Affairs wardens generally engage in on-reservation enforcement of federal conservation laws and other federal laws that apply to tribal lands. There currently are no Bureau wardens stationed in the ceded territory. Bureau wardens are stationed in the Minneapolis Area Office and are available to go to Wisconsin as necessary.

U.S. Fish and Wildlife Service wardens may enforce federal conservation laws anywhere. There are no Service wardens currently stationed in the ceded territory. However, normally two or more Service officers are located in each state to cover situations as necessary.

Each agency has its own training requirements. However, these are either the same or very similar. Commission and Wisconsin Department of Natural Resources wardens are required to complete essentially identical training requirements that include a 640 hour basic training course, annual training seminars, and firearms qualifications. Commission wardens have participated in Department sponsored training sessions and Department wardens have participated in Commission sponsored training sessions.

Because of the complex intermix of tribal, state and federal conservation laws in the ceded territory, the agencies coordinate their law enforcement efforts to ensure efficiency and effectiveness. Wardens from each agency routinely provide information to other agencies when they detect a violation that falls within the authority of the other agency. In some instances, joint undercover operations have been undertaken. More formally, the Chippewa Tribes and the State have agreed in the Voigt case that tribal, Commission, and Department wardens will work cooperatively in enforcing tribal off-reservation conservation codes. To facilitate the cooperative intent of these agencies, their chief wardens are required to meet semi-annually to discuss matters of mutual concern. The recent deputization of Commission wardens by the Department of Natural Resources has strengthened this cooperative intent.

The primary role of these agencies is to enforce conservation laws. However, in the context of Chippewa treaty rights, this role has been overshadowed by the need to maintain crowd control at boat landings and to enforce state anti-harassment and criminal laws against protestors. The Commission and tribal wardens are at boat landings during spring spearing to monitor the tribal catch. Most frequently, violations of tribal law are detected at the landing immediately upon return of the violator. Department and Commission wardens routinely patrol on the water during spearing and many violations are detected before a boat returns to the landing. Patrols on the water also have resulted in many citations for violations of boating safety laws.

The County Sheriff is primarily responsible for crowd control at the boat landings. However, the Department, the Commission and some tribal wardens have received training in crowd control techniques. These wardens are available when called upon to assist a Sheriff when necessary.

Continued threats of violent protests force tribal fisherman to focus their spearing on well-protected lakes for reasons of personal safety. This denies tribes the opportunity to spread their fishing effort among more lakes.

Current Management Objectives by Species

Introduction

Sound resource management programs are driven by clearly defined objectives. Objectives provide program direction, suggest appropriate management actions, and allow the results to be quantitatively assessed. Management objectives can be set at different levels. They may be established for individual species, regionally or on individual waters; may differ for various user groups; may change with changing environmental conditions; or change as new information is collected. In many cases, overall fish community objectives are more appropriate than individual species objectives. However, since current management programs for the ceded territory target individual species, it is appropriate for this report to identify and discuss current management objectives for individual species in the region as set by both state and tribal management agencies.

General Objectives

The paramount objective of both state and tribal management agencies is to protect naturally reproducing fish populations and communities. Self-sustaining fish populations offer the most cost-effective management alternative and assure the long-term viability of the fishery. This objective involves primarily habitat protection, harvest controls and restocking; but it also includes harvest and population monitoring, and a strong public education component.

The second general objective of both state and tribal management agencies is to restore and manipulate fisheries to provide optimal fishing opportunities for the resource users. The primary emphasis for both state and tribal users is harvesting fish for consumption, although state users also desire high catch rates and large-sized fish for sporting and trophy purposes on some waters and for some species. It may not be possible to meet all three objectives - harvest, sport and trophy - on each water. However, different waters can have different objectives such that all objectives can be met regionally.

Management objectives sometimes vary between agencies. The federal courts have ruled that primary management responsibility rests with the Wisconsin Department of Natural Resources. Objectives established by that agency are largely driven by resource protection and sport fishing demands. Tribal management authorities such as the Great Lakes Indian Fish and Wildlife Commission retain a strong interest and stake in the management of ceded territory fisheries and in many cases have established parallel management objectives. Tribal management objectives are also driven by resource protection but emphasize harvest for subsistence purposes rather than sport or trophy objectives. For some species, state and tribal management agencies have been able to coordinate management objectives, but in many cases additional work will be required to develop joint management objectives.

