Available online at www.sciencedirect.com
SCIENCE DIRECT®
Environmental Science & Policy 7 (2004) 315–328
Environmental Science & Policy
www.elsevier.com/locate/envsci

Factors influencing the effectiveness of local versus national protection of migratory species: a case study of lake sturgeon in the Great Lakes, North America

Amy B. Welsh*

Department of Animal Science, University of California – Davis, 1 Shields Avenue, Davis, CA 95616, USA

Abstract

As political administrations change, the focus on state versus federal management of endangered species can also shift. I present a case study evaluating the effectiveness of state protection of a migratory species in the absence of federal protection. The lake sturgeon, *Acipenser fulvescens*, in the Great Lakes Basin (North America), migrates across state, tribal, and international boundaries. The legislation, as well as its implementation, for the protection of endangered species in each state bordering the Great Lakes is evaluated and compared to the federal Endangered Species Act. The impact of state versus federal protection on tribal and international jurisdictions is assessed. Consistency in regulations among the states and countries varies. Of the eight states examined in this analysis, four extend protection to the level of species, two to subspecies, and two to populations. Many of the states have not explicitly included the destruction of habitat as a form of take. Citizen suits are permitted in three of the states examined, permitting citizen oversight of endangered species management. State endangered species legislation appears to be weaker than federal legislation. Despite this apparent weakness, state management of the lake sturgeon has been successful. Jurisdictional coordination through the Great Lakes Fishery Commission and voluntary management efforts have helped facilitate this success.

Keywords: Endangered Species Act; *Acipenser fulvescens*; State management; Interjurisdictional

1. Introduction

As political administrations change through the years, the emphasis on either federal or state regulation can also shift. In recent years, increased focus has centered on the role of the U.S. states in the management of endangered species, as evidenced by the development of Candidate Conservation Agreements (64 Federal Register (FR) 32726). Although political sentiment can often determine the role state or federal governments play, it is important to understand the impact the designated regulator can have on the conservation of endangered species. State oversight of endangered species may be weaker than federal regulation (George et al., 1997, 1998; Goble et al., 1999; List et al., 2002) and may not encompass the range of the species. I will attempt to address the following questions: (1) Do states have sufficient legislation to adequately protect endangered species? and (2) Can states facilitate the recovery of endangered species with the legislation and resources they possess?

States can be involved in endangered species conservation through two primary routes: (1) federal funding and management coordination under Section 6 of the United States Endangered Species Act (ESA; U.S., 1973), or (2) protection of non-federally listed species through state conservation laws. The former method provides federal oversight over state management of listed species. Consequences of inadequate protection under state laws include federal listing under the ESA. However, population sizes of the threatened species may then be at a very low level, resulting in inefficient management and decreased likelihood of recovery. States that are managing non-federally listed species encounter additional challenges when protecting migratory species. Non-uniform management strategies that may result from a lack of federal listing could potentially impede the species' recovery.

Migratory species may utilize habitat under different jurisdictions for activities such as feeding, resting, mating, and nursing. Different legislation and regulations among jurisdictions can result in ineffective management. If a species is unregulated in one of its necessary habitats, the management strategies implemented in the more restrictive jurisdiction could be nullified. Federal listing of the species would

* Tel.: +1 530 752 6351; fax: +1 530 752 0175.
E-mail address: abwelsh@ucdavis.edu (A.B. Welsh).

1462-9011/$ – see front matter © 2004 Elsevier Ltd. All rights reserved.
doi:10.1016/j.envsci.2004.03.003

instead offer a more uniform conservation strategy throughout all the species' critical habitats by permitting one jurisdictional authority over the species' management.

As migratory species cross international boundaries, the interjurisdictional management issues become more complex. For effective management to occur, it is often necessary to establish treaties between participating countries. Federal authority is required for treaty development and states play a limited role. This further begs the question of whether states can adequately protect migratory species that are not federally protected.

2. Case study: lake sturgeon of the Great Lakes

The lake sturgeon, *Acipenser fulvescens*, of the Great Lakes Basin (North America) is a model organism for examining what state endangered species laws can offer. This fish species was listed as a category 2 candidate species under the federal ESA in 1982 (47 FR 58454). Category 2 indicated that listing of the species was possibly appropriate; however, sufficient data were unavailable for a determination. This category was eliminated in 1996 and lake sturgeon were no longer listed as a candidate species (61 FR 7595). Lake sturgeon are therefore not listed under the federal ESA, and instead receive varying protection within each of the states in the Great Lakes region. Because they are not federally listed, we can evaluate the protection they receive within the state and how that differs from the protection they would receive under the federal ESA.

Lake sturgeon are migratory and would demonstrate the impact of interjurisdictional policy issues and the effects of any inconsistencies among state laws and regulations. Migration routes of the lake sturgeon take them through different states, different tribal waters, and different countries, thereby representing many of the jurisdictions involved in migratory species management. These sturgeon enter rivers throughout the Basin to spawn and spend the remaining time in the open waters of the Great Lakes Basin (Harkness and Dymond, 1961), while some populations on larger rivers are permanent river residents (Borkholder et al., 2002). Spawning is intermittent (Noakes et al., 1999); as a result, individual lake sturgeon spend the majority of their lives in non-spawning habitat. Migration distances following spawning have extended as far as 280 km from the spawning site (Auer, 1999a). While in the lakes or bays, migration distances are more uncertain. From the few radio telemetry studies tracking lake sturgeon migrations, migration patterns have shown fish movements between lakes (Fortin et al., 1993; Thomas and Haas, 2002). Other radio telemetry studies have demonstrated movement across interjurisdictional lines, including movement between states (Knights et al., 2002) and between countries (Rusak and Mosindy, 1997). Lake sturgeon have also been recaptured in different lakes within the five Great Lakes from which they were originally captured (Mohr, personal communication). As lake sturgeon migrate, they may be subject to varying levels of protection, depending upon the jurisdiction through which they are swimming. As states try to protect the spawning populations in the rivers, human activities in non-spawning habitat can have a profound impact on the success of management in the rivers.

Problems faced by the lake sturgeon include overfishing, dams, habitat loss, and pollution (Birstein et al., 1997). During the late 1800's, commercial fishing for lake sturgeon was at its peak, supplying a market for smoked sturgeon meat and caviar (Auer, 1999b). Commercial fishing for lake sturgeon has been eliminated in the United States. Canadian commercial fisheries remain in Lake Huron, Lake St. Clair, and the St. Lawrence River (Auer, 1999b). Recreational fishing remains in Canada and portions of the United States. Regulation of fishing is critical to the lake sturgeons' recovery. Lake sturgeon are long-lived fish with late sexual maturity and intermittent spawning (Noakes et al., 1999), making it difficult for population sizes to quickly rebound following heavy harvest. Dams are barriers to lake sturgeon on river migrations to spawning habitat (Auer, 1999b) and can also fragment populations (Thuemler, 1997). In addition, water flow regimes and water temperatures from dams can detrimentally impact spawning activity (Auer, 1996). Habitat loss and/or degradation are obstacles to lake sturgeon recovery, as with many endangered species. Dredging and filling have destroyed important nursery areas (Auer, 1999b), while logging (Brousseau and Goodchild, 1989), dam construction, and industrial wastes (Harkness and Dymond, 1961) have damaged spawning habitats. Habitat restoration has increased lake sturgeon spawning success (Bruch, 1999). Pollution may not be as great of concern for lake sturgeon recovery as it was in the past. The ecosystem-wide effects of pollution in the Great Lakes Basin generated basin-wide approaches to lake cleanups (e.g. Lakewide Management Plans (International Joint Commission, 1989).

