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ROLE OF SOCIAL NETWORK STRUCTURE IN THE GOVERNANCE OF GREAT LAKES TRANSBOUNDARY FISH STOCKS

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ROLE OF SOCIAL NETWORK STRUCTURE IN THE GOVERNANCE OF GREAT LAKES TRANSBOUNDARY FISH STOCKS

By

Nancy Jacynthe Leonard

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ABSTRACT

ROLE OF SOCIAL NETWORK STRUCTURE IN THE GOVERNANCE OF GREAT LAKES TRANSBOUNDARY FISH STOCKS

By

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Governance of fish stocks that cross-political boundaries (transboundary) generally involves individuals representing different institutions and jurisdictions, and varying socio-cultural and expertise backgrounds. At times, these individuals are required to collaboratively make decisions in the absence of social ties, which inhibits the effectiveness and efficiency of group decision-making. The importance of social ties among participants involved in the governance of transboundary fish stocks is recognized as being important, however, there is limited research on the importance of social ties in the governance of transboundary fish stocks. In this dissertation, I discuss how recognition of the ineffectiveness of governing transboundary fish stocks through uncoordinated actions of individual jurisdictions has resulted in the adoption of collaborative governance institutions for transboundary fish stocks. I present a case study on lake sturgeon in the Great Lakes that illustrates how the lack of a coordinated and collaborative governance approach results in conflicting management actions being implemented, which can hinder the sustainability of these lake sturgeon. Next, I evaluate the perceptions of individuals involved in the implementation of the Joint Strategic Plan

on governance of transboundary fish stocks in the Great Lakes, as well as the role of their social ties and social network structure in enhancing fishery management decision-making in the Great Lakes. Overall, participants of the Joint Strategic Plan are supportive of coordinated governance of transboundary fish stocks in the Great Lakes, and believe it is essential to assure sustainability of transboundary fish stocks. The two different social network structures detected by depicting the flow of Great Lakes fish stocks information and the flow of lake sturgeon information, revealed that both networks have an even flow of information throughout the network. This means that the information is not restricted to any given individuals or pairs of individuals. In summary, governance institutions for transboundary fish stocks should emphasize the need to nurture social ties among participants. Social ties and related social structures contribute to governance institutions by facilitating the flow of information or other resources, and thereby influencing the effectiveness of the institution in sustaining transboundary fish stocks.

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I leave you with a strange quote I came across in the book *A Dry White Season* by Andre Brink that resonated with me while I was struggling to accomplish everything I wanted to complete for my dissertation while meeting a looming deadline:

There are only two kinds of madness one should guard against, ...

One is the belief that we can do everything.

The other is the belief that we can do nothing.

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CHAPTER ONE

Prologue - Collaborative Governance of Transboundary Fish Stocks in the Great Lakes

Agencies with authority for the management of fish stocks that migrate across jurisdictional boundaries (transboundary fish stocks) have recently begun to collaborate to ensure enhanced management of these stocks. The impetus for this collaboration has generally been related to two main factors (1) the decline or collapse of fish stocks valued by society, and (2) the realization that this downward trend in fish abundance cannot be resolved by one jurisdiction's independent actions. The decline or collapse of transboundary fish stocks is a concern shared worldwide, as evidenced globally by the dismal state of the numerous marine fisheries that are harvested by multiple nations. Today, 35% of the world's fisheries are classified as being overexploited and 25% as being fully exploited (Myers and Worms 2003, FAO-Fisheries 2007). Inland fisheries are not exempted from this fate, as many populations throughout the world are in serious states of decline (FAO-Fisheries 2007). Recognition of the complexity of the challenges faced by agencies with management authority over declining or collapsed transboundary fish stocks has made it evident that a collaborative approach is needed to ensure sustainable fish stocks. This collaboration allows for overcoming the limitations of individual institutions, such as lack of funds, specialized skills (Van de Ven and Ferry 1980, Wimpfhemier et al. 1991), or more simply, lack of governance authority over all pertinent components influencing the status of the fish stock, such as habitat quality and harvest regulations in all fishing jurisdictions.

The increase in the number of governance[1] institutions established during the last half of the 20th century for transboundary fish stocks, such as the Inter-American Tropical Tuna Commission, International Pacific Halibut Commission, Pacific Salmon Commission, Northwest Atlantic Fisheries Organization, and Atlantic States Marine Fishery Commission, are well-noted outcomes of collaboration among fishery management agencies to address the challenges of managing transboundary fish stocks (Cole 2003, Kooiman et al. 2005, Schechter and Leonard 2008). These governance institutions for transboundary fish stocks, however, have varied greatly in their effectiveness and success in governing transboundary fish stocks in sustainable manners (FAO 2001, Schechter and Leonard 2008). This variability is due to numerous factors, one of which is whether the processes used to make decisions and have them implemented are effective and efficient (Schechter and Leonard 2008). Two examples of this factor are The United Nations Food and Agriculture Organization's Code of Conduct for Responsible Fisheries (Code), and the World Bank's fisheries sector. The Code is recognized as being the global framework for fisheries, however, its effectiveness is variable because it is implemented on a voluntary basis and is not enforceable (FAO 2004, IMM 2007). The World Bank is in the opposite situation because it could leverage its other sectors and financial resources to implement beneficial changes to fish stock sustainability, e.g., reducing fishing pressure by providing alternative employment in

[1] Governance is not a synonym for management or government. This term includes governmental actors, non-state actors, "hard laws" such as treaties, "soft laws" such as codes of conduct, formal and informal rules, understandings that influence behavior, and private governance such as market mechanisms. A governance institution focuses more on the sharing of responsibility and setting the policy agenda then on the actual process for implementing management actions (Rosenau 1995, Sissenweine and Mace 2003, Schechter and Leonard 2008).

development in fishing communities, but has chosen not to use that leverage (World Bank 2004).

Another factor that contributes to the variability observed in the effectiveness and success of governance institutions for transboundary fish stocks is the spectrum of personalities and expertise of individuals participating in the development and implementation of the governance institution. These individuals are often selected to be part of the 'team' because they can contribute different expertise, have different disciplinary backgrounds, or because they represent different cultures, societal groups, and sovereign jurisdictions. The diversity among the 'team' participants can be an added challenge to the governance of transboundary fish stocks, because participant diversity has been found to have both positive and negative impacts on group effectiveness and work quality (Shaw and Barrett-Power 1998). Diversity in team participants', for instance, can decrease group effectiveness (Campion et al. 1993, Pitts and Jarry 2005), whereas, other studies have found that diversity can enhance team performance (Magjuka and Baldwin 1991), as well as producing more creative decisions (McLeod et al. 1996).

Most studies to-date that assess existing governance institutions for transboundary fish stocks have not focused on the participants engaged in the institution, but instead have focused on the institution's structure and framework. Of these studies, most have focused on the decision-making processes, the authorities delegated to the institution, or the management tools used, such as stocking fish and setting harvest regulations, to understand how these may be contributing to the effectiveness[2] of the institution (Taylor and Ferreri 1999, Kooiman et al. 2005, Schechter et al. 2008). Studies that assessed the

[2] The term 'effectiveness' in this chapter is used as the Merriam-Webster Dictionary defines the word 'effective', "producing a decided, decisive, or desired effect" (1974).

role of participants on the effectiveness of the institution have found that social relations (hereon referred to as social ties[3]) can be effectively used to achieve the governance institution's desired outcomes. The use of sanctions by members of a fishery to stop individuals engaging in behaviors that are perceived as negatively impacting the fish stock (Grafton 2005), such as occurs in the Maine lobster fishery (Acheson 1975) and in the Turks and Caicos Island spiny lobster fishery (Bennett and Clerveaux 2003), has been very effective in stopping unsustainable fishing practices. Studies also have found that social ties can be used to learn about the location of desired fish species and thereby increase fishing success, such as with Great Lakes salmonid charter-boat fishing captains (Mueller 2004) and with the Alaska commercial seine skippers (Gatewood 1984, 1987). Studying social ties among a defined group of individuals also can reveal the social network[4] structure and how resources, such as information on preventing the spread of fish pathogens, flow among participants of that social network through their social ties. This understanding can then reveal if a subset of the social network's participants are not receiving information, or which subset of participants should be targeted to assure efficient flow of new information to all other participants. For instance, the flow of information among fisheries stakeholder groups can be revealed by studying their social ties and social network structure (Lynch 2001). This knowledge can then be used to enhance the flow of information, such as information on new regulations, among

[3] Social tie is defined as the relationship linking two individuals together. This relationship may be based on individuals respecting one another, exchanging resources, belonging to the same affiliation or association, formal relationship such as employer and employee, biological relationship such as siblings, and so forth (Wasserman and Faust 1994).

[4] Social network is defined as consisting of "a finite set or sets of actors and the relation or relations [i.e., social ties] defined on them" (Wasserman and Faust 1994).

stakeholder groups as well as between stakeholders and agency personnel (Maiolo and Johnson 1992), by assuring that the information is provided to individuals that are well-connected to others within the social network structure. Generally, even though the importance of social ties among participants is recognized in fisheries governance (e.g., Decker and Krueger 1999, Acheson 1975), few studies have examined the role of social ties and their social network structure on the effectiveness of the institution in developing and implementing fisheries policies.

The role that social ties may have on the effectiveness of governance institutions with responsibilities for transboundary fish stocks deserves closer examination, as these institutions are increasingly used to resolve fisheries disputes, i.e., the Food and Agriculture Organization's Regional Fisheries Bodies. In these governance institutions, it is common for a diversity of fisheries professionals and stakeholders to be selected to work together on governance issues of mutual concern. Once selected to participate in such 'teams', the individuals need to establish social ties to facilitate effective decision-making. Establishment of social ties generally requires individuals to develop a level of trust and respect for one another (Jones and George 1998, Newell and Swan 2000). Frequently, these social ties must be newly established so that the needed working relationships are present to effectively and cooperatively tackle issues of concern (Dodgson 1993, Jones and George 1998, Newell and Swan 2000). In the absence of establishing social ties, the group may fail to meet its objectives in a timely fashion, if at all, as the individuals will not be able to work together to make needed decisions (Jones and George 1998, Newell and Swan 2000). The importance of social ties among group participants for successful, cooperative interaction and exchange of information, such as

is needed for decision-making, has long been recognized and often studied in disciplines such as sociology, psychology, and organizational development (e.g., Jones and Georges 1998, Newell and Swan 2000).

The social ties of individuals participating in the governance of transboundary fish stocks, and the structure of their social network, also contribute to the group's success by restricting or enabling access to needed resources, such as information on a given fishery or access to technological expertise (Wasserman and Faust 1994). The ability of individuals to access needed material, i.e., computers, or a non-material resource, i.e., expertise, through their social ties is referred to as an individual's social capital (Frank et al. 2007, Rudd 2000). The larger an individual's social capital the more resources that individual will be able to access. If individuals participating in a governance institution have low social capital, they may not have the resources available to be effective, as they will not be able to gain access to individuals that have the resources that they need. The social ties linking the individuals, as well as the level of trust among individuals of the social network, all contribute to the amount of social capital to which an individual has access (Frank and Yasumoto 1998, Pretty and Ward 2000, Grafton 2005). The development of social ties among individuals working together is important because of the resources contributed by participants to the group as well as it's facilitation of group progress in making decisions. Surprisingly, although the governance of transboundary fish stocks has become increasingly dependent on cooperative multijurisdictional efforts, the importance of social ties in fisheries governance has not received the level of attention observed in other disciplines where collaboration is also essential for success.

In this dissertation, I assessed the need for more effective governance institutions with responsibility over transboundary fish stocks using case studies from all regions of the world. I conducted a specific case study on the fishery policies governing lake sturgeon (*Acipenser fulvescens*) in the Laurentian Great Lakes, using it as an illustration of the conflicting management actions that are implemented when coordination among fisheries management agencies is lacking. Lastly, I assessed the role of the social ties among participants of a governance institution for the governance of transboundary fish stocks, and their social network structure, on the effectiveness of that institution. I selected as my case study the governance of the Laurentian Great Lakes fishery for two main reasons: (1) the formal adoption and implementation of a governance institution for transboundary fish stocks, *A Joint Strategic Plan for Management of Great Lakes Fisheries*, and (2) the diversity, such as education level, employer, culture, and country of residence, of participants involved in the implementation of this institution. In the next section I provide an overview of the system I studied for the case study on the governance of the Laurentian Great Lakes fishery.