Walleye

State and tribal biologists have agreed on four basic objectives for managing walleye populations in the ceded territory. They are:

1. Maintain or achieve self-sustaining walleye populations, at abundance levels commensurate with available habitat and food. Indicators of healthy reproducing populations are 3 adult spawners per acre, and 5 year classes of females in a sample or 3 year classes in a sample of 100 females that each contribute at least 15 percent of the sample. Populations that fall below these levels typically require management actions such as harvest restrictions or stocking.
2. Maintain or achieve walleye populations that optimize fishing opportunities by increasing abundance or growth rates. Increase abundance in lakes with poor reproduction, overharvest, or high natural mortality. Increase size of fish in lakes with overharvest or overpopulation.
3. Maintain or achieve walleye populations that, through predation, optimize abundance and/or growth rates of other species.
4. Promote stability of desired populations.

These joint objectives attempt to meet the two primary general objectives discussed above; allow flexibility for tailoring management objectives for specific waters; and provide quantitative measures for evaluating the effectiveness of management actions.

Agency biologists also agree that walleye populations should not be subjected to total exploitation rates that consistently exceed 35 percent of the adult stock annually. This rate was based on past analyses and will be jointly reviewed as data from on-going sampling programs are compiled.

The Wisconsin Department of Natural Resources has established the following objectives specifically for walleye sport angling:

1. Maintain populations that allow a catch rate of one fish per 8 hours of sport angling. No more than 33 percent of the harvest should be less than 13" in length, and at least 40 percent of the harvest should be at least 15" in length.
2. Increase the harvest of walleyes larger than 15" in selected waters.

To meet these sport fishing objectives, several major problems must be addressed. Specifically: more information on the harvest and populations of walleyes is needed; a better understanding of the costs and benefits of walleye stocking must be developed; and harvest regulations must be tailored to individual waters.

Muskellunge

State and tribal biologists have agreed that adult muskellunge stocks should not be subjected to total exploitation rates that consistently exceed 27 percent; and that the preservation and enhancement of self-sustaining populations is a critical objective. Other management objectives differ based on the needs of the respective user groups.

Wisconsin Department of Natural Resources sport fishing objectives emphasize trophy management in the ceded territory:

1. Maintain a trophy fishery for muskellunge.
2. Muskellunge harvest should not consistently exceed 27 percent of the standing crop of fish 32" or longer in most fisheries and should not exceed 17 percent in designated trophy fisheries.
3. Maintain populations that provide a catch rate of 1 fish per 8 muskellunge angling trips and ensure that 35 percent of those caught will be at least 32".
4. Develop muskellunge populations in selected waters that will provide a number of fish larger than 45 pounds.
5. Protect and develop habitat suitable for as much natural reproduction as is practical.

To accomplish these objectives, the Department has identified these information needs: additional information on harvest, angler pressure, and exploitation; costs and benefits of muskellunge stocking; and effects of various harvest regulations.

Great Lakes Indian Fisheries and Wildlife Commission and tribal management objectives emphasize self-sustaining stocks and maximum use opportunities:

1. Manage a fishery for maximum opportunity for use.
2. Preservation of self-sustaining natural populations.
3. Restoration of formerly self-sustaining natural populations.

Cisco

Cisco are only rarely harvested in the ceded territory either by state or tribal fishers. As a result, little management emphasis has been placed on the cisco fishery. No current tribal management objectives have been established. Regional management objectives of the State emphasize maintaining existing fisheries and collecting additional information:

1. Determine the supply and demand of cisco fishing opportunities.
2. Maintain known populations and fisheries.

Northern Pike

Although northern pike are a popular sport angling target, there has been little tribal harvest. Consequently, no current tribal management objectives are available. The Wisconsin Department of Natural Resources sport harvest objective is very general:

1. Increase northern pike populations to meet or exceed projected angler demand.

To accomplish this objective, the Department recommends gathering additional information on the fishery resource and its use; identifying and protecting critical northern pike habitat, primarily riparian wetlands; evaluating the current stocking program; and evaluating inter-specific competition and predation impacts of northern pike.

Northern pike objectives are general because of regional disparities in the role of northern pike in local angling fisheries. In the south and west parts of the state, northern pike are considered a valuable sport fish. In the north-central part of the state, northern pike are thought to be competitors with muskellunge.

The need for restrictive harvest regulations is controversial because of high natural mortality rates which are apparently common in northern pike populations. As a result, overall Wisconsin Department of natural Resources sport fishing objectives were left general so that individual water management plans could be tailored to local needs.