3. U.S. state policies

Individual legislation in each state directly adjacent to the Great Lakes will be evaluated for its ability to: (1) protect subspecies and/or distinct populations, (2) prohibit take of listed species, (3) protect critical habitats, and (4) permit citizen suits. Legislation that offers protection to subspecies and/or distinct populations, as the federal ESA provides for vertebrates, allows greater flexibility in listing. Abundance of the species within certain parts of its range could otherwise impede listing of distinct populations or subspecies that may be imperiled. The definition of *take* can be narrow, incorporating only direct take of the species, or can include indirect take through habitat modification. The federal ESA states that harm to a listed species is included in the definition of take. Regulations by the United States Fish and Wildlife Service (USFWS) include habitat modification

Table 1
Summary of endangered species legislation in eight Great Lakes states and the United States

	Status	Lowest taxon recognized	Definition of take	Habitat consideration	Citizen suits permitted?	Active management?
Minnesota	Special concern	Species	Not defined	No	Yes	Yes
Wisconsin	Not listed	Species	Direct	Permits	No	Yes
Illinois	Endangered	Species	Harm	Essential habitat ID upon listing; permits	No	No
Indiana	Endangered	Subspecies	Direct	Listing	Yes	No
Michigan	Threatened	Populations	Harm	No	Yes	Yes
Ohio	Endangered	Species	Not defined	No	No	No
Pennsylvania	Endangered	Subspecies	Not defined	No	No	No
New York	Threatened	Populations	Habitat	Taking	No	Yes
USA	Not listed	Populations	Habitat	Critical habitat ID upon listing permits; taking	Yes	Yes

Table includes the listing status of the lake sturgeon, *Acipenser fulvescens*; the lowest taxa recognized for listing under the respective endangered species legislation; the definition of take (direct = hunting, shooting at, killing; not defined = definition not included in either the legislation or regulations; harm = included in the definition of take, but not further defined; habitat = destroying or modifying habitat can constitute a taking); the role of habitat consideration in the protection process (permits = considered when issuing an incidental take permit; listing = role of habitat modification considered; taking = habitat interference considered a taking); the allowance of citizen suits; the existence of current active management of lake sturgeon.

within the definition of harm (50 Code of Federal Regulations (CFR) 17.13). Habitat protection is essential to species recovery as habitat loss and/or degradation is often a primary cause for the endangered species' status. The federal ESA requires critical habitat designations for all listed species. Finally, citizen suits are often the impetus for careful adhesion to statutory guidelines, providing the opportunity for critical citizen oversight. Citizen suits are permitted regarding the federal ESA and have often resulted in clarification of regulations. Table 1 provides a comparison of state and federal endangered species legislation.

Actual management activities will also be reviewed to provide insight into implementation of existing policies. Impacts of state versus federal protection on the coordination of federal, international, and tribal jurisdictions will be examined as well. This analysis will provide an examination of the policy scale relevant and necessary for the conservation of migratory species.

3.1. Minnesota

3.1.1. Status

Spawning populations of lake sturgeon are found along the St. Louis River, portions of which are shared with the state of Wisconsin, and the Pigeon River, which borders the Canadian province of Ontario (Fig. 1; Great Lakes Lake Sturgeon Coordination Meeting (GLLSCM, 2002)). The spawning populations in the St. Louis River were extirpated and lake sturgeon have been reintroduced. Non-spawning populations are found in the waters of Lake Superior, which are shared with the states of Wisconsin, Michigan, and the Canadian province of Ontario. Spawning and non-spawning populations are also found in the Lake of the Woods and Rainy River system, which border with Ontario. Although technically part of the Hudson Bay basin (Rusak and Mosindy, 1997), this area will also be considered as it presents international management coordination issues. The lake sturgeon is listed as a species of special concern in the state of Minnesota.

3.1.2. Legislation

Minnesota's Endangered Species Statute (Minnesota Statutes, Section 84.0895) allows for the listing of endangered and threatened species, as well as species of special concern. The species of special concern status includes species that are uncommon in the state, species with habitat requirements that require careful monitoring, or species that were once listed as endangered or threatened. This status does not confer any legal protection upon the species and instead denotes a species that requires monitoring. Listing is limited to the taxonomic classification of species.

If lake sturgeon were listed as either endangered or threatened in Minnesota, the statute would prohibit taking of the species without a permit obtained from the Department of Natural Resources (DNR). Take is not defined in either the statute or rules developed by the DNR. Permits can be issued for zoological, scientific, or educational purposes. The statute also allows issuance of a permit if "the social and economic benefits of the act outweigh the harm caused by it". Applicants must demonstrate all alternatives to take were carefully evaluated and reasons for rejection of alternatives. Neither the statute nor the rules developed by the Minnesota DNR require consideration of habitat. A citizen suit statute permits suits against any person for any threat to the environment (George et al., 1997).

3.1.3. Implementation

Although lake sturgeon do not receive the protection accorded to endangered and threatened species, rules have been developed by the Minnesota DNR regulating fishing of lake sturgeon in state waters. Fishing of lake sturgeon is not allowed except within portions of the boundary waters. Along the Minnesota–Wisconsin border, fishing for lake sturgeon along the St. Louis River is prohibited (Minnesota Rules

Fig. 1. Map depicting states and countries in the Great Lakes region and lake sturgeon (*Acipenser fulvescens*) spawning locations. Provinces of Canada are in gray; states of the U.S. are in white. Light gray portions of the lakes represent U.S. waters; dark gray portions represent Canadian waters. Drawn rivers represent known spawning locations. Labeled locations represent interjurisdictional waters. Source of U.S. map: National Atlas of the United States of America. River locations for Canada are approximate.

6266.0500). In the waters bordering Minnesota and Canada (Lake of the Woods and the Rainy River; Fig. 1), sturgeon fishing is permitted most of the year, excluding the spawning season (Minnesota Rules 6266.0700). Changes in existing regulations are being proposed (Minnesota DNR, 2003) as biological evidence shows that the population may not be sustained with current catch levels. Shortening the harvest season and narrowing the size window of targeted fish are proposed. However, as sturgeon migrate throughout this system, it is difficult to assess whether the damage to population recovery is from the regulations of Minnesota or the regulations of neighboring Ontario (see Section 6 of this paper). The Canadian province of Ontario has more lenient fishing regulations regarding lake sturgeon. As lake sturgeon migrate throughout the lakes, the sturgeon that are fished in Ontario may be the sturgeon that spawn in the rivers of Minnesota. In addition to regulating fishing along boundary waters, the state of Minnesota, in conjunction with the state of Wisconsin, is also monitoring sturgeon in the reintroduced spawning population in the lower part of the St. Louis River (GLLSCM, 2002).

3.2. Wisconsin

3.2.1. Status

Along the shores of Lake Superior, spawning populations are present in the Bad River and White River. Several rivers off the shore of Lake Michigan contain spawning populations, while lake sturgeon have been extirpated in approximately seven other rivers. Spawning populations along the Menominee River border the state of Michigan (Fig. 1; GLLSCM, 2002). Non-spawning populations exist in Lake Winnebago (corresponding spawning populations along the Wolf River fall within Menominee Tribe jurisdiction), Lake Michigan (which also borders the states of Illinois, Indiana, and Michigan), and Lake Superior (also bordering the states of Minnesota, Michigan, and the province of Ontario). Lake sturgeon are on an unofficial watch status in the state of Wisconsin.

3.2.2. Legislation

Wisconsin's endangered species statute recognizes endangered and threatened species (Wisconsin Statute 29.604). Public hearings are required during the listing process and petitions for listing from the public are considered. Listing is not applicable below the species level. Because of this limitation and the large populations of lake sturgeon that do exist within Wisconsin, the regions within Wisconsin jurisdiction where lake sturgeon are rare could not be listed if they were determined to indeed be distinct populations.

According to the rules established by the Wisconsin DNR, take of listed species is prohibited. Take is defined as "shooting, shooting at, pursuing, hunting, catching, or killing any wild animal ..." (Wisconsin Administrative Rule NR 27.01). The definition does not include lesser degrees of harm to the listed species, such as habitat modification. Permits for incidental take may be issued and, during application review, the effect of the proposed action upon

the species' habitat is considered (WI §29.604(6m)(f)(4)). Wisconsin does not permit citizen suits (George et al., 1997).