Study System

The Laurentian Great Lakes fish stocks span the binational boundary between Canada and the United States. These fish stocks are collaboratively managed through *A Joint Strategic Plan for Management of Great Lakes Fisheries* (Joint Strategic Plan) by eight state, two tribal, and one provincial fisheries management agencies. The Joint Strategic Plan and the participants involved in its implementation are an ideal system for which to study the role of social ties and social network structure on the effectiveness of

this governance institution for two reasons: (1) the perceived success of this governance institution in governing transboundary fish stocks in the Great Lakes based on signatory agencies collaboratively implementing management decisions (Stein and Goddard 2008, Gaden 2007), and, (2) the diversity in participants involved in the implementation of the Joint Strategic Plan. Below I describe the historical background leading to the implementation of the Great Lakes Fishery Commission, the enactment of the Joint Strategic Plan, and the Joint Strategic Plan's perceived success. I also describe the Great Lakes Fishery Commission (GLFC) structure, and the committee structure facilitated by the GLFC through which the Joint Strategic Plan is implemented to provide an understanding of its framework. Lastly, I describe the diversity of participants involved in the Joint Strategic Plan, both official signatory agencies and unofficial participants, as this diversity can affect the effective implementation of the Joint Strategic Plan.

The Great Lakes fishery is a well-documented case study that has faced a history of declining fish stocks and failed attempts to reverse this decline through unilateral decisions. This history of failures is the precursor to the eventual successful establishment of the Great Lakes Fishery Commission and the Joint Strategic Plan. When the Europeans first colonized the Great Lakes, fisheries governance consisted mainly of a *laissez-faire* approach with few if any fisheries regulations (Nielson 1999). This approach arose from fishers and managers believing that the Great Lakes fish resources were so abundant that it was inconceivable that these fish stocks could ever be depleted (Bogue 2000).

This belief was soon shattered, as increasing harvest pressure (Brown et al. 1999, Bogue 2000) facilitated by improved harvest technologies (Stein and Goddard 2008),

compounded by the negative impacts of aquatic habitat degradation and pollution (Beeton et al. 1999, Brown et al. 1999, Bogue 2000, Stein and Goddard 2008), and later, aquatic nuisance species (Eshenroder and Burnham-Curtis 1999, Leach et al. 1999), all contributed to the decline of Great Lakes fishery stocks. By the mid-19th century the need for fishery management[5] became apparent in the Great Lakes.

Declining fish stocks and the increasing pressures on these stocks, lead to the implementation of first local, then regional approaches to management, and ultimately to a binational fishery resources governance approach (Brown et al. 1999, Dochoda 1999, Bogue 2000). The local and regional approaches, historically, consisted of fisheries managers from the eight Great Lakes states and the province of Ontario with management authority for Great Lakes fish stocks, focusing their efforts exclusively on fish stocks within their fisheries management jurisdiction (Dochoda 1999, Cole 2003). This management approach usually occurred only after the stocks were declining or had collapsed (Nielson 1999). This local and regional approach was, therefore, divided based on the political boundaries of the eight Great Lakes states and by the international boundary dividing the four Great Lakes shared with the Canadian province of Ontario (Figure 1).

[5] Fisheries management is defined as: "the manipulation of aquatic organisms, aquatic environments, and their human users to produce sustained and ever increasing benefits for people" (Nielson 1999).

Figure 1: The political boundaries dividing the Great Lakes among the eight Great Lakes states and the province of Ontario. The political boundary between Canada and the United States is located approximately in the middle of the four shared Great Lakes, Lake Superior, Lake Huron, Lake Erie, and Lake Ontario. The headquarters' locations of the two tribal organizations that have management authority of fish stocks within their ceded territories in the United States side of the Great Lakes are also indicated.

Efforts at establishing a binational, basin-wide, collaborative fishery resources governance institution during the late 19th and 20th centuries for these inherently transboundary fish stocks in the Great Lakes were marked by several failed attempts (Brown et al. 1999, Gaden 2007, Stein and Goddard 2008). The eventual collapse of commercial and recreational fisheries from the combined effects of overharvest, habitat destruction, ineffective fisheries management, and the establishment of the invasive and parasitic sea lamprey (*Petromyzon marinus*), provided the needed impetus for Canada

and the United States to create by treaty, the binational GLFC in 1955 (GLFC 1955, Christie and Goddard 2004).

The GLFC was established to undertake and coordinate fisheries research, to provide advice to governments about the measures necessary to ensure the maximum productivity of fish stocks of common concern, and to implement a sea lamprey control program (Dochoda and Jones 2002). Taking advantage of the international framework provided by the GLFC, the eight Great Lakes states and the province of Ontario established five Lake Committees – one for each of the Great Lakes, under the auspices of the commission to better facilitate cooperative fisheries management for these transboundary fish stocks (Figure 2). Established in 1965, these Lake Committees were composed of fishery managers from each of the state and provincial agencies with fishery resources authority on each of the Great Lakes (Eshenroder 1987). Representatives from Chippewa-Ottawa Resource Authority and the Great Lakes Indian Fish and Wildlife Commission were subsequently included in the Lake Committees in 1989. The Lake Committees do not include members from the federal fishery management agencies, as the fisheries management authority in the Great Lakes resides solely with state, provincial and tribal agencies in the Great Lakes basin. Members of the Lake Committees currently make the fishery management decisions by consensus and are each representing for implementing the decisions within their respective jurisdiction (Stein and Goddard 2008).

The Council of Lake Committees, comprised of the Lake Committees' representatives, addresses basin-wide Great Lakes fisheries issues and facilitates information exchanges between the Great Lakes Law Enforcement Committee and the

Lake Committees. The Law Enforcement Committee addresses fishery resources law enforcement topics of common concern within each Great Lake and basin-wide. Within the GLFC's framework, there are two additional committees that are Agency-Appointed, the Council of Great Lakes Fishery Management Agencies and the Great Lakes Fish Health Committee (Figure 2). These two committees, unlike the others include representation from all signatory agencies, including the federal agencies signatory to the Joint Strategic Plan (discussed in greater detail below). The federal agencies represented on these two committees include Fisheries and Oceans Canada, National Oceanic and Atmospheric Administration –Fisheries (formerly named the National Marine Fisheries Service), U.S. Geological Survey - Biological Resources Division, and the U.S. Fish and Wildlife Service. The Council of Great Lakes Fishery Management Agencies serves to guide the implementation of the Joint Strategic Plan, as well as a forum to which the GLFC and the CLC can bring forth emerging or unresolved Great Lakes fishery issues of concern. The Great Lakes Fish Health Committee coordinates basin-wide efforts to stop the introduction and spread of fish pathogens that may threaten the health of the Great Lakes fish stocks. This fishery resources governance decision-making process, which is implemented through the Lake Committees, Council of Lake Committees (CLC) and its Law Enforcement Committee, was formalized in 1978 with the enactment of the Joint Strategic Plan (GLFC 1997).

The Joint Strategic Plan was signed by one province, two-tribes, eight states, and four federal agencies:

- Ontario Ministry of Natural Resources,
- Chippewa-Ottawa Resource Authority,

- Great Lakes Indian Fish and Wildlife Commission,
- Illinois Department of Conservation,
- Indiana Department of Natural Resources,
- Michigan Department of Natural Resources,
- Minnesota Department of Natural Resources,
- New York State Department of Environmental Conservation,
- Ohio Department of Natural Resources,
- Pennsylvania Fish and Boat Commission,
- Wisconsin Department of Natural Resources,
- Canada Department of Fisheries and Oceans,
- National Oceanic and Atmospheric Administration-Fisheries
- United States Fish and Wildlife Service, and
- United States Geological Survey – Biological Resources Division.

The four federal agencies, although not having fisheries management authority in the Great Lakes, are signatory agencies to the Joint Strategic Plan because of the role they have in protecting, rehabilitating, and conserving the Great Lakes fish stocks, such as through the Endangered Species Act. The Department of Fisheries and Oceans Canada has conservation authority in the Great Lakes, which entails ecosystem based research, the protection of fish habitat, and assistance with the implementation of the GLFC's sea lamprey population control, all of which impact the health of Great Lakes fish stocks managed by the Ontario Ministry of Natural Resources (Dochoda 1999). The National Oceanic and Atmospheric Administration, U.S. Geological Survey-Biological Resources Division, and the U. S Fish and Wildlife Services are all signatories to the Joint Strategic

Plan due to the supportive role they provide Great Lakes fishery management agencies, in areas such as fisheries and water quality research, protection and rehabilitation of endangered species, implementation of the GLFC's sea lamprey control program, and fishery law enforcement (Dochoda 1999).

The Joint Strategic Plan serves as the framework for fishery resources governance decision-making and is based on the best available science and achieving consensus. The philosophy underlying the Joint Strategic Plan is that each of the Great Lakes fishery resources governance agencies shares responsibility for the Great Lakes ecosystem and that in the interest of the "common good," fishery resources governance authority must be cooperative, rather than unilateral. The GLFC, although not a signatory to the Joint Strategic Plan, facilitates the operation of the Joint Strategic Plan. The Joint Strategic Plan is now viewed by some as one of the most successful institutions for coordinated governance of transboundary fish stocks (GLFC 1997, Gaden 2007, Stein and Goddard 2008). This perception is based on the Joint Strategic Plan signatory parties achieving consensus on fisheries management decisions, sharing information with one another, and implementing coordinated fishery management activities in the Great Lakes (Gaden 2007). This perceived effectiveness of the Joint Strategic Plan makes it an appropriate case study for assessment of the role of its participants and their social ties on its effectiveness.