Smallmouth Bass

Although smallmouth bass are a popular sport angling target, there has been little tribal harvest. Consequently, no current tribal management objectives have been established for this species. Wisconsin Department of Natural Resource sport harvest objectives are very general and reflect additional information needs:

1. Maintain smallmouth bass angling opportunities at current levels.
2. Determine the supply and demand for angling opportunities for smallmouth bass in the state.

Recently the Department has raised sport fishing minimum size limits for smallmouth bass. This reflects an increasing emphasis on sport and trophy fishing opportunities for this species.

Largemouth Bass

Although largemouth bass are a popular sport angling target, there has been little tribal harvest. Consequently, no current tribal management objectives have been established for this species. Wisconsin Department of Natural Resource sport harvest objectives are general but reflect an emphasis on providing sport and trophy fishing opportunities:

1. Maintain the supply of largemouth bass fishing opportunities in Wisconsin.
2. Increase the quality of largemouth bass fishing in Wisconsin, especially near large urban centers.

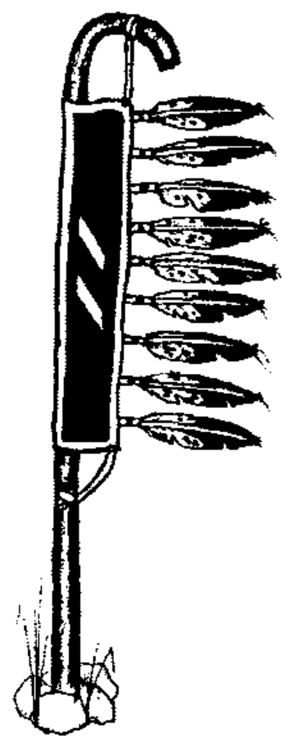
Recently the Department has raised sport fishing minimum size limits for largemouth bass. This reflects an increasing emphasis on sport and trophy fishing opportunities.

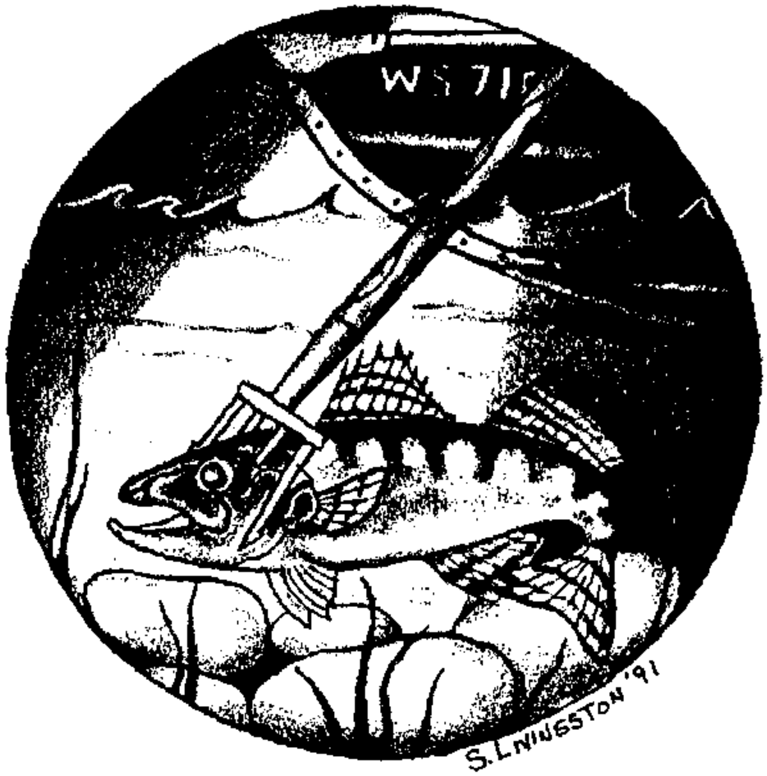
In meeting these objectives, the Department has identified several problems: increased information is needed on angler harvest, pressure, and exploitation particularly in high demand areas; exploitation must be reduced to increase the recruitment of larger bass in heavily fished waters; and competition and predation - particularly by over-abundant panfish - may be limiting bass reproduction.

Objectives for Individual Waters

This section has described regional and overall management objectives for species of concern as far as they currently exist. However, specific management plans and objectives have been developed for individual waters and fisheries throughout the ceded territory. Most of these plans were developed by the Wisconsin Department of Natural Resources, but tribal and Great Lakes Indian Fish and Wildlife Commission biologists have had input into some of the plans and have developed additional plans for selected waters. For example, tribal biologists are currently attempting to enhance walleye populations on Big Sand Lake in Burnett County through stocking and bullhead removal.