3.2.3. Implementation

Since lake sturgeon are not listed as endangered or threatened under Wisconsin law, they are not subject to restrictions on take stated in the statute. Wisconsin instead regulates the fishing of each population according to its status. Regulations vary throughout the state. In reference to the Menominee River bordering with the state of Michigan, there is an open season for approximately 2 months, with the allowance of one fish per season (Wisconsin DNR, 2003). However, Thuemler (1997) found that two of the three sections of the Menominee River population were still being overexploited. Closing the season every other year was recommended. In the waters shared with Minnesota, regulations correspond to Minnesota's regulations. In the waters of Lake Superior, the lake sturgeon fishery is open all year, permitting the catch of one fish per year. This regulation differs from other states' and Canada's regulations, who also share the waters of Lake Superior. In Minnesota and Michigan, fishing is not permitted in Lake Superior. In Ontario, lake sturgeon fishing is open all year with the permitted catch of one fish per day with a sportfishing license. The lake sturgeon fishery in Lake Michigan is closed, which corresponds to the regulations of neighboring states.

Sturgeon spearing is an important part of the sportfishing culture within the Great Lakes states. Each year, many people eagerly anticipate braving the cold to wheel their ice shanties onto the frozen lakes, prepared to make their hole in the ice in the hope of spearing a sturgeon. Lake Winnebago in Wisconsin hosts a large population of lake sturgeon and sturgeon spearing is permitted with a license during a 2-week period in the month of February (Bruch, 1999). Harvest maximums are set and licensees are permitted to take one lake sturgeon. Population sizes within the lake are monitored (Bruch, 1999) to ensure that this fishery is sustainable and does not result in detrimental impacts on the population.

In addition to regulating fishing, the state of Wisconsin has developed a lake sturgeon management plan (Scheidegger, 2000). The management plan contains research and management objectives and recommendations, including goals for population densities, priority locations for rehabilitation, and concrete recommendations for habitat enhancement. The state of Wisconsin is also conducting status assessments and monitoring several spawning populations along the rivers and shoreline of Lake Michigan and Lake Superior (GLLSCM, 2002). Reintroduction programs have been initiated on the Menominee River, Lake Winnebago, and the St. Louis River (in conjunction with the State of Minnesota). Active management is occurring on the Menominee River and Lake Winnebago. Fish passage devices are being tested on dams along the Menominee River (GLLSCM, 2002). Spawning habitat restoration has been conducted on the Lake Winnebago–Wolf River system (Bruch, 1999).

3.3. Illinois

3.3.1. Status

The state of Illinois borders the waters of Lake Michigan (Fig. 1), where populations of non-spawning lake sturgeon reside. However, none of the rivers flowing from Lake Michigan into the state of Illinois support spawning populations of lake sturgeon (GLLSCM, 2002). The waters of Lake Michigan are shared with the states of Michigan, Wisconsin, and Indiana. Lake sturgeon are listed as endangered in Illinois.

3.3.2. Legislation

The Illinois ESA (Illinois Statute 520.10) allows for the listing of endangered and threatened species. Taxonomic classifications below the species level are not considered for listing. Both listing and delisting are subject to public hearings.

Take of listed species is prohibited under the Illinois ESA and take includes any actions or attempts "to harm, hunt, shoot, pursue, lure, wound, kill, destroy, harass, gig, spear, ensnare, trap, capture, collect . . . " a listed animal. Further interpretation of the term harm is not supplied in either the statute or regulations; it is unclear whether habitat modification is implied in the term. The Illinois ESA does require the identification of essential habitat when a species is listed and consideration of habitat impacts when issuing an incidental take permit. According to George et al. (1997), the state of Illinois allowed citizen suits against any person or the state for any threat to the environment. However, in 1999, the Illinois Supreme Court (1999) held that the constitutional right to a "healthful environment" does not include protecting threatened or endangered species, effectively blocking citizen suits to enforce the state's endangered species law.

3.3.3. Implementation

Beyond fishing prohibitions, active management of lake sturgeon is not currently implemented by the state of Illinois. A recovery plan has not been developed for this listed species (Kruse, 2003, personal communication).

3.4. Indiana

3.4.1. Status

The state of Indiana shares the waters of Lake Michigan with the states of Michigan, Wisconsin, and Illinois (Fig. 1). The only spawning population in Indiana from Lake Michigan remains between dams on the St. Joseph River (GLLSCM, 2002), a system shared with the state of Michigan. The lake sturgeon is listed as an endangered species in the state of Indiana.

3.4.2. Legislation

The Indiana statute (IC 14-22-34) authorizes the listing of endangered species. Threatened species do not have a distinct listing and are instead incorporated within the

definition of endangered species. The statute recognizes the taxonomic classification of subspecies.

Taking, as well as incidental taking, is prohibited by the Indiana endangered species statute. Permits may be issued for taking of a species for scientific, educational, or zoological purposes. Take is defined by the statute as harassing, hunting, capturing, or killing, or attempting to do those actions. The definition of *take* does not include harm to the animal. Habitat is considered during the listing process. Indiana has a citizen suit statute that permits suits against any person for any threat to the environment (George et al., 1997).

3.4.3. Implementation

Beyond fishing prohibitions, the state of Indiana monitors lake sturgeon along the Lake Michigan shoreline incidentally to other monitoring activities (GLLSCM, 2002). A management plan has not been developed for the lake sturgeon in Indiana (Fisher, 2003, personal communication).

3.5. Michigan

3.5.1. Status

The state of Michigan is surrounded by four of the five Great Lakes (Fig. 1), all supporting non-spawning lake sturgeon populations: Superior, Michigan, Huron, and Erie. This results in interactions between Michigan's policies and the other seven states included in this analysis, as well as the Canadian province of Ontario. On rivers off of Lake Superior, Michigan has one spawning population (GLLSCM, 2002). There are several remnant spawning populations on the rivers stemming from Lake Michigan (GLLSCM, 2002), including the Menominee River which borders the state of Wisconsin, and the St. Joseph's River which is shared with the state of Indiana. In the rivers of Lake Huron (waters of which border with Ontario), several spawning populations exist in Michigan. Within the Lake Erie system, Michigan shares spawning populations with Ontario along the Detroit River, Lake St. Clair, and the St. Clair River (GLLSCM, 2002). The lake sturgeon is listed as a threatened species in the state of Michigan.

3.5.2. Legislation

Michigan's Natural Resources and Environmental Protection Act (Michigan Act 451, Part 365) defines "species" to include subspecies, as well as groups of species or subspecies that are in "common spatial arrangement that interbreed". This language permits the agency to list populations that may be considered endangered or threatened, despite the large numbers that may be present in other locations. Threatened species are not afforded the same protection as endangered species. Whereas take (which includes harm) of endangered species is prohibited except through a permit for scientific purposes, take of threatened species can be allowed if the agency believes a controlled harvest will not detrimentally affect the abundance of the species. Habitat consideration is not required in the protection process. Michigan had the first citizen suit statute in the U.S., permitting citizen suits against any person for any threat to the environment (George et al., 1997).

3.5.3. Implementation

Lake sturgeon fishing regulations permit a catch and release fishery throughout the state. In certain locations, fishers are permitted to retain fish caught (Michigan DNR, 2003). In Lake St. Clair and the St. Clair River (which border the Canadian province of Ontario), there is approximately a 2.5-month open season with the catch of one fish permitted per season and a very restricted permissible size range. On the Menominee River (which borders the state of Wisconsin), there is an approximate 2-month fishing season with a limit of one sturgeon per season. This regulation corresponds to the regulation set by Wisconsin. Lake sturgeon are stocked in Ostego Lake; therefore, there is no closed season, but there is a limit of one fish per season. As in Wisconsin, one lake (Black Lake) is designated for a 2-week period of sturgeon spearing, where a lottery system is implemented and there is a five fish quota for the season.

The state of Michigan has also developed a lake sturgeon rehabilitation strategy (Hay-Chmielewski and Whelan, 1997) that outlines research needs, evaluates present and potential habitat, establishes clear population goals, and presents specific management recommendations. The state is conducting status assessments and monitoring in many of its rivers within each lake basin, and has reintroduced sturgeon in the Ontonagon River (GLLSCM, 2002).