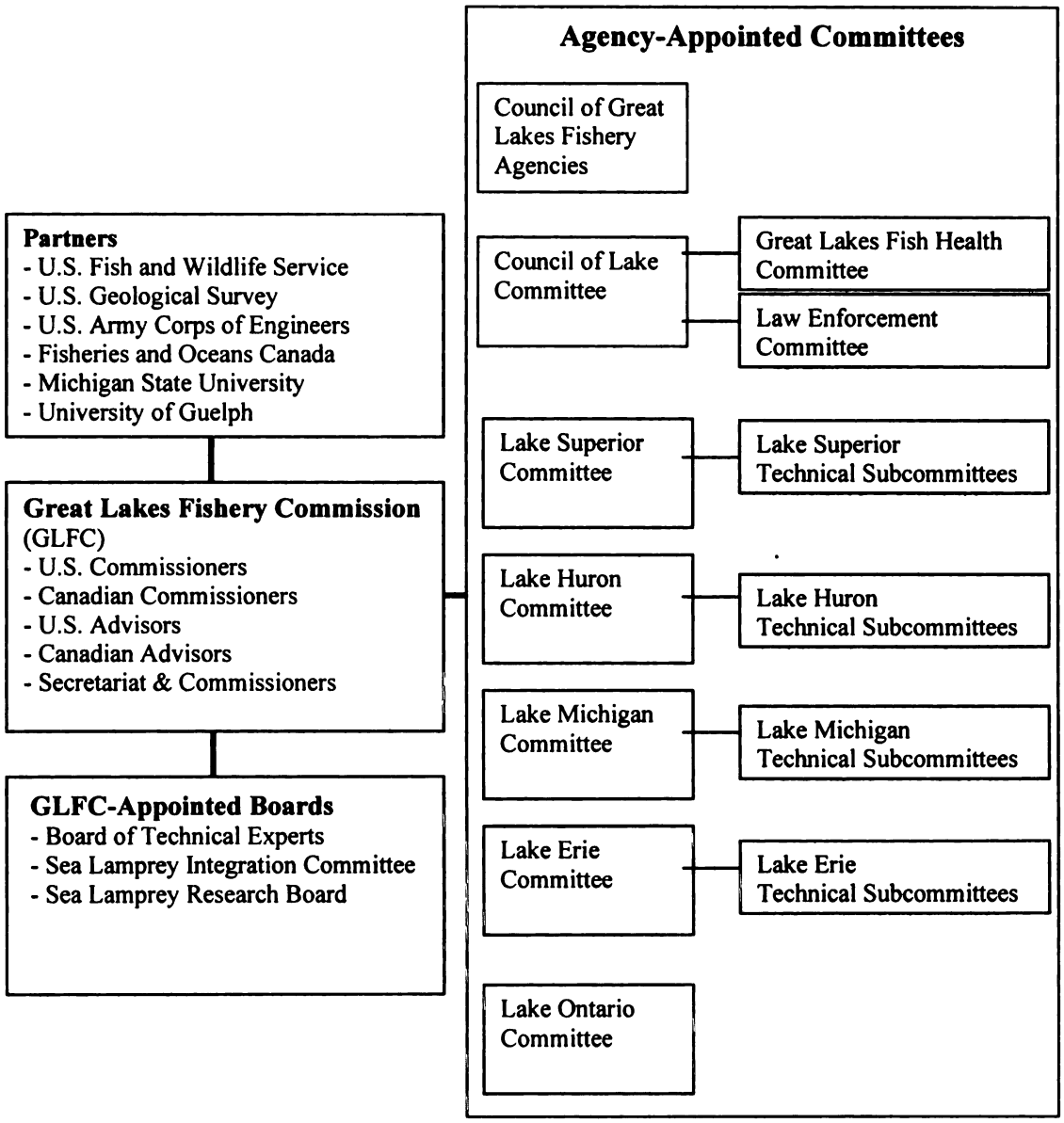

Figure 2: Organizational structure of the Great Lakes Fishery Commission

The second component that makes the Great Lakes transboundary fish stocks an appropriate case study for my dissertation is the diversity of participants involved in the implementation of the Joint Strategic Plan. As stated above, the signatory members of the Joint Strategic Plan represent tribal, provincial, state, and federal agencies. There are also non-voting participants in the Joint Strategic Plan, representing academia, non-

governmental organizations, private sector, commercial fishers, and recreational fishers, who provide input through invited expert presentations, formally established advisory groups, and public comments, and thus may influence governance decisions. This assemblage of individuals is diverse in terms of the organizations they represent, as well as their expertise, personalities, beliefs, perspectives, values, disciplines, and cultures, which can affect how these individuals interact together and hence affect the decision-making process (e.g., Shaw and Barrett-Power 1998). Additionally, these individuals vary in how long they have been participants, the frequency of interactions they have with other participants, and the social ties they develop with one another, all of which may affect the ability of the individuals to work effectively together as participants of the Joint Strategic Plan, its Agency-Appointed committees, or GLFC groups. Furthermore, individuals need to have a certain level of trust and respect for one another to effectively and successfully work together (Jones and George 1998, Newell and Swan 2000, Grafton 2005), which is achieved by investing the time to get to know one another professionally as well as personally, thereby developing social ties. This diversity among participants, variability in how well they know, trust, and respect one another all adds to the challenge of participants working together to reach consensus on governance decisions for transboundary fish stocks as this variability may decrease group effectiveness (Campion et al. 1993, Shaw and Barrett-Power 1998, Pitts and Jarry 2005). In this dissertation I assess how the social ties and the social network structure of the Joint Strategic Plan participants influence the effectiveness of the Joint Strategic Plan by affecting the flow of information among participants. This understanding contributes to improving the effectiveness of governance institutions increasingly being used to address transboundary

fish stocks of concern and hopefully avoid negative impacts on these fish stocks which may arise from unilateral decision-making.

Dissertation Format

This dissertation is composed of three central chapters, bounded by an introduction chapter and conclusion chapter. I studied the governance of Great Lakes transboundary fish stocks from three aspects that illustrate how (1) the need for more effective governance of transboundary fish stocks is resulting in the implementation of governance institutions for these transboundary fish stocks (2) lack of coordination on the management of a transboundary fish stock, i.e., lake sturgeon (*Acipenser fulvescens*), can lead to conflicting fishery resources governance policies, and (3) social ties among participants governing transboundary fish stocks in the Great Lakes, and their social network structure, affect the decision-making process. Each of these aspects is addressed in a separate chapter of this dissertation.

The second chapter examines how the need for a better approach in addressing the needs of transboundary fish stocks has giving rise to a diversity of governance institutions for these transboundary fish stocks. This chapter evaluates the adequacy of current governance institutions for transboundary fish stocks and explores potential alternatives that may further improve governance of these fish stocks. This first chapter has been published in *International Governance of Fisheries Ecosystems: Learning from the Past, Finding Solutions for the Future* (Schechter et al. 2008).

The third chapter illustrates the conflicting governance decisions and the lack of coordination and cooperation in the management of lake sturgeon in the Great Lakes. In

this chapter, an overview of the governance institutions and resulting variable harvest management regulations across eight states and two provinces is presented. The need for consistency among jurisdictions to assure the improved and sustained health of Great Lakes lake sturgeon is discussed. The potential role of the Joint Strategic Plan governance institution, as facilitated by the GLFC and implemented by the Lake Committees, Council of Lake Committees and its Law Enforcement Committee, in terms of achieving consistency in the management regulations is described. This chapter has been published in *Sturgeons and Paddlefish of North America* (LeBreton et al. 2004).

The fourth chapter improves the understanding of the role of social ties among participants of the Great Lakes fisheries governance institution, Joint Strategic Plan, in the decision-making process. Social ties, although not often studied in fishery resources governance, have been researched in both organizational and sociological fields to enhance the understanding of how interactions among individuals affect group effectiveness (Granovetter 1973, Magjuka and Baldwin 1991, Burt 1992, Campion et al. 1993, Wasserman and Faust 1994, McLeod et al. 1996, Abrahamsom and Rosenkopf 1997, Shaw and Barrett-Power 1998, Frank et al. 2004, Pitts and Jarry 2005). These studies found that social ties likely determine the resources, such as information, that an individual will have access to, how quickly these resources will be available to the individual, whether a new idea will be accepted by individuals within a group, and may potentially be related to the amount of influence an individual can exert on group decisions. Hence, understanding the role of social ties within the social network of Great Lakes fishery governance institutions can disclose how resources flow among individuals within the governance infrastructure, e.g., whether uniformly or restricted to certain

subgroups, and how this may affect the decision-making process related to the governance of transboundary fish stocks.

The Conclusion chapter, chapter five, reviews the main findings from the three core chapters, and highlights how these chapters are connected with one another. In brief, these chapters are connected by the implementation of governance institutions to address concerns with transboundary fish stocks, which generally results in engaging participants to collaboratively work together in coordinating governance efforts at all jurisdictional levels. The need for these institutions is evident based on the multiple jurisdictions with management authority over transboundary fish stocks, and the contradicting policy decisions that can arise in the absence of coordination. These institutions, while relying on the ability of participants to effectively and efficiently work together, must recognize the importance of developing social ties among participants to achieve an effective group dynamic. The role of social ties and social network structure, therefore, must be considered in designing and implementing governance institutions for transboundary fish stocks.

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CHAPTER TWO

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CHAPTER TWO

Global Fisheries Governance

Fisheries management has existed in some form since prehistoric times, initially arising as a response to local fishing pressures and the need for local management to assure the sustainability of the fish stock (Coull 1993). During the 20th century, fisheries throughout the world began expanding both horizontally to explore new distant stocks and vertically to harvest deeper stocks, as technological advances in vessels, fish capture gear, fish processing, and storage facilitated this expansion (Degnbol 2004). These technological advancements were associated with new threats to global fisheries including overfishing and habitat destruction. Overfishing became internationally recognized as a serious threat to the sustainability of our world fisheries during the early 1900s. It also was a major topic of discussion from the first days of the Food and Agriculture Organization of the United Nations (FAO). It was discussed at the FAO's first Fisheries Technical Committee in 1946 (FAO 2006a), and was the focus of the 1947 London Conference on Overfishing.

The 1996 FAO State of World Fisheries and Aquaculture (SOFIA) report substantiated the concern for the sustainability of fisheries. This report showed that since FAO's onset of data collection in 1950, that fishing pressures on fish stocks have been intensifying leading to a large proportion, 35%, of the world fisheries being overexploited (senescent) and 25% being fully exploited (mature) by 1994 (Figure 1). This evidence of fishing activities' impact on fish stocks created a worldwide concern for their sustainability, and a desire to take action. The FAO called for this action by stating in its

1996 SOFIA report that over 60% of the fish stocks required management (FAO 1996). Fisheries management is defined as: "the manipulation of aquatic organisms, aquatic environments, and their human users to produce sustained and ever increasing benefits for people" (Nielson 1993). Fisheries management was seen as the tool to respond to the increasing international and global harvest pressure on fish stocks (Coull 1993). Accordingly fisheries management became more prominent during the second half of the 20th century (FAO 2006a).

As the perspective on fisheries resources changed from this being an inexhaustible to an exhaustible resource, so did approaches to management. Past management strategies had proved ineffective in preventing unsustainable fishing of targeted fish stocks (Degnbol 2004) and changes had to be made. Fisheries management, mirrored by fisheries science and their fisheries modeling tools, shifted from the focus of expanding and optimizing fisheries operations during the early to mid 1900s, to a focus on sustainable fisheries of targeted stocks, and then during the late 1990s, to ecosystem sustainability and applying the precautionary approach (Degnbol 2004). This change was necessary as the narrower species-focus approach may lead to unsustainable decisions as the underlying cause of the problem may go undetected. For instance, the narrow-focus approach is likely to respond to the problem of declining fish abundance by stocking hatchery reared fish instead considering that decreased abundance may be rooted in habitat deterioration. The broader ecosystem approach brings a more holistic perspective to fisheries management, in that the fish stock of concern is no longer the sole or even the main focus of management activities. This broader approach considers the fish stock, its forage base, and their habitat requirements (Garcia et al. 2003), hereby taking into

account the entire ecosystem when addressing a problem versus only focusing on a small component as in the case of the narrower, species-focus approach. In general, fisheries management and its underlying science have changed during the past century, and continue to change while seeking a better management approach to attain sustainable fisheries.

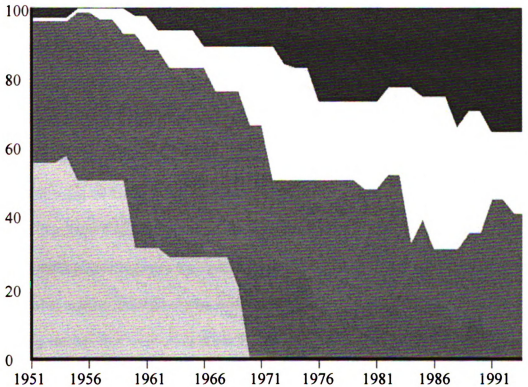

Figure 3: Percentage of major marine resources in various phases of fishery development. The numbers on the x-axis (or bottom axis) is the year, and the numbers on the y-axis (left axis) is the percentage of number of resources. Phase 1, the pale grey color in the bottom left, represents undeveloped resources. Phase 2, medium grey color, represents developing resources. Phase 3, white color, represents mature resources, which equates to fully exploited fisheries. Phase 4, dark gray color in the upper right, represents senescent, which equates to over-exploited fisheries. Modified from the 1994 State of World Fisheries and Aquaculture (FAO 1996).

Compared to the changes observed in fisheries management, however, fisheries governance has been slow in responding to the increasing internationalization and globalization of fish stocks. This difference in response rate may be due to the inherent difficulties of bringing together the authoritative entities, i.e., sovereign states and other actors that are needed to develop a successful, more holistic, ecosystem-like, ideal governance structure for fisheries. Currently, the fisheries governance institutions for shared (high sea, migratory, and straddling) fish stocks are structured similarly to those used within a national boundary. There are however, some fisheries governance institutions that have been established to coordinate among national governance institutions and these differ somewhat from the national institutions. Still, it is our contention that the persistence of the degraded status of shared marine fisheries illustrates strongly the need for changes in fisheries governance institutions in addition to the ongoing changes in fisheries management if the goal of sustainable fisheries is to be attained. The 2005 FAO SOFIA indicates that the changes in fisheries management have not been sufficient to improve the status of our marine stocks (FAO 2007a). About 52% of the global marine fisheries stocks were considered fully exploited and therefore producing catches that were at, or close to, their maximum sustainable limits, with no room for further expansion (FAO 2007a). Additionally, 25% of the fish stocks remained over-exploited, depleted, or recovering from depletion and thus yielding less than their maximum potential owing to excess fishing pressure (FAO 2007a). Furthermore, it is believed that the status for highly migratory species is in a worse state than the other marine fish stocks, with nearly two-thirds of the stocks for which information is available currently being classified as overexploited or depleted (FAO 2007a). In order to achieve

our goal of sustainable fisheries it is imperative for fisheries governance to evolve into a form capable of addressing the challenges of shared fisheries.