These individual waters plans cannot be detailed here, but are usually contained in survey or investigational report documents maintained in local agency offices. A good compilation of these plans was produced by the Wisconsin Department of Natural Resources Park Falls Area office and covers all lakes larger than 100 acres in that part of the state. Information available for each lake includes basic size and physical characteristics, most recent survey and creel survey information, stocking information, access information, and management strategies and objectives.





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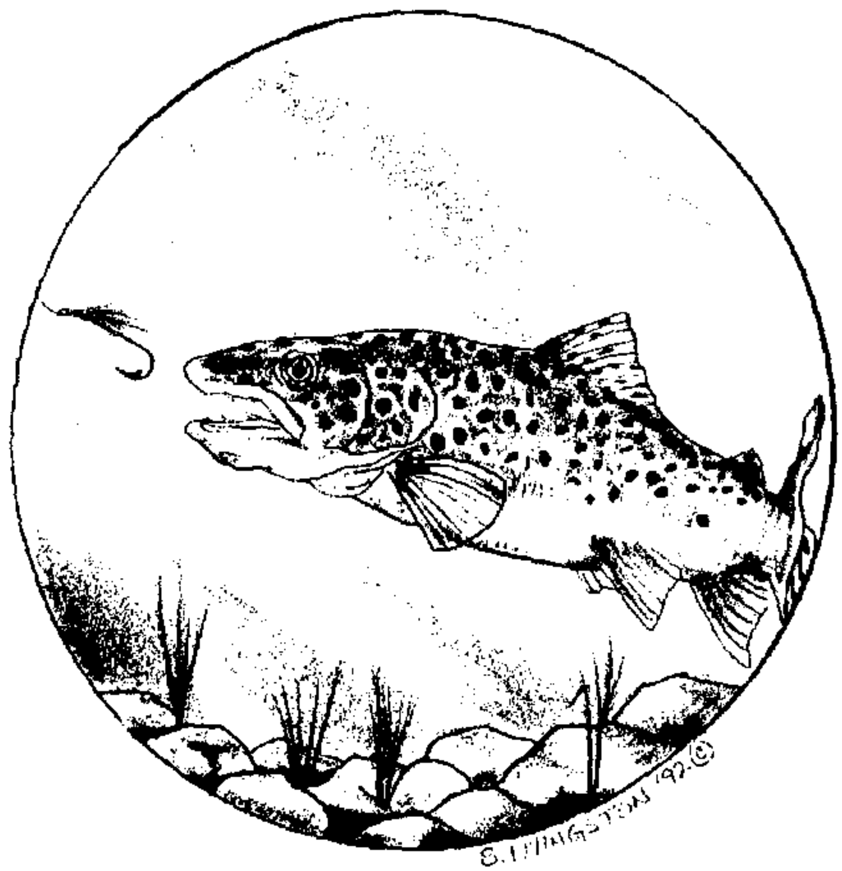

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Conclusions Regarding the State of the Resource

People concerned about the fishery resource of northern Wisconsin can be confident that it is being carefully studied and is protected. Chippewa spearing has not harmed the resource. Fish populations in the ceded territory are healthy. Three major factors currently impact northern Wisconsin fisheries: 1) reaffirmation of the Chippewa Tribes as harvesters; 2) heavy angling pressure; and 3) continually changing environmental factors. As a result, popular fish species, such as walleye and muskellunge, are subjected to considerable stresses.