3.6. Ohio

3.6.1. Status

Little is known about the status of spawning populations in the state of Ohio; however, remnant populations may exist in the rivers off of Lake Erie (GLLSCM, 2002). The waters of Lake Erie are shared with the states of Michigan, Pennsylvania, New York, and the Canadian province of Ontario (Fig. 1). The state of Ohio has listed the lake sturgeon as an endangered species.

3.6.2. Legislation

The Ohio statute regarding the conservation of natural resources (Ohio Revised Code 1531) allows the chief of the division of wildlife to establish rules listing endangered species. The statute provides few guidelines and gives much authority to the Ohio DNR. Threatened species are not considered separately from endangered species. Classifications below species are not formally recognized in either the statute or rules (Administrative Code 1501:31-23-01).

In the development of the rules, the agency is given the freedom to determine the restrictions on taking. The corresponding rules prohibit the taking of endangered species. No definition of the term *take* is provided. Habitat considerations are not required. Ohio does not have a citizen suit statute (George et al., 1997).

3.6.3. Implementation

Because of their listing status and the prohibition on take, lake sturgeon fishing is not permitted in the waters of Ohio. Beyond the fishing restrictions, no active lake sturgeon management has been initiated in the state of Ohio.

3.7. Pennsylvania

3.7.1. Status

Though spawning populations were once found in some Pennsylvania rivers, lake sturgeon are now only in Lake Erie. The waters of Lake Erie are shared with the states of Michigan, Ohio, New York, and the province of Ontario (Fig. 1). The lake sturgeon is listed as an endangered species in the state of Pennsylvania.

3.7.2. Legislation

Under the Pennsylvania statute for fish restoration and management (30 Pennsylvania Consolidated Statutes §2305), the director of the Pennsylvania Fish and Boat Commission is to establish a list of threatened and endangered species. According to the statute, endangered species are species or subspecies of fish that are "threatened with extinction" and threatened species of fish have been determined to "be in such small numbers throughout their range that they may become endangered if their environment worsens . . . ".

The statute provides the Pennsylvania Fish and Boat Commission with the authority to establish regulations regarding the taking of listed species. The regulations developed by the Commission prohibit the taking of listed species without a permit issued by the Director (Title 58, Chapter 75). The justification of extraordinary circumstances is required for the issuance of a permit. No definition of *take* is provided within the regulations. Habitat considerations are not required. Pennsylvania does not have a citizen suit statute (George et al., 1997).

3.7.3. Implementation

Fishing of lake sturgeon within the Pennsylvania waters of Lake Erie is prohibited. No recovery plans or active management of lake sturgeon have been initiated by the state.

3.8. New York

3.8.1. Status

In the New York waters of Lake Erie, spawning populations of lake sturgeon exist in the Niagara River (shared with the Canadian province of Ontario) and the Eastern Basin (Fig. 1; GLLSCM, 2002). In the rivers off of Lake Ontario (waters shared with Ontario), New York supports two remnant spawning populations. Several populations spawn in the tributaries from the St. Lawrence River, which is shared with Ontario and the Canadian province of Quebec. Lake sturgeon are listed as threatened under the state's Environmental Conservation Law.

3.8.2. Legislation

The New York Environmental Conservation Law (New York Consolidated Law Service ECL §11-0535) defines criteria for listing endangered and threatened species. The regulations developed by the New York Department of Environmental Conservation (6 NYCRR Part 182) restrict the statutory definition of endangered and threatened species to native species that are in imminent danger. The regulations also define *species* as including subspecies and distinct population segments.

The statute prohibits the taking of either endangered or threatened species. There is no citizen suit statute (George et al., 1997). Habitat considerations are not required. However, habitat can play a role in the determination of take. According to the statute, taking includes "lesser acts such as disturbing . . . ". In State v. Sour Mt. Realty, Inc. (New York Supreme Court, 2000), it was ruled that taking includes habitat interference. The defendant had erected a fence that interfered with the normal migration route of Bald Hill den rattlesnakes, a species listed as threatened in New York. As a threatened species, lake sturgeon are therefore also protected from the effects of habitat interference under New York law. This could impact the consequences of destruction of habitat critical to successful spawning for lake sturgeon.

3.8.3. Implementation

The state of New York has developed a recovery program for lake sturgeon (Carlson et al., 2002), which has focused on increasing the sizes of current populations in state waters through harvest restrictions and habitat enhancement, and re-establishing stocks in several locations within the state. Active recovery efforts on border waters is minimal, and efforts have instead centered on stock assessments and monitoring. Stocking and monitoring of results has occurred in several water systems in New York (Carlson, 1995).

4. Tribal jurisdictions

Tribes within the United States are sovereign nations and, through treaties with the federal government, are permitted to develop their own constitutions and legislation. The treaties have extended tribal sovereignty to the waters on tribal lands and ceded territories, including the right to fish on these lands and waters. Tribes have become separate entities from the states and federal government, and can develop laws and policies different from surrounding jurisdictions. Because of the coordination necessary to manage interjurisdictional species, this section focuses on how that level of coordination may vary under federal and state listing.

Several tribes throughout the Great Lakes have sovereignty over and manage lake sturgeon waters, primarily in the states of Minnesota, Michigan, and Wisconsin. Restrictions

on harvest in these tribal areas vary and can often differ from the regulations of the corresponding state. State regulations regarding the conservation of endangered species can only usurp tribes' rights to hunting and fishing if five criteria are satisfied (District of Oregon, 1988). All the criteria must be met, and include: (1) the restriction being imposed is reasonable and necessary for the species' conservation, (2) conservation cannot be accomplished through the restriction of activities outside of the tribe, (3) the restriction is the least strict alternative that would accomplish the desired conservation, (4) the regulation does not discriminate against tribal activities, and (5) actions implemented voluntarily by the tribe are insufficient for the conservation of the species.

Coordination of management strategies and policies between states and tribes is voluntary, and the level of coordination varies from state to state. An example of successful coordination is between the state of Wisconsin, the Menominee Tribe, and the federal government. This coordination resulted in the re-establishment of lake sturgeon on reservation lands through stocking and translocation of nearby lake sturgeon (Runstrom et al., 2002). By bringing together the different parties, lake sturgeon were able to spawn again on reservation lands for the first time in 50 years.

For species federally listed under the Endangered Species Act, coordination between the tribes and the federal government is required and not voluntary. A secretarial order released in 1997 entitled "American Indian Tribal Rights, Federal–Tribal Trust Responsibilities, and the Endangered Species Act" requires consultations between the federal government and tribal governments regarding the management of tribal trust resources outside tribal territories. This order was designed to integrate the rights of tribes and the implementation of the ESA (Wilkinson, 1997). In addition, federal funding is made available to tribes for research and management through the Tribal Landowner Incentive Program and the Tribal Wildlife Grant Program, the latter of which has awarded over $ 250,000 US in 2004 to several Great Lakes tribes for lake sturgeon research and rehabilitation (USFWS, 2004). These programs can be used to assist tribes in managing listed species, candidate species, or species that are likely to become candidate species.

Tribes throughout the Great Lakes region have played a significant role in the management and rehabilitation of the lake sturgeon. Although clearly not an exhaustive list of tribal management activities, a few examples follow. The Little River Band of Ottawa Indians in Michigan has been actively fostering public awareness about sturgeon issues and has been conducting assessments of lake sturgeon populations within the Manistee River, Manistee Lake, and Lake Michigan (Holtgren, 2002). The Great Lakes Indian Fish and Wildlife Commission, a collaboration of 11 Ojibwe tribes, has been assisting in lake sturgeon assessments in the Lake Superior basin (Erickson, 2002). The Red Cliff Band and Bad River Band have been actively working on lake sturgeon supplementation programs in the Lake Superior Basin (Rasmussen, 2001).

5. Federal authority

Although the lake sturgeon is not a federally listed species, the USFWS has statutory authority to play a role in their management. The Great Lakes Fish and Wildlife Restoration Act of 1990 (16 USC §§941-941g) established goals for the USFWS in the restoration of the Great Lakes. These goals included the conduction of a comprehensive study assessing the status and management needs of fishes in the Great Lakes Basin, including the lake sturgeon. The USFWS was also required to assist states and tribes in cooperative efforts towards the conservation of species in the Great Lakes. The USFWS also receives statutory authority through the Great Lakes Fishery Act of 1956 (16 USC §§931-931c), which established procedures for coordination among state and federal agencies.