There is global interest in improving global fisheries governance and there is recognition that this is needed, as indicated by the opening remarks of the FAO Fisheries and Aquaculture Department's Assistant Director-General Ichiro Nomura in the 2006 FAO SOFIA. The lessons of the past clearly point to a need for the reordering of the actually existing global fisheries governance institutions[6]. This reordering of institutions, *inter alia,* must result in 1) adopting interdisciplinary and inclusive management processes, including the views of all stakeholders; 2) possessing sufficient authority and enforcement powers to address both intra- and inter-generational concerns; 3) emphasizing soft law, social networks, and nonstate market-driven governance systems; and 4) resolving controversial issues, e.g., subsidies. It is these actually existing global fisheries governance institutions, and the need to evolve towards ideal global fisheries governance institutions to achieve sustainable global fisheries that we will focus on for the remainder of this chapter.

From Fisheries Governance to Global Fisheries Governance

Governance is not a synonym of the term management or of the term government. Management, as defined by Sissenweine and Mace (2003), "is about action, ... about the implementation–in a technical sense–of decisions and actions in accordance with rules (these decisions and actions do not have to be restricted to the implementation of the

[6] The term "actually existing" global governance is a take-off from the much more frequently used phrase "actually existing socialism" to distinguish what existed in state socialist countries from what theorists and advocates hoped could some day exist.

management tools per se, they can also relate to planning and assessment). "
Governments can be viewed as a subset of governance that involves only the governmental actors and associated governmental institutions (Rosenau 1995). Governance "is about sharing responsibility and power; it is about setting the policy agenda," the decision-making process is "about the process of implementing management actions" (Sissenweine and Mace 2003). Governance is more encompassing than government because of the comprehensive focus on the various phases of the policy-making process and because of the variety of institutions that are considered. These institutions include nonstate actors; governmental actors; hard (binding, as with treaties) and soft (nonbinding, as with the United Nations General Assembly resolutions and codes of conduct) law; formal and informal rules; understanding or norms that influence behavior; as well as so-called private governance, such as market mechanisms. Governance is then extended to 'global governance' when it involves "...governing, without sovereign authority, relationships that transcend national frontiers" (Finkelstein 1995).

Global governance departs from traditional international (interstate) relations in numerous ways. For example, in global governance there is no assumed hierarchy of actors. World (global) politics is conceived of as a multilevel system in which local, national, regional and global political processes are inseparably linked; thus it is these interlinkages between the different policy levels that are of great interest in global governance. In global governance it is hard, if not impossible, to discern a hierarchy among forces that drive politics beyond the state level. These forces include power relations, interest-based interstate bargaining, as well as norms and advocacy networks. Additionally, global

governance recognizes authority beyond the sovereign state, including universal (open to all) and regional intergovernmental organizations, private actors like the Marine Stewardship Council, and informal networks that include epistemic communities. Global governance's central units of analyses include norms and rules in addition to actors and the relations between them. Its analytical goal is to comprehend complexity rather than seeking parsimony (Carin et al. 2006, Dingwerth and Pattberg 2006).

Actually existing global governance does not attain the ideal description of global governance in that it remains state-centric. It is widely agreed, however, that the state-centric elements of governance systems are starting to loosen their grip. This is occurring in a number of ways. In some specific instances, states have agreed to allow intergovernmental institutions to make decisions that will bind them, even when the states do not specifically favor those decisions. For instance the World Trade Organization (WTO) can make binding decisions regarding the use of fishery subsidies; however, the WTO has yet to exercise its powers on this matter. More generally, the delegation of fishery policy responsibility to the European Union (EU) can be viewed as evidence of declining state-centric governance. In practice, however, the EU states still have considerable power in implementing (or not implementing) decisions made at the EU headquarters in Brussels. For instance, EU member states can thwart those decisions by trying to influence the Commission, the Council or, in legal cases, before the European Court of Justice (ECJ). Alternatively, the EU states also can thwart them by simply not passing national legislation called for by the EU or by not monitoring compliance with the legislation that is passed. Currently, there are few global governance institutions with the power to bind member states, indeed they are the exception rather

than the rule (Sarooshi 2005). This ability of global governance institutions to make decisions that bind member states is an important distinction that we use to distinguish existing global fisheries governance from the ideal global fisheries governance. The distinctions outlined above for governance and global governance also apply to the governance of fisheries, whose evolution we discuss below.

Fisheries governance–although this concept was not recognized as such until 1996–had its beginnings very early in human history with authority figures placing fisheries access restrictions on other individuals. The earliest form of fisheries governance most likely consisted of tribal leaders, imperial rulers, the crown, or local constabulary (Coull 1993, Nielson 1993, Bogue 2000). As pressure on local fish stocks increased, competing users interacted, and the doctrine that the ocean's fisheries were inexhaustible was disproved. With this realization, the attitude of *mare librum* (open sea) and *res nullius* (property of none) started to change. In response to this change, sovereign states started claiming ownership of the sea close to their shore (Knight 1975, Coull 1993). By 1982, states' fishing limits were extended out 200 mi from their shoreline under the revisions of the regime of the International Law of the Sea (Knight 1975, Coull 1993). This shifted the governance of the majority of the most productive areas of the ocean away from the *res nullius* and into the governance rights of sovereign states (Coull 1993). As the division of the ocean progressed, sovereign states with adjoining divisions or faced with problems of regulating capture of straddling and highly migratory stocks found both inside and outside the 200 mi limit began seeking means by which to address these difficulties. In response to this need, states began signing agreements and forming commissions or regional councils to determine how fish stocks that crossed these

divisions would be managed. The governance authority over these stocks, however, resided with the sovereign state in which the fish are found at the time of harvest or the flag state if the fish were seaward of the 200 nautical mile line (Coull 1993).

Today's *existing* fisheries global governance institutions consist of sovereign states; intergovernmental organizations (regional and global); global conferences; nongovernmental organizations (NGOs); other stakeholder groups (including fishers themselves); epistemic communities; nonstate market mechanisms; as well as hard and soft law. However, like most actually existing global governance institutions, global fisheries governance remains largely state-centric. Thus states continue to decide whether to agree to soft law declarations, sign international conventions, enforce and/or carry out international commitments, and relinquish authority to intergovernmental institutions. This state-centric nature of the actually existing global fisheries governance system weakens the effectiveness of global fisheries governance institutions. For instance, many fisheries treaties are undermined by key states either refusing to ratify them or not fulfilling their obligations under them, e.g., only paying "lip service" to the concept of sustainable fisheries (Garcia et al. 2003). An illustration of this problem is the crippling of the 10 December 1982 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea. This Agreement was considered to be the most important legally binding global instrument for the conservation and management of fishery resources since the adoption of Third United Nations Convention on the Law of the Sea Treaty (UNCLOS). This Agreement, which is related to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, established a comprehensive legal regime for the conservation and sustainable

use of straddling fish stocks and highly migratory fish stocks. It also included provisions related to the strengthening of flag state responsibilities, as well as the role of subregional (e.g., West African Economic and Monetary Union) and regional (e.g., African Union) fisheries management organizations and arrangements. However, fifteen of the top twenty fishing states failed to ratify this agreement, significantly reducing the strength of a potentially powerful agreement in improving governance of shared fisheries (Riscard 2002).

Another weakness of *existing* global fisheries governance concerns the fact that many of the related governmental and intergovernmental fisheries structures were institutionalized without sufficient concern for involvement of civil society and other private sector actors. These omitted actors include those found throughout the fishery supply chain (from fish stock, harvest industry, wholesaler, retailer to fish product consumer), and voices articulating the interests of future generations, thereby contributing greatly in reducing the effectiveness of existing global fisheries governance systems. Although we can point to instances within the existing global fisheries governance system where intergovernmental institutions, NGOs and other civil society actors have affected fisheries policy and even where soft law is voluntarily adhered to as if they were bound by it, these are exceptional cases. Governments, including those most significant in the global fisheries regime, simply refuse to relinquish the degree of state sovereignty necessary for such governance structures to take hold. As long as states remain the primary authoritative and legitimate decision-making units in the world order, achievement of the ideal global fisheries governance will be impossible.

Nonetheless, movement is occurring, some incremental, and some significant.

Similar to the management of fisheries, the global governance of fisheries is an ever-evolving process. New legal accords are signed and ratified. Nongovernmental organizations and intergovernmental organizations proliferate and some become obsolete. States are relinquishing more and more authority to intergovernmental organizations, and new norms are always in the process of transitioning from soft to harder law. Additionally, there currently exists evidence that institutional innovation is moving us towards a more authoritative global governance approach. This evidence is mainly in the form of organizations with the ability to pass binding measures, most notably the European Union and the World Trade Organization, which are both discussed later in the chapter. The Food and Agriculture Organization and regional fisheries commissions also remain central to existing global fisheries governance. In the next section we will use examples of fisheries governance institutions that are part of actually existing global fisheries governance to illustrate how this process has evolved so far, and, we hope, will continue to evolve as humans continue to learn from the past, as well as from each other.

Selected Actually Existing Global Fisheries Governance Institutions

There are four main types of actually existing global fisheries governance institutions that we will use to illustrate the various means by which an ideal, more robust, global fisheries governance may evolve. In the discussion, we will present a general overview of these institutions, their role in fisheries governance, provide examples to illustrate their role as part of the actually existing global fisheries governance system, and examine some of their successes and challenges. The four types of institutions we will examine are: Universal Intergovernmental Organizations;

Regional Intergovernmental Organizations (open only to some states, often but not necessarily geographically delimited); Nongovernmental Organizations (defined as not governmental in terms of their membership rather than their funding source), and Nonstate market-driven institutions.

Universal Intergovernmental Organizations

Universal intergovernmental organizations (IGO) are those intergovernmental organizations that are open to all states that want to become members. We have chosen to focus on the three most prominent IGOs that have played an important role in the global governance of fisheries, but this is hardly an exhaustive list. The three that we have selected are the World Trade Organization, the Food and Agriculture Organization, and the World Bank.

One of the most important intergovernmental actors involved in fisheries governance is the World Trade Organization (WTO). The WTO was created following the conclusion of The General Agreements on Tariffs and Trade (GATT)'s 1986 to 1994 negotiation round, known as the Uruguay Round. Originally, the 1947 GATT served as an agreement to negotiate and reduce barriers to the international trade of goods. GATT gradually gave rise to an informal international organization also named GATT that similarly dealt mainly with the trade of goods. However, the GATT's Uruguay Round led to the creation of the WTO whose trade agreement oversight includes GATT as well as agreements concerning trade in services, inventions, and intellectual property. The WTO provides a forum for the negotiation of world trade agreements, their administration and

monitoring, and dispute resolution. Its members consist of any state or customs territory that has sovereignty over its trade policies and who agrees to abide by the terms of the WTO. Decisions are normally made by consensus of the membership as a whole. The WTO rules, which are enforced by each individual member's government, include imposing trade sanctions on governments that fail to enforce WTO rules. Additionally the WTO assists economically less developed countries, and cooperates with other international organizations, so as to facilitate international trade (World Trade Organization, no date).

The WTO can have an important role in global fisheries governance because, unlike most other intergovernmental organizations, it can make rulings that can be costly to member states and that are binding (Pigman 1998, Odell and Eichengreen 2000). Most of its fisheries-related authority lies in settling disputes among member states over unfair trade practices that may result in a fishery product from one state being preferred over another. An example of this is the WTO's members' adherence to the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), an international agreement that establishes minimum measures to be taken to assure food safety and animal and plant health (World Trade Organization, no date). Because sanitary measures requirements could be utilized by states to block the importation of goods so as to protect domestic producers from competition, the SPS Agreement aims to ensure that health and safety regulations are not being used as excuses for protection of domestic producers, including those trading in fish and fish products (Lem 2004).