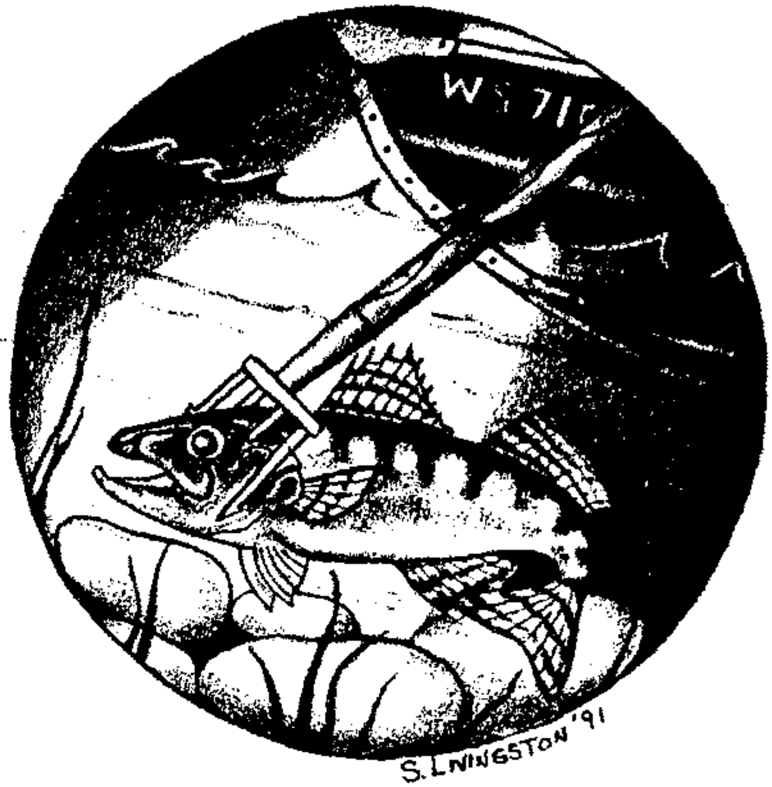
Available information suggests a number of conclusions concerning the effects of these stresses on the northern Wisconsin fishery. At this time, fish populations are not being over-exploited in most cases. For example, the average harvest of walleye does not exceed the agreed-upon maximum of 35 percent of the available adult stocks. In the lakes sampled, tribal spearing harvest of walleye has never exceeded this level. However, overall exploitation in some waters is of particular concern because lakes under 500 acres are more vulnerable to overfishing and environmental pressures than larger lakes. Further studies in such lakes are needed to monitor the effects of harvest levels and management actions. Moreover, current fish populations in most cases meet or exceed agreed-upon population goals. In 70 percent of walleye lakes studied, the populations are at or above the established goals. The number of female age classes exceed the agreed-upon goals in all lakes examined during 1986-90. This indicates stable reproductive capacity in those lakes. However, in 30 percent of the lakes, walleye numbers are below desired levels. This indicates that such lakes must receive further study to determine why the numbers are low and to ensure that the lakes are not being over-harvested.

Current information does not allow biologists to draw any conclusions about long-term trends in individual fish populations. While current information indicates relatively healthy fisheries, long-term population trends currently can not be detected. Fish managers recognize that there is a need to establish a reliable mechanism for assessing changes in fisheries and aquatic ecosystems. They have implemented a population sampling program that will monitor long-term trends that are not discernable today.

Managers also recognize that they must continually evaluate population goals and determine if changes in management strategies are needed. They agree that fish populations must be optimized, but that the methods for assessing the health of a population are still developing. Assessment methods must be adapted to provide the types of information that will identify changes in the resource, show the factors causing those changes, and indicate required management action. This study of the Northern Wisconsin fishery is unprecedented in its scope.

The tribal, state and federal managers have embarked upon one of the largest studies of fishing ever conducted. They are using state-of-the-art methods and have collected a large pool of valuable information. They have established joint population goals and are standardizing assessment methods.

Preparation of the report yielded one very clear conclusion: The fishery of the ceded territory faces increasing pressures from all factors. The managers must continue to monitor populations and harvest levels, and evaluate assessment methods and management strategies. The pressures on the fishery require a continuation and further expansion of the joint monitoring and assessment efforts. The managers have demonstrated that they have the expertise to manage the Northern Wisconsin fishery for the benefit of all users. They are committed to management efforts that will assure that Northern Wisconsin's fishery resource remains one of the best protected and best managed in the country.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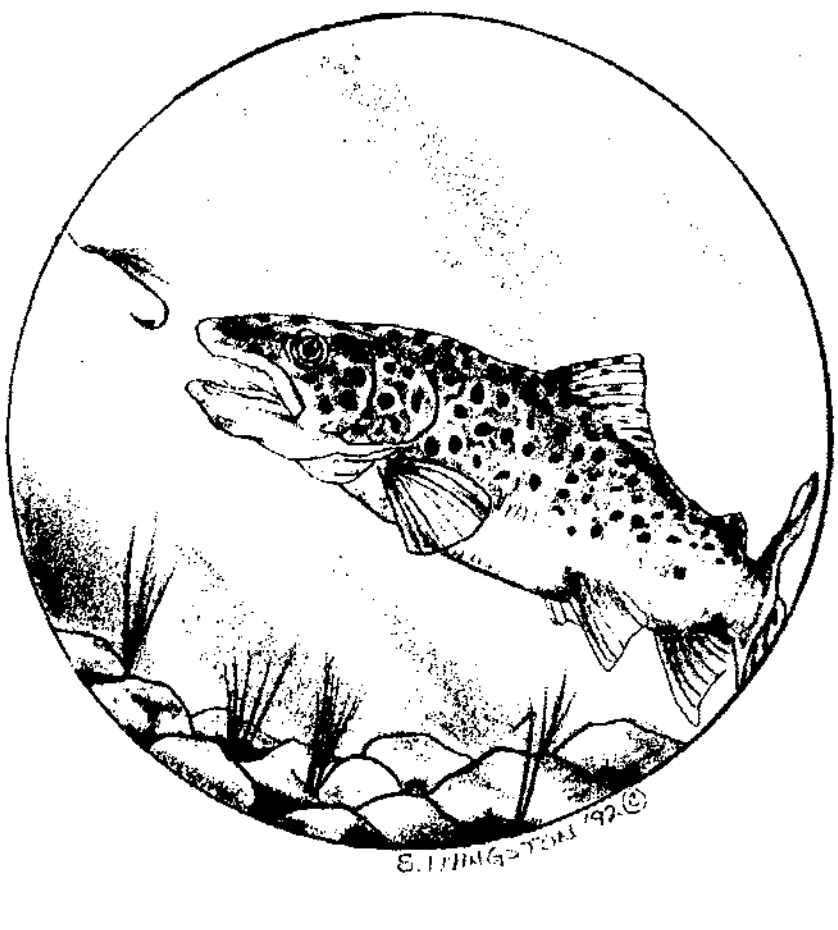
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Assessment and Harvest Monitoring