By exercising this statutory authority, the USFWS has nine service offices conducting lake sturgeon activities. These offices have been doing status assessments, researching, and monitoring lake sturgeon populations in several locations throughout each of the Great Lakes. The USFWS has been active in management of lake sturgeon along the Menominee River examining fish passage options. Habitat assessments have also occurred along the Genesee River in New York to determine feasibility of sturgeon reintroductions.

These legislative acts facilitate the coordination necessary for effective management of migratory species that could substitute for the uniformity that listing under the federal ESA would otherwise provide. Contrary to the ESA, which often focuses on conservation at the species level, these acts provide the opportunity to implement more regionally-based conservation measures. Through federal acts on a regional scale, lake sturgeon benefit as well as other fish species that may be in jeopardy. This can provide for more effective management as regional management plans are developed that encompass greater portions of the whole ecosystem than what may be reflected in a species recovery plan.

6. Canadian jurisdictions

When a migratory species receives state protection only, coordination with other countries, although critical for conservation of the species, is completely voluntary. However, if the federal government has an interest in the species, i.e. if the species is listed under the federal ESA, treaties can be established between the countries involved. These treaties can incorporate a precautionary approach, as several international policies currently embrace (Richards and Maguire, 1998), which would particularly benefit lake sturgeon as many biological characteristics remain uncertain. The Convention on Great Lakes Fisheries was ratified by the U.S. and Canada in 1954 to coordinate research and management. Despite this coordination, the two countries maintain their independence in the management of the shared species.

The Canadian province of Ontario shares the waters of the Great Lakes with the United States. The Ontario Ministry of Natural Resources is actively monitoring and researching lake sturgeon in many of the waters under its jurisdiction. The Canadian government recently enacted the Canadian Species at Risk Act (Bill C-5, 2002), offering national protection for listed species. According to the Committee on the Status of Endangered Wildlife in Canada, lake sturgeon are not considered to be a species at risk; however, within the individual provinces, the status varies. In the province of Ontario, lake sturgeon are considered to be a sensitive species (Canadian Endangered Species Conservation Council, 2001). Despite this status, both recreational and commercial fishing of lake sturgeon occurs within Ontario's waters. Among recreational fishers, fishing is regulated through a dual licensing system, where either a sportfishing license or a conservation license may be purchased (Ontario Ministry of Natural Resources, 2003). Upon purchase of a sportfishing license, one lake sturgeon per day may be removed from the waters of Ontario. The conservation license allows for a catch-and-release fishery of lake sturgeon. In 2001, approximately 47% of the licenses sold were conservation licenses (Mohr, 2003, personal communication). The effects of hooking mortality and stress upon the conservation of the lake sturgeon is uncertain, although data from similar fish species indicate the impact may be low (Scarnecchia et al., 1997). Due to the long distances lake sturgeon are capable of migrating, the more lenient fishing regulations in Ontario may have a detrimental impact upon the protected spawning populations in the states within the U.S. that also share the lakes' resources. In addition to recreational fishing, Ontario also supports lake sturgeon commercial fisheries, albeit small and seemingly stable. Elevated interest in participation among aboriginal people in Ontario in the commercial fisheries may increase their size (Mohr, 2003, personal communication). The commercial fishery constitutes an added public component to the management of lake sturgeon.

7. Coordination of lake sturgeon management

The migratory nature of lake sturgeon and the many jurisdictions involved in managing the species necessitate a high level of coordination between the different agencies involved. As the lake sturgeon may be a different priority for each of the jurisdictions, establishing cooperative management can be challenging. To facilitate coordination in the management of fisheries, including lake sturgeon, within the Great Lakes, the Great Lakes Fishery Commission (GLFC) was established. In 1954, the governments of Canada and the United States ratified the Convention on Great Lakes Fisheries, thereby creating the GLFC to encourage collaboration between the two countries.

The role of the GLFC includes both the coordination of research between the different states, tribes, and Canada, and the coordination of recommended management strategies based on the research findings. Several committees are formed to address the various needs within the Great Lakes, including a committee for each lake. Within the Lake Superior Committee, a Lake Sturgeon Subcommittee has been formed with the goals of describing the current status of the lake sturgeon and developing a rehabilitation plan for the lake sturgeon, which has been recently completed (Auer, 2003). Within the Lake Michigan Committee, a Lake Sturgeon Task Group has recently been formed to develop and recommend a lakewide rehabilitation plan for lake sturgeon in Lake Michigan. These various committees bring managers and biologists from the different jurisdictions and universities together to discuss appropriate management strategies for the lake as a whole, taking an ecosystem approach to management. A law enforcement committee also exists, which addresses the issues of coordinated enforcement and education about varying legislation among jurisdictions. The GLFC has been successful in facilitating coordination among the different agencies. This success may be partly due to its relative neutrality, as the Commission was formed outside from any existing agencies and does not represent one agency's interests over another.

In addition to the GLFC, several other management teams have been formed to foster a collaborative spirit. The Central Great Lakes Bi-National Lake Sturgeon Group focuses its management efforts on Lakes Huron and Erie, bringing together federal, state, provincial, and academic scientists. The Great Lakes Fishery Trust was created in 1996 in response to a court settlement for fish losses at a hydroelectric facility. The trust is administered by a board of state, federal, and tribal representatives, and provides for funding of various research, restoration, and education projects. The trust has also funded workshops for the coordination of lake sturgeon research activities. An additional example of successful interagency coordination is the previously mentioned collaborative restoration project between a state, tribe, and the federal government on the Wolf River (Runstrom et al., 2002).

8. Lessons from species protection by states

8.1. Consistency among states

An important consequence of state protection of species that is particularly relevant to migratory species is inconsistency among states regarding the species' listing status. In the case of the lake sturgeon, spawning and non-spawning habitats are different, and lake sturgeon may be utilizing the waters of different jurisdictions throughout their lives. Because the listing status of the lake sturgeon varies among the states, the protection afforded them also varies, which impacts the protection of the species as a whole. Although the listing status of the lake sturgeon may be the same between certain states, the statutory requirements for protection of

listed species may vary. These differences among states are particularly apparent in the boundary waters.

Taking of lake sturgeon is prohibited throughout most of the state of Michigan, with the exception of several boundary waters and two inland lakes. In the neighboring state of Wisconsin, fishing of lake sturgeon is permitted throughout many of the state's waters. The fishing regulations in the waters bordering the two states are consistent between the states. Reasons for the consistency may be two-fold. Biologically, the populations in these boundary waters may be sufficient to sustain a recreational fishery. Consistent fishing regulations between the states facilitate more efficient enforcement of the regulations. However, the corresponding fishing regulations lead to the question concerning what dictates listing decisions and management strategies. With species protection in the hands of the state, the risk of the "race to the bottom" (Engel, 1997) exists. Generally, this occurs as a consequence of competition among states for financial resources, resulting in state policies reflecting the lowest common denominator. Although large financial resources are not at stake with the management of lake sturgeon recreational fisheries, the bottom may still be reached as politics may call for the lowest common denominator.

Along the waters bordering Ontario and Minnesota, a similar situation exists. Minnesota is currently re-evaluating its fishing regulations in those boundary waters, as current fishing levels are exceeding the maximum sustainable harvest. The biological necessity of change in fishing regulations in these boundary waters is apparent, but the management outcome is less clear.

Discrepancies in state listing status and regulations were one of the reasons for the listing of the pallid sturgeon, *Scaphirhynchus albus*. The species was not listed in the states of Arkansas or Mississippi. Harvest was permitted in the state of Kentucky, while weight provisions were set in the state of Montana. Harvest of pallid sturgeon was banned in the remaining states. Although current overexploitation was not the primary cause for the pallid sturgeon's decline, the USFWS felt that any harvest would further deplete a population that is not replenishing itself (55 FR 36641).

8.2. Limits in recognized taxa

One of the limitations in state protection is the taxa that are recognized by state legislation or regulations. Many of the states do not recognize taxa below the species level. Without recognition of lower taxa, such as subspecies or populations, an organism may be less likely to receive the state protection needed by declining populations.