Subsidies is another area where the WTO can potentially have an important impact on fisheries. While the WTO has already exercised its authority to address

subsidies on a number of issues, fisheries subsidies is a difficult one to address as it is a very complex and contentious issue. Even the definition of fisheries subsidies is contested, not to mention whether their effects are positive or negative. In this context, the WTO Negotiating Group on Rules has experienced "heated debates" about the elimination of fisheries subsidies. Members' positions seem to fall into three opposing approaches. The first, the "no need" approach, is taken by governments, including those of Japan, South Korea and Canada, who believe that the fisheries sector is no different from any other sector in the economy and therefore there is no need for any special subsidy agreement. The second, the "traffic light approach" is taken by the EU, China and the countries that make up the "Friends of the Fish" (Australia, Chile, Ecuador, Iceland, New Zealand, Peru, the Philippines and the USA), who believe that there is an emerging consensus among fisheries policy makers that effort and capacity enhancing subsidies tend to exacerbate the most fundamental problem in most fisheries in the world, thus most subsidies should be prohibited. However, there are exceptions to this belief, for instance the EU believes that some subsidies are needed to mitigate the social and economic consequences of restructuring the fisheries sector. The third, the "special and differential treatment approach," is held by some economically less developed countries that believe that some forms of support, such as charging other states access fees and providing development assistance to small vulnerable coastal states, are important to them (Benitah 2004). Regardless of these debates, there is general agreement that the elimination of subsidies is critical to meeting the challenges of unsustainable fishing.

Fishery subsidies currently have high priority on the WTO agenda, including identifying what subsidies actually exist. Still, vested interests in member states are

strongly supportive of maintaining at least some subsidies. This support is not unexpected given that most subsidies were implemented for reasons that governments deemed legitimate and important, such as raising national income and maintaining coastal communities and their culture. In the fisheries industry, subsidies have been used in a variety of ways including direct government payments to the industry to purchase new fishing vessels, vessel decommissioning payments, fishermen's unemployment insurance, compensation for closed seasons, gear development, and fisheries management. Other types of fisheries related subsidies include price support payments; tax waivers and deferrals such as special income tax deductions for fishermen and deferred tax programs; government loans and loan guarantees; insurance; implicit payments such as payments for fishing rights to foreign countries; and general programs that affect fisheries such as tax waivers and depreciation schemes (Schrank 2003). Agreement to maintain some subsidies for some countries obviously makes elimination of others that much more difficult (Schrank 2003, Westlund 2004). Subsidies, not surprisingly, are difficult to get rid of once they are put in place.

In spite of these obstacles, progress is being made in the WTO's Doha Round towards addressing fisheries subsidies. The Round is a part of the Doha Development Agenda (DDA) Negotiating Group on Rules, which follows from the 20 November 2001 Doha Ministerial Declaration that mandated a clarification and improvement of WTO disciplines on fisheries subsidies (Lem 2004, USTR 2005, USTR 2007, World Trade Organization, no date). During the Doha Round the U.S. delegation has taken the lead by submitting a proposal aimed at banning subsidies to enterprises that capture ocean fish commercially and regarding the treatment of buyback programs, an example of so-called

"good subsidies" (USTR 2005, U.S. Mission 2007, USTR 2007). This proposal has resulted in WTO members clashing on how to discipline fisheries subsidies, and other countries combining to submit their own proposal. As of the 30 November 2007 WTO's Negotiating Group on Rules meeting, the WTO's decision on this topic remains undecided, with future meetings planned (World Trade Organization 2007). The Doha Development Agenda has already exceeded its anticipated end date of 2006 (Doha Development Agenda, no date). Hopefully, WTO members will reach a consensus on means to protect marine fish stocks.

Food and Agriculture Organization

The Food and Agriculture Organization (FAO) was founded following a meeting of 44 governments in Hot Springs, Virginia during 1943. In 1945 the first session of the FAO Conference established the FAO as a United Nations (UN) specialized agency (FAO 2006a). The FAO Conference, which meets every two years, is the organization's supreme decision-making body. It has delegated considerable authority to the FAO Council, which meets at least four times between meetings of the Conference. Membership of the FAO is open to any sovereign state that submits its application for membership along with a formal declaration that it accepts the obligations of FAO's constitution (FAO 2006c). Regional economic integration organizations are also eligible to apply for membership. Decision-making within FAO is generally by a majority of the votes cast. Each member receives one vote (FAO 2006c).

The FAO's mission is to lead international efforts to defeat hunger. It assists

economically less developed countries, and countries in economic transition, to modernize and improve agricultural, forestry and fisheries practices, as well as seeking to ensure good nutrition for all residents of these countries. Its four main activities consist of 1) being an information network and providing information in an easily accessible format, 2) providing policy expertise to its members, 3) providing a neutral forum to facilitate interactions among nations, and 4) providing technical knowledge to field projects. Ongoing responsibilities for the FAO's operations are carried out by a small number of committees that are part of the FAO's governing bodies, but that are subsidiary bodies of the FAO Council. These committees serve to verify that the FAO's vision and policies are being properly carried out and thus contribute to FAO complying with its mandate (FAO Governing Bodies 2007).

The FAO is organized into eight departments, with the Department of Fisheries and Aquaculture being one of them (FAO 2007b). The FAO's Department of Fisheries and Aquaculture's mission "is to facilitate and secure the long-term sustainable development and utilization of the world's fisheries and aquaculture" (FAO—Fisheries and Aquaculture Department 2007a). The Department of Fisheries and Aquaculture's main function is to " [promote] policies and strategies aiming at sustainable and responsible development of fisheries and aquaculture in inland and marine waters," by providing, among other things, "discussion fora, information, legal and policy frameworks, codes and guidelines, options for strategies, scientific advice, and training material" (FAO—Fisheries and Aquaculture Department 2007a). Fisheries bureaucrats have described the FAO as *the* global organization concerned with the preservation of living resources of the seas. This reputation comes from a number of phenomena,

including its activities in gathering world fishery production estimates and status of commercially important fish stocks, which started in 1945 (FAO 1996), and that are used by many organizations, academics, and people involved with fisheries.

The Committee on Fisheries (COFI) was established by the FAO in 1965, as a subsidiary body of the FAO Council (FAO—Fisheries and Aquaculture Department 2007b). Any country with FAO membership, or nonmembers that are eligible as FAO observers, can become a COFI member. Other specified types of multi-national organizations can also participate in the COFI discussions but do not have the right to vote. This large membership renders COFI very slow in making decisions. However, COFI is the only global intergovernmental forum where fisheries and aquaculture problems are examined, and where recommendations are made to governments, regional fishery bodies, nongovernmental organizations (NGOs), fish-workers, as well as the international community. COFI has also served as a forum for negotiation of global agreements and nonbinding instruments. COFI's main functions consist of reviewing fisheries and aquaculture related FAO programs and overseeing their implementation, as well as periodically reviewing international fishery and aquaculture problems. COFI is meant to complement the work of other fisheries and aquaculture organizations, not to replace them (FAO 2006b). For example, COFI's work complements and seeks to implement the declarations and decisions of the periodic conferences convened by the FAO. Notable in this regard are the 2001 Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem, and the September 2006 Bergen Conference on Implementing the Ecosystem Approach to Fisheries.

An illustration of the FAO's authority in global fisheries governance is its 1995

Code of Conduct for Responsible Fisheries, developed by its Fisheries and Aquaculture Department and negotiated within COFI. The FAO's Code is generally recognized as *the* global framework for capture fisheries and aquaculture (FAO 2004, IMM 2007), whether in marine or inland water, within the Exclusive Economic Zones (EEZs) or the high seas (National Marine Fisheries Service 1997). While the Code is voluntary, i.e. it is a soft law, it has acquired considerable legitimacy over time; indeed many in the international fisheries community refer to it as the bible of sustainable fisheries. What neither COFI nor the FAO can do in a state-centric world is to *force* governments and their constituents to alter practices that are contrary to the goals of fishery sustainability. Similarly, while the FAO provides a venue for discussing the ways that fishery subsidies contribute to un-sustainable fishing, and has conducted some basic research in support of such a contention, it cannot effectuate change in any direct way. Likewise, the FAO provides a venue for the promotion of the widespread application of the precautionary principle to the fisheries sector, but governments decide whether to apply this principle or not

The World Bank

The World Bank, formally named the International Bank for Reconstruction and Development, was agreed to in 1944 during the Bretton Woods conference (World Bank, no date). It initially consisted of one institution and was established to facilitate postwar reconstruction and then promote economic development. Over time the World Bank also has evolved to consist of a coordinated group of development institutions that fall under the title of the World Bank Group. These consist of five institutions: International Bank

for Reconstruction and Development (IBRD); International Development Association (IDA); International Finance Corporation (IFC); Multilateral Investment Guarantee Agency (MIGA); and International Centre for the Settlement of Investment Disputes (ICSID). The World Bank Group is run like a cooperative with member states being shareholders (World Bank 2006). The number of shares held by a given member state is related to the size of its economy. A Board of Governors generally consisting of Ministers of Finance or Ministers of Development represents each of the shareholding states (World Bank 2006). The Board of Governors meets annually and has the ultimate decision-making authority. The 24 Executive Directors make the daily decisions such as approving loans, new policies, and financial decisions (World Bank 2006). The World Bank currently focuses on the alleviation of worldwide poverty and improvement of living standards, and has 185 member states (World Bank, no date).

The World Bank first funded fisheries projects in 1964. Similar to other intergovernmental organizations and development banks, the bulk of the World Bank's lending operations went to finance acquisition of fishing vessels for large- and small-scale fishing industries, as well as to support fishing infrastructure for ports and harbors (World Bank 2004). A number of the World Bank's early fisheries projects were initiated in the absence of satisfactory evidence as to the fishing resource's harvest potential let alone a legal framework for management (World Bank 1994). The World Bank's 1984 review of its projects identified one of the common problems with its fisheries projects as being "insufficient attention to exploitation" (World Bank 1992). This started to change during the mid-1980s when the World Bank shifted some of its financial support from the fishery section towards research on fish stock status. During the last decade, the focus of

the World Bank has been on coastal zone management and aquaculture operations, with very little attention being given to funding sustainable fisheries activities (World Bank 2004). The World Bank's candid explanation for its recent "paltry support" of the fisheries sector, $420 million of which $10 million is invested in marine fisheries, is worth quoting:

"One of the reasons for this paltry support is the disappointing performance of fisheries projects. This is, in part, because of the erroneous approaches of the past, which in the 1980s focused mostly on increasing productivity while [fishery] resources were already declining, or in the 1990s on one species or types of fisheries, without the required attention to the overall ecosystem and its governance" (World Bank 2004).

This lack of involvement in sustainable fisheries activities began to change following adoption of the 2000 UN Millennium Development Goals (MDG) and of the Johannesburg Plan of Action during the 2002 World Summit on Sustainable Development (WSSD)[7]. The MDG and the WSSD both list among their goals the alleviation of poverty. It is this common goal that provided World Bank staff seeking to get the World Bank Group back into the fisheries arena a basis for action. The World Bank's involvement in fisheries now focuses on poverty alleviation and fishery sustainability rather than on its past focus of maximizing yield (World Bank 2004). Much of this involvement is part of its Program for Fisheries (PROFISH) that was started in 2005, and whose main activities include: 1) ensuring sustainable fisheries initiatives are included in national plans and poverty reduction strategies (small-scale fisheries were

[7] Johannesburg Plan of Implementation. Article 30(d) and 31 (a) Available: http://www.johannesburgsummit.org/html/document/summit_docs/2309_planfinal.doc (November 2006).

rarely taken into account when the strategies were first developed); 2) building national and regional consensus on pro-poor sustainable fisheries initiatives and activities to implement the FAO's Code of Conduct for Responsible Fisheries; and 3) aligning and enhancing international assistance on fisheries and sustainable use of aquatic ecosystems. Particular emphasis was to be on Africa, a long-standing priority region for the Bank (PROFISH 2006).