The most important needs identified by this status report concern resource assessment and harvest monitoring. Although more fishery information exists on the ceded territory walleye fishery than on virtually any other inland fishery in the world, this report identifies some areas that need increased attention. These needs are justified by the enormous value of the ceded territory to the tribes and state economy and the need to protect and preserve its resources for future state and tribal needs in the face of increasing user demands. The following needs must be addressed:

1. *Fishery assessment targeting species other than walleyes.*
   - Better coordination of state and tribal walleye assessments to make resources available for assessments of other species.
   - Seek Federal funding to expand resource assessment capabilities of both state and tribal agencies targeting other species.
   - Improve and update existing inventories of populations in individual waters for species other than walleye.

2 *Increase data handling and analysis capabilities, particularly among tribal resource groups.*
   - Provide Federal funding and support for a statistician/data analyst and expanded computer capabilities (both hardware and software) for the Great Lakes Indian Fish and Wildlife Commission.
   - Develop computer-based linkages to allow data and electronic mail exchanges between the Wisconsin Department of Natural Resources and the Great Lakes Indian Fish and Wildlife Commission.

3. *Development of a better inter-agency assessment and harvest monitoring program.*
   - Develop mutual agreement and acceptance of sampling methods and data analyses including angling harvest monitoring procedures.
   - Agree on a comprehensive set of sampling objectives and ensure that annual work plans maximize efficiency of available sampling effort toward those objectives.
   - Where feasible, use inter-agency work teams for fishery assessment and harvest monitoring activities.
   - Where feasible, conduct joint data analyses and produce joint, inter-agency resource status and harvest reports.
   - Develop a formal conflict resolution process so state and tribal administrations can mediate issues not resolved through the state-tribal Technical Working Group.

4. *Improve fishery resource assessments and harvest monitoring on reservation and border lakes.*
   - Increased cooperation between state and tribal leadership when border lake surveys are attempted by the state.
   - Systems to monitor or estimate the on-reservation portion of tribal spear and net harvest.
   - Increased efforts by the state or tribes to monitor on-reservation, state-licensed sport angling harvesst.
   - Increased Federal funding to expand on-reservation fishery assessment capabilities of local tribal resource agencies.

5. *Incidental mortality rates resulting from spearfishing are unknown.*
   - Design and conduct a controlled, statistically valid study to estimate the wounding and mortality rates associated with normal walleye and muskellunge spearfishing practices. Ideally, this study should be jointly planned and conducted.
   - Jointly evaluate the results of this study to determine the significance, if any, of such mortality; and, if necessary, what adjustments may be necessary in the management of the mixed fisheries.

6. Specifically address status of walleye populations in small (<500 acres) ceded territory lakes.

- Jointly develop information needs for small lakes.
- Results of the current assessment and monitoring programs should be reviewed to determine whether they meet the information needs.
- If necessary, additional state and tribal resources should be added or reallocated from existing programs to adequately monitor small lakes.

7. River walleye populations have received little attention.

- Improve and update existing inventories of population status for ceded territory riverine walleye populations.
- Jointly develop and implement resource assessment programs designed to delineate riverine walleye populations and assess their population status.