The fine-scale delineation of the population structure of lake sturgeon still remains uncertain. Evidence on a larger scale, however, suggests that genetically distinct populations exist between various spawning locations throughout the Great Lakes Basin (DeHaan, 2003; McQuown et al., 2003; Welsh and May, 2003). Research priorities for lake sturgeon include analysis of the population genetic structure of lake sturgeon, migration patterns of the lake sturgeon, and population status (Zollweg et al., 2002). If distinct populations do exist, many of the states do not have the legislation or regulations to identify a population as endangered or threatened. The federal ESA, however, authorizes the listing of distinct population segments of vertebrates.

The USFWS and the National Marine Fisheries Service, both of which administer the ESA, have together further defined a distinct population segment (DPS; 61 FR 4722). The policy identifies three criteria required for DPS determination, and listing and delisting. These include: (1) the discreteness of the population segment, (2) the significance of the population segment, and (3) the conservation status of the population segment. *Discreteness* is further defined as meeting one of two conditions: (1) the population segment is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors", or (2) the population is delimited by international boundaries where the governments differ in management of the species, resulting in significant differences in listing status. The first criterion can be met by demonstrating genetic or morphological distinctions, and evidence suggests that many spawning populations of lake sturgeon may be genetically discrete from other such populations (DeHaan, 2003; McQuown et al., 2003; Welsh and May, 2003).

The significance of the population segment needs to be considered in the identification of a DPS to conform to Congress' requirement that listing of DPSs be used sparingly (U.S. Senate, 1979). Consideration of the significance of the population segment includes, but is not limited to, several factors listed in the policy, such as the presence of distinct genetic characteristics or a resultant gap in the taxon's range resulting from the population segment's loss. Finally, the conservation status of the population segment is determined on the definitions of *endangered* and *threatened* provided by the ESA. This policy's focus on genetic distinctiveness and significance of the populations has been criticized for being too narrow and not encompassing the intentions of Congress in the protection of DPSs (Pennock and Dimmick, 1997). However, as the term *population* is often used broadly in the ecological sense, it is necessary to narrowly define the term to conform to Congress' intention of sparing usage.

If states were to recognize populations for protection under their respective endangered species laws, they would not be required to adopt the more restrictive federal definition of DPSs. With a more lenient definition of population unrestricted by the intent of Congress, the states could offer protection to declining populations of lake sturgeon that may not be sufficiently "discrete" or "significant" to warrant federal protection. This early protection of declining populations could result in more effective conservation for the species as a whole.

8.3. Definition of take

In two of the eight states examined, take was prohibited but not defined in either the statute or the ensuing regulations. Of the remaining states that include definitions of the term *take* or avoid use of the term altogether, three do not include lesser degrees of take, such as harm to the species. Two of the states that prohibit harm to the listed species do not further define what constitutes harm. The last remaining state does formally prohibit lesser degrees of take, including habitat interference. This pattern is reflective of the definition of take throughout the remaining states within the U.S. (Goble et al., 1999). Many states do not formally recognize significant habitat modification or degradation as a form of take. The ESA, however, recognizes this as a form of take when it results in harm to wildlife by significantly impairing essential behavioral patterns (50 CFR 17.13). As habitat loss is often the primary cause of a species' demise, this shortcoming in state legislations can be detrimental to the protection of endangered species.

The population declines of the lake sturgeon have been caused by overfishing, dams, habitat loss, and pollution. The protection offered by many state environmental statutes can only prevent take in the more traditional sense. Many species with conservation needs are, or have been in the recent past, game species. Exploitation of the species may result in large declines in the species' numbers. However, states already possess the authority to regulate fishing and hunting, whether or not the species is endangered or threatened. Therefore, it begs the question: What added protections do state environmental statutes contribute when the definition of take is restricted and excludes lesser degrees of take?

With regards to overfishing, state environmental statutes can obligate states to restrict take of listed species; without listing, the states would have the ability to do so but would not be required. Fishing would therefore be permitted only if the species were delisted. Within the states examined, fishing of lake sturgeon is only permitted in states where it is not listed as endangered or threatened, with the exception of Michigan (which permits take of threatened species). Listing can also provide a greater deterrent to poaching as the fines for violation would increase.

The more comprehensive definitions of take can protect lake sturgeon from the impacts of dam operation. The water flows and temperature of water released from dams can result in increased egg and larval mortality (Auer, 1999b), resulting in a take of lake sturgeon. The inability to regulate this form of take can result in federal listing, as observed in the Kootenai River population of the white sturgeon, *Acipenser transmontanus*.

White sturgeon is a North American sturgeon along the Pacific coast. The Kootenai River population of white sturgeon was listed as endangered under the federal ESA in 1994 (59 FR 45989). The Kootenai River system originates in the province of British Columbia in Canada, flows south into the U.S. state of Montana, and then flows northwest into the state of Idaho (Duke et al., 1999). The primary reason for its decline is the modification of the natural river system by human activities.

Prior to listing, the USFWS joined efforts with the state, tribal, Canadian, and other federal agencies to form the Kootenai River White Sturgeon Technical Committee (59 FR 45989). The goal of the committee was to research the environmental factors impacting sturgeon recovery and to develop a recovery plan as a basis for a conservation agreement under Section 6 of the ESA. Despite the level of coordination between the various agencies, the Kootenai River white sturgeon population was listed under the ESA in 1994.

The primary reason for the necessity of federal listing was the need to regulate dam operations (59 FR 45989). Neither the states nor the tribe had the authority to regulate the habitat needed by the white sturgeon. During the 1992 coordinated effort of devising a recovery plan, an interim flow proposal from Libby Dam was adopted. However, the operating agency only committed to providing experimental flows in some years, with several qualifying conditions. Demands outside the needs of the sturgeon population continued to be of higher priority in the dam operations.

When the proposal for listing of the population was opened to public comment, the Kootenai tribe, as well as the state agencies, submitted recovery plans to be implemented in lieu of federal listing. The USFWS determined that the submitted plans would not be sufficient to securing a self-sustaining population of white sturgeon in the wild (59 FR 45989). The plans would not be binding on the operation of the dam and the longevity of the plans could not be guaranteed. Therefore, the USFWS determined that existing regulatory mechanisms were inadequate to ensure the recovery of the Kootenai River white sturgeon population.

Narrow definitions of take in state legislation provide little help with habitat loss and destruction issues. Modification of spawning habitat and dredging are problems affecting the recovery of the lake sturgeon. Lake sturgeon utilize spawning habitat once a year and the modification of habitat may not occur during spawning; therefore, take in the traditional sense has not occurred. Under the federal ESA, critical habitat is supposed to be designated at the time of listing, and adverse modification of this designated habitat is prohibited. For many listed species, this designation has not occurred as the USFWS claims that habitat critical to the species' survival and recovery is protected by Section 7 of the ESA, ensuring that federal actions do not jeopardize the existence of the species (Patlis, 2001). For actions of individuals, habitat is incorporated into the USFWS' definition of harm (50 CFR 17.13). Despite the controversy surrounding critical habitat designations, habitat required by listed species is protected by the federal ESA, while state statutes do not often formally grant this protection.

Citizen suits have often stimulated the detailed definitions supplied through the USFWS' regulations. Many of the state's definitions have remained vague because they have

not been challenged in the courtroom, resulting in little case law clarifying the boundaries of terms such as *take* and *harm*.

8.4. Citizen suits

Of the eight Great Lakes states examined, three have provisions for citizen suits. This pattern does not accurately reflect the presence of citizen suit provisions in the rest of the United States; only 11 other states in the U.S. permit citizen suits regarding environmental actions (George et al., 1997). Citizen suits provide additional oversight to the environmental laws and regulations established by the states. They challenge the limits of the definitions set out in the statutes and delineate the species protection supplied by the state. The detailed definitions regarding the federal ESA have often indirectly resulted from, or have been challenged through, citizen suits (e.g. U.S. Supreme Court, 1995) permitted through Section 11 of the ESA. As many state agencies have limited resources, citizen suits ensure that tasks mandated by the statute are completed. Again, in the federal arena, the lack of critical habitat designations has been challenged through citizen suits (e.g. Fifth Circuit, 2001). By permitting citizen suits against any person, these suits also aid in the enforcement of the established laws and regulations.