The World Bank can take advantage of its multi-sectoral structure and significant resource base to invest in providing economic alternatives to fishing communities with degraded fisheries. For instance, if the World Bank cuts off support for artisanal fishers, it can provide financial and technical aid for transition to alternative professions. The World Bank can also try to have the International Finance Corporation (IFC), a member of the World Bank Group that is limited to funding projects in the private sector, invest in developing alternative professions. Successful experiences with alternative livelihoods exist in World Bank projects in China, where most alternative employment was found in aquaculture; and in Indonesia, where most fishers found occupations outside of the fisheries and aquaculture sector. The World Bank's experience suggests that alternative livelihoods to fishing can best be promoted through community-driven development and microfinance programs (World Bank 2004). The World Bank also found that indigenous and marginalized fishers are convinced that their children need new professions and thus are receptive to alternatives, knowing that they are earning too little money for a livelihood. The World Bank is less clear, however in how to cope with the current generation of fishers.

Consistent with its past focus, but also innovatively, the World Bank has provided

funds to The World Conservation Union (IUCN) to develop a prototype for a database of "irresponsible vessels" (i.e., a public listing of vessels as defined by the FAO's International Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing, IPOA-IUU). The Bank sees this as a "market mechanism" to reduce the capital value of irresponsible vessels. It also represents an innovative way in which various islands of global governance can work together to curtail unsustainable fishing. The list would assist Regional Fisheries Management Organizations as well as national governments, and exemplifies IGO funding for an NGO, using the soft law developed by yet another IGO, such as the FAO's IPOA-IUU (Cohen 2007).

The importance of the re-entry of the World Bank Group in support of fisheries sustainability cannot be overstated. It is also important to take note of the fact that the Bank, especially in its PROFISH initiative, is moving from managing fish and fishing to recognizing the need to manage people and social change (i.e., an ecosystem approach). Indeed, there are some who suggest that the FAO's Code of Conduct itself might have been skewed toward the technical to the detriment of social solutions and thus the Bank's evolution is particularly promising and noteworthy (World Bank Group 2007).

Regional Intergovernmental Organizations

There are numerous regional (or subregional) intergovernmental organizations that have a governance role in fisheries. The importance of their role in affecting fisheries and the amount of time they have been involved in fisheries governance differs. The European Union has had a long-standing role in European fisheries throughout its evolu-

tion; and the FAO's Regional Fisheries Bodies continue to receive more responsibilities in governing their respective fish stocks. Other regional fisheries bodies that are unrelated to FAO also exist and have a varying degree of responsibilities and effectiveness in governing fish stocks within their jurisdictions. For instance there is the New Partnership for Africa's Development and its role in the African Union's fisheries; Asia-Pacific Economic Cooperation's (APEC) governance role with Asian fisheries; and the Caribbean Regional Fisheries Mechanisms (CRFM) with the Caribbean region's fisheries.

Although there are regional and subregional intergovernmental fisheries organization that are diverse in their responsibilities and approach, we will focus the remainder of this section on the fisheries governance roles of the European Union and the FAO's Regional Fisheries Bodies. Our rationale for picking these intergovernmental regional organizations is based on the fact that no other regional IGOs have as long a historical involvement with common fisheries policies as does the European Union or are as centrally involved as FAO's Regional Fisheries Bodies.

The European Union

The European Union (EU) with its current 27 members is the world's biggest market for fishery products and third largest fishing power (France 2006). The EU began its existence when six states ratified the 1952 Treaty in Paris, thereby establishing the European Coal and Steel Community (ECSC). The ECSC remained in effect until 2002. On 25 March 1957, the Rome Treaty was signed and came into force on 1 January 1958

thereby establishing the European Economic Community (EEC) and the European Atomic Energy Community (EURATOM). These three organizations, ECSC, EEC, and EURATOM merged in 1967 to form the European Communities with a single commission and council. The Single European Act (SEA), which entered into force on 1 July 1987, established the basis for a common internal market. On 7 February 1992, the Treaty on European Union was signed in Maastricht, and came into effect in 1993. The Treaty of Amsterdam, signed in 1997 and effective in 1999, amended and renumbered EU Treaties. The Treaty of Nice, signed on 26 February 2001 and effective 1 February 2003, reformed the Union's institutions so they deal more effectively with the enlarged EU. It also consolidated the previous treaties into one. Today the EU constitutes five institutions: the European Parliament that represents citizens; the European Court of Justice that is the guardian of the EU's treaties and laws; the Council of Ministers, that represents the member states; the European Council that defines the general political guidelines of the Union; and the European Commission that represents the interests of the Union. In 2004, the EU's Heads of State and Government adopted a Constitution, but it failed to get the necessary ratifications necessary for it to enter into force.

This structure of the five institutions makes the EU a unique intergovernmental and supranational union that aims to enhance political, economic, and social cooperation (Pollack 2006). To achieve these aims, the EU has divided its activities into three pillars: 1) the European Community with responsibility for internal market policies, agriculture, competition policy, immigration, asylum, as well as economic and monetary union; 2) common foreign and security policy; and 3) police and judicial cooperation in policy matters. The decision-making styles differ among the pillars. The first is supranational;

the second is primarily intergovernmental; and the third is also usually intergovernmental (Bomberg and Stubb 2003, European Union 2005).

Voting within the European Union's institutions is conducted, as detailed in the 2006 consolidated versions of the Treaty on European Union and of the Treaty Establishing the European Community[8] and the 2001 Treaty of Nice[9], by majority. Depending on the specific situation and institution the definition of majority may constitute qualified majority, two-third majority, four-fifth of majority of its members, or the majority of votes cast. The directives, decisions, and regulations passed by the European Union's are binding on its member states, leaving up to member states the means by which they are to be implemented. This can take any number of forms or may require no action at all. (Folsom 1995, European Commission Ireland 2007).

Fisheries was recognized as an important resource that needed to be managed as a common resource by the initial six founding states in 1957. These six states identified fisheries as one of the few topics upon which a common policy was explicitly agreed, and they included fisheries under the same heading as agricultural products (Rome Treaty, Article 38). The first regulations pertaining to fisheries were issued in 1970 and consisted of three measures: 1) creation of a common market organization for fisheries products; 2) structural aids for the modernization of the fishery sector; and 3) guarantees of equal

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[8] European Union — Consolidated Versions of the Treaty on European Union and of the Treaty Establishing the European Community (consolidated text). Official Journal C 321E of 29 December 2006. Available: http://europa.eu.int/eur-lex/lex/en/treaties/index.htm (30 June 2007).

[9] Treaty of Nice amending the treaty on European Union, the treaties establishing the European Communities and certain related acts. Official Journal C 80, 10 March 2001. Available: http://europa.eu.int/eur-lex/lex/en/treaties/index.htm (30 June 2007).

access for fishing vessels to the waters of all member states, subject to certain conditions (Lequesne 2005). However, it took until 1983 for the Common Fishery Policy (CFP) to evolve to something akin to its present format. The delay in instituting the current form of the CFP is related to the slow, but positive, movement towards recognizing the need for a CFP to assure the sustainability of fisheries resources as outlined below.

By the middle of the 1970s, European governments became aware of the consequences for overfishing of overcapitalization in the fisheries sector. As a consequence, the governments transferred to the EU additional powers, notably the power to conduct foreign policy in the fisheries sector (European Commission 2004) and instigated the first fisheries regulations (Lequesne 2005). This new power was used by the EU to alleviate the pressures on national fish stocks by encouraging efforts to be refocused on distant stocks (Iudicello et al. 1999), and later during the 1980s to negotiate access to previously harvested fish stocks that was now within the newly extended 200 mi Exclusive Economic Zone (EEZ) of foreign states (European Commission 2004). Thus the EU has signed, on the member states' behalf, multilateral agreements for the conservation and division of stocks in the high seas, and bilateral agreements with third countries aiming to allow access of EU vessels to fish in their waters. For instance the EU paid African countries $350 million annually in fees and grants to be able to harvest fish resources from these countries. These agreements, which can be seen as subsidies to the fishery sector, mostly helped the Spanish, Portuguese and French fleets (Iudicello et al. 1999).

The transfer of power over fisheries policy to the EU did not solve its members' fisheries problems. By the early 1980s, it became clear that the European Union's own

policies, such as the above-mentioned bilateral agreements and more specifically its structural policies, were contributing to unsustainable fishing within and beyond the members' national boundaries. Consequently, at the initiative of the European Commission's Director General (DG) for Fish, structural policies in the fishery sector were linked more strongly to resource conservation. In the multi-annual guidance programs (MAGPs), begun in 1983, the Commission's DG for Fish set fleet reduction objectives for each member state and each type of occupation before aid was granted for cessation of fishing activities or employment retraining schemes. Additionally, Regulation 170/83 was adopted in January 1983; it established for the first time a Community system aimed at the conservation and management of fisheries resources (Lequesne 2005). The objectives of this new system were to prevent unsustainable fishing; to guarantee that fishers had sustainable livelihoods, and to ensure a regular supply, at reasonable prices, to processing companies and consumers. Accordingly, each year the EU set maximum quantities of fish called total allowable catches (TACs) that could be harvested without risk of unsustainable exploitation. The TACs are divided among the member states as national quotas (European Commission 2004, France 2006).

By the 1990s, however, it was "recurrently acknowledged" that these national quotas were not enough to curb unsustainable fishing. For example, the EU's 1983 decision to reduce the size of members' fleets was adopted even as the EU continued subsidizing fleet construction and modernization at nearly twice the rate at which it was scrapping or laying up vessels; thus social peace was achieved, but EU fleets continued expanding (Iudicello et al. 1999). In 2002, the CFP underwent reform to better balance the needs of sustainable management with the socio-economic needs of fisheries. The

2002 reformed CFP consists of four general components: 1) science-based management of fish stocks for sustainable conservation; 2) development of the market and modernization of vessels to increase its profitability while eliminating overcapacity; 3); organization of the common fisheries market to assure *inter alia* product quality, reasonable prices, and fishermen's incomes; and 4) engage in third countries to gain access to fish stocks falling within the 200 mi EEZ of foreign states (France 2006). More specifically, the reform entailed: 1) matching the status of the fish stock to its regulation including the use of recovery plans for at-risk fish stocks; 2) use of multi-annual TACs and quotas to manage fish stocks; 3) a reinforced control policy for the systems; 4) modification of the structural component of the CFP so as to eliminate building assistance; 5) government aid for modernization only if it does not increase fishing capacity; and 6) requests for increased participation by the fisheries sector in developing policy (France 2006). The CFP's overall goal is to "ensure exploitation of living aquatic resources that provides sustainable economic, environmental and social conditions" (European Commission 2004). In line with this goal, it was agreed that government assistance to building was to be eliminated as of 1 January 2005 (France 2006).

Complicating the achievement of the EU's Common Fisheries Policy objectives, however, is the fact that the control over policy implementation still rests with national institutions that vary considerably in terms of resources, effectiveness, and degree of influence exerted by domestic interest groups. Moreover, states that saw the EU Commission's decisions as unfair, such as Spain whose fishers had a strong interest in gaining access to the French, Irish and British EEZs, had no problem allowing violations of quotas to continue (Lequesne 2004, Lequesne 2005). Spain's noncompliance with the

European Union Commission's decision regarding fisheries quotas is only emblematic of the state-centric nature of the actually existing global governance system for fisheries. A similar story could be told in each of the disagreements between the EU Commission and the "Friends of Fishermen," i.e. France, Spain, Ireland, Greece, Italy and Portugal (Lequesne 2005), such as the disagreements over the reform of the Common Fisheries Policy negotiated in 2002 (Andersson 2006).

Regional Fishery Bodies

There are a wide variety of diverse institutions aimed at managing and monitoring that participate in high seas fisheries. Among these are dozens of Regional Fishery Bodies (RFBs) worldwide. Traditionally most of these have had extremely limited authority and, in effect, can only provide advice to member states. Some, however, also referred to as Regional Fisheries Management Organizations (RFMOs), do have the authority and technical capacity to assess, among other things, the status of fish stocks of commercial value within their areas of jurisdiction; set limits on catch quantities and the number of vessels allowed to fish; and regulate the types of gear that can be used.