8. More accurately quantify user demands on the resource.

- Seek Federal or State general funding to perform quantitative and statistically valid surveys of various ceded territory user groups. Such surveys could also be used to explore the popularity and impact of alternative management strategies and more accurately develop tribal harvest declarations.
- Seek to involve other State or Federal agencies such as the State Tourism agency in these activities.

Research

Research provides the fundamental principles required to effectively manage and protect the fish resources of the ceded territory. Cooperation between the resource agencies in planning, conducting, and evaluating results of research activities is critical to acceptance and implementation of research recommendations. Several of the identified items are closely tied to assessment. Data from assessment efforts become material for research when the data set becomes large enough. This emphasizes the need to develop long term data series.

The steering committee has identified several new research needs and recommends emphasis be placed on many of the current research activities. The following research activities must be accomplished in order to enhance future management and to protect the fishery resources of the ceded territory.

1. Develop a better understanding of the effects of harvest on fish populations in the ceded territory.

- determine the impacts of size selective harvest on fish populations.
- determine the individual and combined effects of spearing and angling (open water and ice fishing) harvest on fish populations
- determine the effects of technological advances in fishing equipment on the catchability of fish.
- determine if harvest activity disrupts fish spawning and if so, to what extent.
- develop spearing equipment that will reduce the loss of speared muskellunge.

2. Improve understanding of basic biological characteristics of fish populations.

- increase understanding of fish species interactions.
- determine vital statistics on fish stocks from rivers.
- evaluate current walleye and muskellunge sustainable exploitation rates and develop target exploitation rates for other sportfish species.

3. Develop new techniques, or refinements of current methods for making harvest management decisions.

- evaluate the effectiveness of other variables for use in enhancing fish abundance regression models.
- develop comprehensive models for simulating fish community dynamics in response to changes in environmental and harvest characteristics.

4. Evaluate and improve the effectiveness of fish population assessment techniques for achieving management objectives.

- evaluate use of new technology for fish population assessment.
- determine possible adverse effects of assessment activity on spawning fish.
- evaluate current fish population assessment techniques.
- integrate assessment data into the Geographic Information System.

5. Improve our understanding of the effectiveness and application of fishing regulations.

- determine the effects of season regulations on the harvest and stability of fish populations.
- determine the effectiveness of maximum and minimum size limits.
- determine angler compliance with size and bag limit regulations.
- evaluate the need for reductions in bag limits on all lakes where there is a reasonable chance that over-harvest may occur.

6. Increase efforts to evaluate fish stocking.

- determine the effectiveness and possible impacts of put-and-take and put-grow-and-take stocking practices.
- evaluate the success of current stocking programs considering the number stocked, size of fish stocked, survival, timing of stocking, return to the harvest, and the effects on natural populations.
- improve fish cultural techniques.
- improve fish transportation methods.

7. Increase efforts to improve habitat and water quality.

- increase research on contaminant levels in fish and methods for abatement.
- determine factors limiting productivity of waters.
- determine the impacts of shoreline development on the habitat and fish populations.
- increase research on methods for enhancing aquatic habitats.

Public Involvement

1. Identify and explain to the public the current cooperative Department of Natural Resources and Great Lakes Indian Fish and Wildlife Commission management and resource activities that are currently being done and those that are planned.

- Provide methods for public access to the cooperative process.
- Encourage public involvement through volunteer programs.
- Enlist public involvement in stemming violence.
- Encourage more tribal participation in the Conservation Congress.
- Contact public to define stakeholders in the treaty rights issue and clarify public expectations.

2. Explain the process of exercising court-defined rights.

- Clearly define agreements and disagreements so public can understand them.
- Examine the public perception of spearing walleyes in the ceded territory compared to the spearing of sturgeon on Lake Winnebago.
- Poll the Wisconsin public to see if they would allow state-licensed spearfishing.

3. Improve information transfer for public consumption through more joint positive news releases.

- Conduct more joint information forums and workshops with the public.

Public Education and Information

1. Improve public understanding of the ceded territory resources, the capabilities and limitations, and better define the meanings of percentages and numbers presented to the public.

- Provide summary of Steering Committee report for average public understanding and consumption.
- Conduct media education sessions.
- Implement the proposed information strategy plan.

2. Explain cultural similarities and differences in attitude about the use of resources to the public through presentations and publications.

- Provide the Steering Committee report to the Department of Public Instruction for use in curriculum development and make any curriculum developed available to general public.

3. Develop a public concept of the purpose for which the resource is being managed and emphasize stewardship of the resources.

- Implement the proposed information strategy plan.
- Conduct media education sessions.