8.5. Ecosystem possibilities

The apparent limitations of state endangered species legislation could also have a positive result by permitting more of an ecosystem-wide approach to species conservation. The federal ESA focuses on individual species, whereas it may be more efficient and beneficial to direct conservation efforts on a larger scale. The ESA states that the ecosystems upon which species depend also need to be conserved. In practice, however, the framework of the ESA is created to accommodate individual organisms. Ecosystems are not listed as endangered or threatened. Critical habitat and recovery plans are defined in terms of a listed species. Population numbers as opposed to ecosystem health are used to determine conservation status. Within this framework, the USFWS has tried to incorporate an ecosystem approach through the creation of Habitat Conservation Plans (HCPs). HCPs are designed in response to the incidental take of a listed species (Section 10a of the ESA) and their benefits to the listed species can be controversial. This ecosystem approach is not implemented until permitted take of the listed species occurs. The services have also established policy to develop recovery plans on an ecosystem basis, when relevant. Compromises may be needed in this approach to accommodate the varying needs of different listed species (Clark and Harvey, 2002), and the legal framework of the ESA may not sufficiently facilitate these necessary compromises.

Many of the problems lake sturgeon face are the same problems affecting the general health of the Great Lakes ecosystem. Since the state endangered species laws are generally less restrictive than the federal ESA, there may be greater flexibility for the management of the ecosystem as a whole. Greater flexibility in state endangered species statutes could provide the impetus for more creative solutions in the conservation of endangered species. State protection of endangered species can be viewed as a proactive approach to species conservation. By permitting increased flexibility in management at this stage, the ecosystem as a whole can be improved and an adaptive management approach can be implemented to explore different management strategies. If successful, federal listing may not be necessary and the ecosystem as a whole could benefit. If unsuccessful, the reactive approach of the federal ESA could provide the necessary ambulatory care for the species within its more restrictive framework.

9. Conclusion

The lake sturgeon in the Great Lakes region is a model organism for examining the protection offered by state endangered species legislation and regulations. This fish species is capable of long-distance migrations and is the management responsibility of several different state, federal, tribal, and international jurisdictions. Lake sturgeon do not receive federal protection under the ESA and instead depend upon the protection offered by the individual jurisdictions. In a political climate where greater emphasis is being placed on state species protection, lake sturgeon provide a case study to closely examine existing state legislation.

Despite the shortcomings in many of the states' endangered species legislation, management of lake sturgeon seems to be effective and has thus far prevented listing under the federal ESA. Voluntary coordination efforts between the various jurisdictions abound, resulting in integrated management strategies. Many of the individual states have exceeded the minimum requirements of their state legislation and have taken active management roles. Individual and coordinated tribal efforts have contributed substantially to data acquisition and management implementation.

Many states would rather manage their own natural resources; therefore, state protection can engender a more hospitable management atmosphere. Federal involvement can be viewed as an interference by some states and cooperation with the state can then be hindered. The possibility of federal listing could therefore provide an impetus for the state to better manage the species and for state endangered species legislation to further evolve. Jurisdictions then have the freedom (and the challenge) to develop creative approaches to management, such as the creation of the GLFC in response to Great Lakes fisheries issues. Protection by the states may best be viewed as the first stage of species protection, allowing federal resources (both financial and human) to be allocated elsewhere. If states are unable to demonstrate active management in the furtherance of the species' recovery, federal listing under the ESA would then be required.

Examination of the scale of policy required for effective management of species that cross jurisdictional boundaries is a critical element for species survival and recovery, and extends well beyond the case of the lake sturgeon. Currently in the United States, the gray wolf (*Canis lupus*) is being considered for delisting (68 FR 15876) and states will be responsible for this species' management. Because the gray wolf is unaware of our political boundaries, differential management of the wolf could result and the possible impediments to recovery analyzed here should be considered. Beyond North America, many countries struggle with regional versus federal control of natural resources, and coordination with other countries is often critical to successful species management. Lake sturgeon management can provide a model for successful interjurisdictional coordination that can potentially benefit migratory species management elsewhere in the world.

Acknowledgements

My sincerest thanks go to Holly Doremus for the valuable insights, discussion, and support she provided for this paper. I would like to acknowledge Bernie May for his support and Charles Wooley, Lloyd Mohr, Chris Goddard, Gary Whelan, Robert Lumadue, Doug Carlson, and Tracy Hill for their contributions. The author received funding support from the Great Lakes Fishery Trust, the University of California – Davis block grant fellowship, and the Hart, Cole, Goss Summer Research Fellowship while researching and writing this manuscript.

References

Auer, N.A., 1996. Response of spawning lake sturgeon to change in hydroelectric facility operation. Trans. Am. Fisheries Soc. 125, 66–77.

Auer, N.A., 1999a. Population characteristics and movements of lake sturgeon in the Sturgeon River and Lake Superior. J. Great Lakes Res. 25, 282–293.

Auer, N.A., 1999b. Lake sturgeon: a unique and imperiled species in the Great Lakes, in: Taylor W.W., Ferreri C.P. (Eds.), Great Lakes Fisheries Policy and Management: a Binational Perspective. Michigan State University Press, Michigan, pp. 515–536.

Auer, N.A. (Ed.), 2003. A Lake Sturgeon Rehabilitation Plan for Lake Superior. Great Lakes Fishery Commission, Miscellaneous Publication 2003-02.

Birstein, V.J., Bemis, W.E., Waldman, J.R., 1997. The threatened status of acipenseriform species: a summary. Environ. Biol. Fishes 48, 427–435.

Borkholder, B.D., Morse, S.D., Weaver, H.T., Hugill, R.A., Linder, A.T., Schwarzkopf, L.M., Perrault, T.E., Zacher, M.J., Frank, J.A., 2002. Evidence of a year-round resident population of lake sturgeon in the Kettle River, Minnesota, based on radiotelemetry and tagging. North Am. J. Fisheries Manag. 22, 888–894.

Brousseau, C.S., Goodchild, G.A., 1989. Fisheries and yields in the Moose River Basin, Ontario, Proceedings of the International Large River Symposium. Canadian Special Publication of Fisheries and Aquatic Sciences, vol. 106, pp. 145–158.

Bruch, R.M., 1999. Management of lake sturgeon on the Winnebago System – long term impacts of harvest and regulations on population structure. J. Appl. Ichthyol. 15, 142–152.

Canadian Endangered Species Conservation Council, 2001. Wild Species 2000: The General Status of Species in Canada. Minister of Public Works and Government Services, Ottawa, Canada.

Carlson, D.M., 1995. Lake sturgeon waters and fisheries in New York State. J. Great Lakes Res. 21, 35–41.

Carlson, D.M., Colesante, R., Hayes, J.S., Schlueter, S.L., 2002. Lake Sturgeon (*Acipenser fulvescens*) and its Recovery Programs in New York State. New York State Department of Environmental Conservation, New York.

Clark, J.A., Harvey, E., 2002. Assessing multi-species recovery plans under the Endangered Species Act. Ecol. Appl. 12, 655–662.

DeHaan, P.W., 2003. Demographic and Life History Characteristics of Remnant Lake Sturgeon Populations in the Upper Great Lakes Basin: Inferences Based on Genetic Analyses. Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI.

District of Oregon, 1988. United States v. Oregon. F. Supp. 699, 1456, 1458.

Duke, S., Anders, P., Ennis, G., Hallock, R., Hammond, J., Ireland, S., Laufle, J., Lauzier, R., Lockhard, L., Marotz, B., Paragamian, V.L., Westerhof, R., 1999. Recovery plan for Kootenai River white sturgeon (*Acipenser transmontanus*). J. Appl. Ichthyol. 15, 157–163.

Engel, K.H., 1997. State environmental standard-setting: is there a race and is it to the bottom? Hastings Law J. 48, 281–348.

Erickson, S. (Ed.), 2002. Seasons of the Ojibwe. Great Lakes Indian Fish and Wildlife Commission, Odanah, WI.