Currently ten FAO RFBs under FAO-COFI and 32 RFBs that do not directly report to COFI exist. The FAO RFBs are: 1) Asia-Pacific Fishery Commission (APFIC); 2) Comission for Inland Fisheries of Latin America (COPESCAL); 3) General Fisheries Commission for the Mediterranean (GFCM); 4) South West Indian Ocean Fisheries Commission (SWIOFC); 5) Fishery Committee for the Eastern Central Atlantic (CECAF); 6) Indian Ocean Tuna Commission (IOTC); 7) Western Central Atlantic Fishery Commission (WECAFC); 8) Committee for Inland Fisheries of Africa (CIFA); 9)

European Inland Fisheries Advisory Commission (EIFAC); and 10) the Regional Commission for Fisheries—Gulf States (RECOFI). The Indian Ocean Fisheries Commission (IOFC) was dissolved in 1999. These FAO-RFBs serve multiple purposes such as directly establishing management measures (GFCM and IOTC) and providing members with scientific and management *advice* (APFIC, CECAF, CIFA, COPESCAL, EIFAC, RECOFI, SWIOFC and WECAFC).

Some of the non-FAO RFBs are similar to the Advisory Committee on Fisheries Research (ACFR) which are actually global in scope, but categorized as regional by the FAO. The 32 non-FAO regional fisheries bodies also have as purposes the establishment of management measures, providing members with scientific management advice, or providing information and scientific advice. A 33rd non-FAO regional fishery body, the South Pacific Fisheries Management Organization, is being contemplated as a gap currently exists in the international conservation and management of non-highly migratory fisheries and protection of biodiversity in the marine environment in high seas areas of the South Pacific Ocean. As the proposed 33rd regional fisheries body suggests, FAO intends to have a network of RFBs covering the globe (Figure 4).

Most RFBs have at some point wrestled with the notion that they should become rule-makers aimed at managing unsustainable fishing. Indeed, there has been pressure on the RFBs, from members of their research staffs and advisory committees who are linked to the broader transnational fisheries scientific community, to become more proactive in this area. Additional pressure for the RFBs to become more proactive in unsustainable fishing came in the aftermath of global United Nations-sponsored conferences beginning with the Third Law of the Sea Conference, which finally concluded in 1982 with

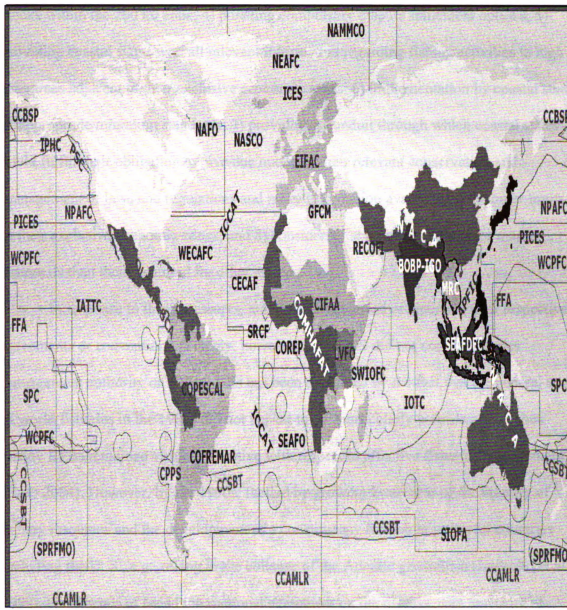

Figure 4: Map of the current jurisdiction of Regional Fishery Bodies. Modified from FAO—Fisheries and Aquaculture Department's map of Regional Fishery Bodies (FAO—Fisheries and Aquaculture Department 2008).

agreement on the Third United Nations Convention on the Law of the Sea (UNCLOS). UNCLOS suggested additional activities to be taken on by the RFBs such as: 1) protecting stocks associated with harvested stocks from depletion; 2) conserving stocks outside the 200 mi zone; 3) providing advice to coastal states on the conservation of

stocks within the 200 mi zone; 4) pursuing compulsory dispute settlement options; 5) providing coastal states with all relevant information regarding fishing activities in high seas areas adjacent to their exclusive economic zones; 6) implementation by coastal states of appropriate minimum standards; 7) providing a conduit through which coastal states could fulfill their obligation to give due notice of their relevant conservation and management of laws and regulations and make information available on the outer limits to their exclusive economic zones; and 8) considering stricter regulations for marine mammals than those required for other species.

In response to these pressures, many RFBs reviewed or amended their respective agreements or conventions. Notably, however, UNCLOS did not confer fisheries management authority on RFBs. This has been explained by the fact that the general state of world fisheries in the 1980s did not appear to be "particularly worrisome...," thus "many RFBs remained virtually inactive with respect to effective fisheries management" (FAO 2004). However, by the 1990s, fuelled by growing awareness of the scarcity of fishery resources and the development of a constituency for fish in powerful countries including the U. S., e.g., owing to the collapse of the Atlantic groundfish (Iudicello et al. 1999), the absence of broad international agreement on the management authority of RFBs began to receive increased attention. Accordingly, the need for strengthened fisheries governance through RFBs became a pressing issue. It was acknowledged that in order to be effective, RFBs needed clear mandates to manage the fishery resources in their convention areas in full conformity with international law.

During this same time period, UN member states, inspired by the 1992 United Nations Conference on Environment and Development (UNCED), adopted numerous

fisheries instruments. Chapter 17 of UNCED's Agenda 21 called for sustainable use of marine living resources on the high seas, including through the promotion of the development and use of selective fishing gear, as well as through practices that minimize waste in the catch of target species and minimize bycatch of nontarget species. Among the succeeding instruments, there are three that we want to highlight. The first is the Fish Stocks Agreement, which introduces the precautionary approach, vessel monitoring systems, and transparency in regional fishery management. The second is the 1993 Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas that requires licensing of vessels on the high seas, and that this licensing be conditioned with the abiding of international agreed upon conservation and management measures. The third is the aforementioned FAO Code of Conduct.

By the late 1990s RFBs had begun implementing the post-UNCED international fisheries instruments, with the aim of trying to rebuild over-harvested stocks; preventing unsustainable-harvest of other fish stocks; and stopping illegal, unregulated, and unreported (IUU) fishing. Thus some RFBs are clearly making important contributions to fisheries governance, *inter alia*, in the following areas: 1) promoting the development of national research and management capacity; 2) improving and strengthening data collection, handling and dissemination; 3) addressing new issues such as IUU fishing, the management of fleet capacity, the effect of the payment of subsidies and the reduction of bycatch and discards; 4) adopting management measures and resolutions relating to such issues as fishing effort reductions, the use of gear, minimum fish sizes, mesh restriction; 5) adopting rules and procedures for boarding, inspection and enforcement; and 6) taking

measures to enable the implementation of recent international instruments. The stature of RFBs in fisheries governance began to grow following the implementation of the post-UNCED international fisheries instruments. This growth resulted in expanding obligations of states to cooperate through RFBs, in part fueled by a climate of increased public demands for accountability and transparency (Swan 2004). All of these changes are exemplified by the June 2003 adoption of the Convention for the Strengthening of the Inter-American Tropical Tuna Convention.

The role of RFBs in the global governance of fisheries, and in protecting that resource, is very important. When a RFB fails in its fisheries governance objectives, this has repercussions on the fish resource as well as for relations among its members. A 1995 case in the Northwest Atlantic involving a non-FAO regional fishery body, the Northwest Atlantic Fisheries Organization (NAFO), and its members serves as a good example of repercussions linked to an RFB's governance failure. NAFO has responsibilities for most fishery resources of the Northwest Atlantic except salmon, tunas/marlins, whales and sedentary species (e.g., shellfish). NAFO has 13 members, including four coastal members bordering the convention area: U. S., Canada, France (in respect to St. Pierre and Miquelon), and Denmark, who represent the Faroe Islands and Greenland (NAFO, no date). NAFO's Fisheries Commission is responsible for the management and conservation of the fishery resources outside the members' EEZs. It annually decides on the NAFO fisheries regulations, TACs and national quotas. NAFO also has a Scientific Council, a General Council and a Secretariat. NAFO rules, however, allow member states to object to specific quota decisions made by any of its member states (NAFO, no date), resulting in the objecting state no longer being bound by the decision. NAFO is not a

supranational organization.

In 1995, as in the previous 10 years, NAFO members agreed to allocate the largest turbot quota to Canada (16,300 tons) based on its proximity to the turbot stock. The EU, representing Spain, objected to this allocation based on the fact that Spain's and Portugal's vessels had in the past taken the largest catches, and should therefore be allocated a larger quota than its 3,400 tons. By raising this objection the EU was not legally bound by NAFO's decision, and its vessels could harvest above the 3,400 tons. Indeed the EU indicated that it would abide by a self-imposed quota of 19,000 tons (DeSombre and Barkin 2002). Not surprisingly, it became apparent early during the 1995 season that the total catch of turbot in international waters would be unsustainably high. Canada first attempted to deal with the problem through the appropriate channels of NAFO, calling for a 60 day moratorium on turbot fishing. When this proved fruitless, as the EU officials ignored the request for a moratorium, Canada resorted to unilateral action.

In accordance with new fisheries legislation adopted in 1994 that allowed the Canadian Coast Guard to take enforcement steps to protect straddling stocks from ships operating beyond the 200-mi EEZ, the Canadian Coast Guard seized and impounded a Spanish trawler outside Canada's EEZ and arrested its crew. The Canadian Coast Guard claimed that the Spanish trawlers were fishing in excess of the TAC, using illegal equipment, and catching fish smaller than the minimum size allowed under NAFO rules. The EU protested that because the trawler had been on the high seas, the seizure constituted a violation of international law by the Canadian government. The EU further stated that this action undermined NAFO because a regional IGO could not operate

effectively when faced by the unilateral use of force by one of its members. In the end, after a failed attempt to have the International Court of Justice (ICJ) hear the case, as the ICJ ruled in 1998 that it lacked jurisdiction, a compromise was reached. This was initially reached between the EU and Canada, but subsequently endorsed by all of the members of NAFO. In this compromise, Canada agreed to give approximately 6,000 tons of its quota to Spain, and in return the EU accepted the TAC and its division (Dumont et al. 1995). The parties also agreed to more restrictive regulations on minimum mesh sizes for nets and for fish, and, most importantly, for increased independent observer coverage and satellite tracking of fishing vessels in the NAFO regulatory area. This latter was presumably to compensate for NAFO's historic weakness in monitoring (DeSombre and Barkin 2002).

Improving NAFO's governance and surveillance abilities might have prevented the Canada-Spain tension. Assessments of RFBs' performance, however, have shown that improving their governance abilities does not automatically enable them to be more effective at fisheries management. Any of several other constraints can hinder a RFB's management abilities. The first is their focus and structure. The single species focus of four out of eleven international fisheries commissions established before 1977 is an obvious problem when trying to address issues like unsustainable fishing. Similarly the "tight compartmentalization" within fisheries commissions makes issue-linkages difficult, thus making it hard to induce cooperation among members through side-payments. Furthermore, the lack of necessary authority is also a hindrance. All eleven of the pre-1977 commissions are mandated to discuss implementation and propose improvements for managing the fishery. This allows them to discuss the topic of

improving the currently lax enforcement (Peterson 1993). The commissions, however, cannot monitor or evaluate whether or how members are trying to increase enforcement, because the individual members report on their own actions (Peterson 1993). The NAFO example underscores the serious consequences of 'weak' enforcement abilities of commissions as this can result in unilateral action, including legislation; exploitation of fish on the high seas; and the use of force; even by countries considered among the most law abiding.