Interagency Cooperation/ Communication

The establishment of our steering committee to provide this report to Senator Inouye has strengthened the foundation for evolving a cooperative attitude among Federal, state and tribal government and natural resource agencies.

The cooperative infra-structure needed to responsibly manage the ceded territory fisheries must include:

1. *Consensus by the governments and agencies on the structure and function of inter-agency cooperation/ communication using a MOU to:*
   - understand management agencies needs, capabilities, and requirements.
   - clarify management agency administrative structures - define and identify cooperative participants.
   - identify management agency roles and responsibilities.
   - initiate policy guidelines to deal with post-litigation management dynamics.

2. *Strengthened communication and cooperation among goverments and management agencies.*
   - improve trust and accountability.
   - facilitate interaction between the Wisconsin Natural Resources Board and the Voigt Inter-Tribal Task Force.
   - document past cooperative accomplishments.
   - improve biologist interaction.
   - jointly pursue research monies.

Resource Planning

The demands placed on the resource warrant increased joint resource planning. Future planning efforts of the responsible ceded territory management agencies need to be better integrated and coordinated. Several planning needs were identified by the steering committee:

1. *Incorporate strategic planning to identify common goals and objectives between tribal, state and local communities.*
   - lake by lake joint planning with public involvement.
   - planning has to recognize harvest and sport ethics.
   - plan for the final outcome of the Voigt trial.

2. *Assess hatchery production with respect to strategic plan goals and objectives.*
   - develop a rational fish stocking plan for the ceded territory incorporating present and future capabilities and needs from state, Federal and tribal hatcheries.

3. *Integrate social and environmental (particularly mining and economic) impacts on fisheries into the planning process.*
4. *Achieve a common understanding of the harvestable resource and the dynamics of fisheries population estimates.*
   - develop a system for recognizing and responding to changes in the resource base.
   - adopt a joint, standard formula for harvest and regulation strategies.

Enforcement and Compliance

Effective enforcement of all conservation laws requires a partnership between the governments and agencies involved. Joint law enforcement efforts have been successful to date and they need to continue in the future. Specifically, the involved law enforcement agencies must:

1. *Develop integrated enforcement plans as part of the semi-annual law enforcement meetings required by the Voigt case.*
   - annual enforcement plans must be jointly developed for both the tribal and state harvesters.
   - integrated enforcement plans must be periodically evaluated and their effectiveness assessed.
   - conservation enforcement agencies must understand their role in keeping the peace at boat landings and on the water.
   - officers from different agencies must continue joint patrols.

2. *Develop a clear, common understanding of all applicable conservation laws.*
   - wardens must develop consistent interpretations of the laws they are enforcing.
   - agencies must understand the authority and procedures of tribal and state courts.

3. *Continue joint law enforcement training programs.*

• wardens must be informed of changes in applicable laws, developments in enforcement techniques, and particular enforcement problems that should be targeted.

• wardens should draw on the talents and experience of their counterparts from other agencies.

4. *Inform the public of the benefit of integrated law enforcement activities.*

• promote public awareness of the benefits of cross-deputization of state wardens to enforce tribal laws and of tribal wardens to enforce state laws.

• a joint annual report of law enforcement activities and results should be considered.

• public must understand the role of conservation wardens in keeping the peace at boat landings and on the water.

Workloads/Staffing

Budget tightening, staff shortages, and complex environmental and public education issues strain the capabilities and diminish the effectiveness of the ceded territory management agencies.

The need for increased assessments and monitoring of the fishery resource has already been documented. This need was the highest priority identified by the steering committee. Increased data collection will have little value, however, if the following needs are not considered:

1. *Increase data analysis and processing capabilities at all ceded territory management agencies.*

• better integrate data analysis.

• co-location of biological staff.

• overall funding increases for personnel and equipment.

2. *Increase staffing to facilitate cooperative projects.*

• establish joint tribal/state/Federal assessment crews.

• establish tribal assessment crews at all six Chippewa reservations.

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Joint Assessment Steering Committee Budget Summary

Great Lakes Indian Fish and Wildlife Commission

Steering Committee Expenses..	$17,000
Report Publication Cost	$25,000
Expanded G.L.I.F.W.C. Fishery Assessment	$134,900
Salaries/Fringe	
Travel	
Equipment/Supplies	
Operations/maintenance/Insurance	
St. Croix Fishery Assessment Unit	$33,100

U.S. Fish and Wildlife Service

Data Collection; Report Preparation/Editing/Meeting Facilities	$66,000
Travel	$8,000
Equipment/Supplies	$16,000