Fifth Circuit, 2001. Sierra Club v. U.S. Fish and Wildlife Service. 245 F.3d 434.

Fortin, R., Mongeau, J.-R., Desjardinis, G., Dumont, P., 1993. Movement and biological statistics of lake sturgeon (*Acipenser fulvescens*) populations from the St. Lawrence and Ottawa River system, Quebec. Can. J. Zool. 71, 638–650.

George, S., Snape III, W., Senatore, M., 1998. State Endangered Species Acts: Past, Present, and Future. Available at http://www.defenders.org/publications/sections/lawpolicy.html.

George, S., Snape III, W.J., Rodriguez, R., 1997. The public in action: using state citizen suit statutes to protect biodiversity. Univ. Baltimore J. Environ. Law 6, 1–38.

Goble, D.D., George, S.M., Mazaika, K., Scott, J.M., Karl, J., 1999. Local and national protection of endangered species: an assessment. Environ. Sci. Policy 2, 43–59.

Great Lakes Lake Sturgeon Coordination Meeting (GLLSCM), 2002. Basin overview presentations of status and assessment activities. Presentations by N. Auer, H. Quinlan, M. Holtgren, R. Elliott, M. Thomas, E. Zollweg, A. Mathers, D. Carlson, Sault Ste, Marie, MI.

Harkness, W.J.K., Dymond, J.R., 1961. The Lake Sturgeon: the History of its Fishery and Problems of Conservation. Toronto, Fish and Wildlife Branch, Ontario Department of Lands and Forests.

Hay-Chmielewski, E.M., Whelan, G.E., 1997. Lake Sturgeon Rehabilitation Strategy. Available at http://www.michigandnr.com/PUBLICATIONS/PDFS/ifr/ifrlibra/special/reports/18sr.pdf.

Holtgren, J.M., 2002. Lake sturgeon research, management, and education activities of the Little River Band of Ottawa Indians. Presented at the Great Lakes Lake Sturgeon Coordination Meeting, Sault Ste., Marie, MI.

Illinois Supreme Court, 1999. Glisson v. Marion. 188 Ill.2d 211, 720 NE2d 1034.

International Joint Commission, 1989. Great Lakes Water Quality Agreement of 1978, revised 1989. Available at http://www.ijc.org/agree/quality.html.

Knights, B.C., Vallazza, J.M., Zigler, S.J., Dewey, M.R., 2002. Habitat and movement of lake sturgeon in the upper Mississippi River system, USA. Trans. Am. Fisheries Soc. 131, 507–522.

List, J.A., Bulte, E.H., Shogren, J.F., 2002. "Beggar thy neighbor": testing for free riding in state-level endangered species expenditures. Public Choice 111, 303–315.

McQuown, E.C., Krueger, C.C., Kincaid, H.L., Gall, G.A.E., May, B.P., 2003. Genetic comparison of lake sturgeon populations: differentiation based on allelic frequencies at seven microsatellite loci. J. Great Lakes Res. 29, 3–13.

Michigan DNR, 2003. 2003 Fishing Guide. Available at http://www.michigan.gov/documents/sturgeon_60960_7.pdf.

Michigan DNR, 2003. New Sturgeon Regulations Proposed for Northern Border Waters. Available at http://www.dnr.state.mn.us/news/releases/index.html?id=1057692001.

Mimesota DNR, 2003. New sturgeon regulations proposed for northern border waters. Available at: http://www.dnr.state.mn.us/news/releases/index.html?id=1057692001.

New York Supreme Court, 2000. State v Sour Mt. Realty, Inc. 276 AD2d 8, 714 NYS2d 78, 31 ELR 20167.

Noakes, D.L.G., Beamish, F.W.H., Rossiter, A., 1999. Conservation implications of behaviour and growth of the lake sturgeon, *Acipenser fulvescens*, in northern Ontario. Environ. Biol. Fishes 55, 135–144.

Ontario Ministry of Natural Resources, 2003. 2003 Recreational Fishing Regulations Summary. Available at http://www.mnr.gov.on.ca/MNR/pubs/fishing/fishRegs/2003/AllfishReg2003.pdf.

Patlis, J.M., 2001. Paying tribute to Joseph Heller with the Endangered Species Act: when critical habitat isn't. Stanford Environ. Law J. 20, 133–238.

Pennock, D.S., Dimmick, W.W., 1997. Critique of the evolutionarily significant unit as a definition for "distinct population segments" under the U.S. Endangered Species Act. Conserv. Biol. 11, 611–619.

Rasmussen, C.O., 2001. Lake Superior sturgeon population gets boost from Red Cliff Hatchery, in: Mazina'igan: a Chronicle of the Lake Superior Ojibwe, Fall 2001.

Richards, L.J., Maguire, J.-J., 1998. Recent international agreements and the precautionary approach: new directions for fisheries management science. Can. J. Fisheries Aquat. Sci. 55, 1545–1552.

Runstrom, A., Bruch, R.M., Reiter, D., Cox, D., 2002. Lake sturgeon (*Acipenser fulvescens*) on the Menominee Indian reservation: an effort toward co-management and population restoration. J. Appl. Ichthyol. 18, 481–485.

Rusak, J.A., Mosindy, T., 1997. Seasonal movements of lake sturgeon in Lake of the Woods and the Rainy River, Ontario. Can. J. Zool. 74, 383–395.

Scarnecchia, D.L., Ryckman, L.F., Lee, J., 1997. Implementation and evaluation of a catch-and-release fishery for paddlefish. North Am. J. Fisheries Manag. 17, 795–799.

Scheidegger, K., 2000. The Wisconsin Lake Sturgeon Management Plan. Available at http://www.dnr.state.wi.us/org/water/fhp/fish/sturgeon.

Thomas, M.V., Haas, R.C., 2002. Abundance, age structure, and spatial distribution of lake sturgeon, *Acipenser fulvescens*. J. Appl. Ichthyol. 18, 495–501.

Thuemler, T.F., 1997. The lake sturgeon, *Acipenser fulvescens*, in the Menominee River, Wisconsin–Michigan. Environ. Biol. Fishes 14, 73–78.

U.S., 1973. United States Endangered Species Act. 93-205, 87 Statutes at Large 884.

USFWS, 2004. Secretary Norton announces $ 14 million in grants to tribes to help fund fish and wildlife conservation projects. News release on 1/27/04.

U.S. Senate, 1979. Report 151, 96th Congress, 1st session.

U.S. Supreme Court, 1995. Babbitt v. Sweet Home Chapter of Communities for a Great Oregon. 515 U.S. 687.

Welsh, A.B., May, B.P., 2003. Population genetic structure of lake sturgeon in the Great Lakes basin. Unpublished data.

Wilkinson, C., 1997. Indian law into the twenty-first century: the role of bilateralism in fulfilling the federal-tribal relationship: the tribal rights-endangered species secretarial order. Washington Law Rev. 72, 1063–1109.

Wisconsin DNR, 2003. Guide to Hook and Line Fishing Regulations (2003–2004). Available at http://www.dnr.state.wi.us/org/water/fhp/fish/regspdf/hook03/hook03.pdf.

Zollweg, E.C., Elliott, R.F., Hill, T.D., Quinlan, H.R., Trometer, E., Weisser, J.W., 2002. Great Lakes Lake Sturgeon Coordination Meeting: Proceedings of the December 11–12, 2002 Workshop. Sault Ste., Marie, Michigan. Great Lakes Lake Sturgeon Coordination Meeting, Sault Ste., Marie, MI (Sponsored by the Great Lakes Fishery Trust).

Amy Welsh is a PhD candidate in the Graduate Group in Ecology at the University of California – Davis. Her dissertation research involves the study of lake sturgeon population structure throughout the Great Lakes Basin. This research involves examining the conservation of lake sturgeon at various scales, starting at the foundation by developing genetic markers. These genetic markers permit the understanding of population structure on a landscape scale and aid in the establishment of management guidelines on an ecosystem scale. This manuscript considers conservation on a larger interjurisdictional scale and represents the author's interest in the integration of science and policy.