The personal goals and behavior of member governments within a RFB can also influence whether a RFB will succeed or fail as a fisheries governance institution. Hall (1998) believes that fisheries commissions tend to incorporate incompatible objectives, such as the strict requirements for conservation through rational use, and the participants' common objectives for maintaining employment within their domestic fishing sector. As countries are under considerable pressure to meet their short-term political goals, even if it is to the detriment of the overall conservation goal, this incompatibility in objectives will often contribute to the failings of a fisheries governing body (Hall 1998). In many ways NAFO's quota disagreement between Spain and Canada exemplifies this point. Other factors contributing to the success and failure of a RFB as a global fisheries governing institution include: 1) the lack of willingness on the part of member states to delegate sufficient decision-making power and responsibilities to RFBs; 2) institutional arrangements; 3) mandate and functions; 4) data provided by members; 5) budget and finance; 6) capacity; 7) authority and enforcement mechanisms; 8) nonparties undermining measures; 9) cooperative management; 10) partnerships/stakeholder participation; 11) collaboration with other RFBs; 12) political will to implement

decisions; 13) acceptance of international instruments; and 14) dispute settlement mechanisms (FAO 1992).

Non Governmental Organizations

International nongovernmental environmental groups are especially important in the global governance of fisheries. They serve to bring together individuals that share a common perspective on fisheries issues. Even though they do not have real authority over fisheries stocks, they have played important roles in fisheries governance. For instance NGOs were important in the politicizing of overfishing and lobbying governments and intergovernmental organizations to act on the issue. NGOs also can be important in helping shape the agenda and setting priorities as to which issues are to be attended to first. A statement by the World Wildlife Fund (WWF) is emblematic of this ongoing work by NGOs:

"You may not have noticed, but fish have gradually been getting smaller and smaller. There aren't enough adult fish in the sea to meet demand, so fishermen are catching baby ones. The fish on your plate probably didn't live long enough to reproduce; as a result the stock it came from didn't get a chance to recover. Scientists have been warning the politicians about the disastrous effects of over fishing for years, but the powers that be chose to stick their heads in the sand and think of the short term. Well now it's their last chance. This year [2002 ed note], ministers will vote on the future of the EU common fisheries policy. Unless they make radical changes, marine eco-systems will be destroyed and fish will become a rare delicacy. If we don't stop over fishing now, fishing will be over. . . " (NAUI, no date).

NGOs have also been central in calling for less traditional global governance institutional fora to address issues that they believe are festering. The call by the Deep Sea Conservation Coalition, comprised of such NGOs as Greenpeace International, Seas at Risk, and the International Oceans Network, for the UN General Assembly to take up issues like the threat to deep-sea biodiversity from bottom trawl fishing in areas beyond national jurisdiction on the high seas, exemplifies these general observations. Their rationale for the use of the UN General Assembly, instead of regional fisheries organizations, in this case was multi-faceted: 1) the UN General Assembly would be more effective in facilitating a coordinated approach by the international community given the current lack of effective governance over the high seas; 2) most of the high seas areas of the world's oceans are not covered by regional fisheries organizations with competence to regulate bottom fisheries; 3) in the areas where such organizations exist, with the exception of the CCAMLR, they have not regulated any bottom trawl fisheries for the impacts on deep-sea corals and other vulnerable deep-sea ecosystems within their area of competence; and 4) although the FAO has competence to advise on governments' exploitation of high-seas species, it lacks the expertise to suggest needed action to identify and protect the high-seas' biodiversity in deep-sea areas (Deep Sea Conservation Coalition 1994). Interestingly, the International Coalition of Fisheries Associations (ICFS), an NGO comprised of national fishing trade groups of the leading fishing countries, called for the RFMOs to take up this challenge, with the General Assembly to seek technical advice from the FAO (International Coalition of Fisheries Associations 2006).

Environmental NGOs also use more traditional fora to achieve their global

fisheries governance related objectives. They frequently use public pressure to have national policy-makers change national regulations, or to have them create international pressure to regulate fishing activities. This point is underscored in DeSombre's (2000) research on why the United States government pressed for international regulations relating to krill and finfish when neither of these fisheries is economically important to the U.S. She found the answer in terms of environmental concerns pressed by NGOs on the U.S. government for the international regulations.

The Greenpeace Foundation, later joined by other environmental NGOs were integral to the process culminating in banning purse seine to capture tuna (DeSombre 2000). Their success came from their ability to link the capture of tuna to mortality of dolphin, a mammal for which U.S. citizens have such strong affinity that they treat it in a kind of iconic way. Given the aforementioned lack of enforcement powers of the RFBs, the U.S. NGO environmental group focused on pressuring the U.S. government into pursuing a ban on the use of purse seines when harvesting tuna, including through U.S. legislation restricting imports of tuna harvested that way. This success landed the U.S. government into trouble with the GATT. A GATT, and subsequently WTO, dispute settlement panel saw the ban of the sale of tuna caught by purse seines as an interference with free trade, i.e., a kind of nontariff barrier. In order to comply with the GATT and WTO, the U.S. government could not prohibit the sale of nondolphin-safe cans of tuna in the U.S. As a consequence environmental NGOs adopted a market strategy of encouraging a consumer boycott of tuna not marketed as dolphin-safe. Significantly, foreign tuna fleets began to switch their techniques for catching fish because the cost of the loss of the U.S. market was greater than the costs of changing the methods of capture

(Barkin and DeSombre 2000).

Similar pressures by environmental NGO lobbyists were also successful in the establishment of The Agreement on the International Dolphin Conservation Program (IDCP). The IDCP is an international agreement that was signed in Washington on 15 May 1998 and entered into force on 15 February 1999, following ratification by the required minimum of four states: Ecuador, Mexico, Panama, and the United States. This Agreement was to a large extent simply formalizing two earlier voluntary agreements, the 1992 La Jolla Agreement and the 1995 Panama Declaration. The IDCP has three objectives: 1) to progressively reduce incidental dolphin mortalities in the tuna purse seine fishery to levels approaching zero; 2) to seek ecologically sound means of capturing large yellowfin tunas not in association with dolphins, with the goal of eliminating dolphin mortality; and 3) to ensure the long-term sustainability of the tuna (and related) stocks within the Agreement area. DeSombre's research also made clear that the U.S. government was cognizant of potentially countervailing pressures from U.S. fishers and groups lobbying on their behalf (DeSombre 2000). This awareness is illustrated by the U.S. decision to pressure for international restrictions on driftnets, and later, for similar restrictions on purse seines when used in the capture of tuna. Whereas, NGOs in the U.S. and the U.S. government did not pressure for the implementation of similar regulations regarding the severely depleted, and even endangered, fisheries like cod, haddock, hake, plaice, herring, halibut, Pacific Ocean perch, or even sturgeon until after they had been severely overfished (DeSombre 2000).

What these cases show is that NGOs are becoming increasingly important actors in the global governance of fisheries. The success of NGOs, however, depends on

funding, which oftentimes means turning to governments, intergovernmental organizations and foundations, all of which have their own set of priorities, at times not coincident with the priorities of environmental NGOs. Additionally, the success of NGOs continues to depend on their ability to garner widespread citizen support, and while the communication revolution has assisted here, media interest remains critical and the media's interest is always focused on the sensational. Thus the extinction of fisheries gets some media attention, but advocating the precautionary principle or the need to enhance RFBs' powers does not necessarily capture the media's attention.

Nonstate, Market-Driven, Governance Systems

Private, market-based entities, such as multinational corporations, are becoming increasingly important actors in global environmental governance, including fisheries governance. This is not an entirely new phenomenon. During the 19th century, such entities often set international norms that facilitated business in a liberal world economy; although the norms they set were usually overtaken by states fairly soon after their development. The recent increased growth of nonstate market-driven governance systems (NSMD) has often been explained by the growing recognition of the inability of states to meet the challenges of the 21st century. This explanation is especially pertinent to the establishment and implementation of global environmental norms (Clapp 1998).

In NSMD policy-making, authority is not derived from the state, but from the manipulation of global markets and attention to or manipulation of customer preferences. The popularity of NSMD comes from both a disappointment over the ineffectiveness of

state-derived solutions for sustainable fisheries, and also from growing interest in neo-liberal policy ideas, including the use of voluntary compliance and market mechanisms. The success of such undertakings seems to rely strongly on their perceived legitimacy by key stakeholders such as consumers, suppliers, and other organizations in the supply chain. These supporters then put pressure on producers to accept the rules, as well as social interests including labor, and the media (Cashore 2002). This so-called privatization of governance seeks to use market-oriented consumerism to force policy changes.

Market-based consumer boycotts are one example of NSMD governance systems that are becoming a more popular and pervasive element in global fisheries governance. Their goal is to rely on the market's supply chain to create incentives and force companies to comply with norms and/or legally binding accords. The idea is that consumers will express their preferences for environmentally friendly products, spurring producers to sustainable management practices (Gulbrandsen 2005). Two examples of successful market-based consumer boycott applications, as NSMD governance, are the use of eco-labels, and the voluntary ban of swordfish *Xiphias gladius* by American chefs to protect declining stocks.

Eco-labels are an evolving NSMD governance innovation that relies mainly on the moral suasion of customers and strategic market moves made by producers and professional purchasers. These types of programs normally establish environmental performance standards, as well as establishing standards for socially and economically responsible production. The use of eco-labels first began with the establishment of the Forestry Stewardship Council (FSC) to address rampant resource depletion and

insufficient state action. In the fisheries industry, although dolphin-safe tuna and turtle-safe shrimp labels existed, the first global multi-criteria and certification and labeling scheme for fisheries came from the establishment of the Marine Stewardship Council (MSC) in 1996. The World Wildlife Fund (WWF) a NGO, partnering with one of the world's largest purchasers of fish, the Unilever food conglomerate, set up the MSC, which was modeled after the Forestry Stewardship Council. The MSC is a not-for-profit organization with a small budget, with established principles that are based on the 1995 FAO Code of Conduct for Responsible Fisheries, and with established criteria for its definition of "well-managed fisheries. " The MSC's prescription includes: to stop overfishing; to respect laws and standards; to include consultations with stakeholders; to encourage the use of dispute resolution mechanisms, as well as to assess research plans and procedures for effective enforcement and compliance. MSC views its role as complementing international regulations, not replacing or supplanting them. Some have criticized the MSC's standards for vagueness and perpetuating the status quo. Others have argued that any standards accepted by MSC must be acceptable to multiple stakeholders, and thus are inevitably flexible and compromised. As a consequence, in 2006, the MSC proposed a new standard setting procedure, one that was opened to review and commentary by all stakeholders.

The MSC's certification process is time-consuming, transparent, and now open to stakeholder participation and objections. The MSC requires chain-of-custody tracking, i.e. a paper trail, to ensure that products carrying its logo actually originated in a certified fishery. It seeks to empower consumers. The WWF and Unilever have tried to encourage leading retailers in target countries to stock MSC-labeled products, calling them "The

Best Environmental Choice in Seafood. " As of 2007, over twenty fisheries had been certified in Europe, Australasia and North America, totaling more than 1.8 million tons of seafood. Given that the Asian (especially Chinese) seafood markets, which are by far the world's largest markets, have yet to see any MSC products, the accomplishments of the MSC to date have been modest. Indeed, as with the FSC, the MSC's most significant impact may be the formal and informal understandings among states and private actors regarding what should be regulated (McNichol 2006). Even though these accomplishments have been relatively modest and nonmeasurable, this has not kept some individuals and groups from accusing the MSC of eco-imperialism. Their accusation arises from the fact that most of the fisheries in the developing world have not yet acquired MSC certification. Indeed, some economically less developed countries have complained to the WTO's Committee on Trade and Environment that the MSC scheme is a *de facto* barrier to trade. However, they do not seem to have much of a case against the MSC, because all countries still permit the sale of nonlabeled fish. Additionally, economically less developed countries' *internal* markets have not been affected by the MSC as the MSC products are produced for the export market.

The 1988–2000 "Give Swordfish a Break" initiative is another example of a NSMD governance application (SeaWeb 2002, Knecht 2006, SeaWeb, no date). This country-wide effort by chefs, in conjunction with the SeaWeb and Natural Resources Defence Council NGOs, aimed to reduce the consumer demand for North Atlantic swordfish in the United States. This campaign was a response by concerned chefs to the decline in average swordfish size from 260-lbs in the 1960s to about 100-lbs in the 1980s. The campaign began with 27 U.S. East Coast chefs refusing to serve swordfish until a

recovery plan for the depleted stock was devised and implemented. The decline was related to the shift in harvest method from traditional harpooning to the more effective longlines. This change in harvest method resulted in much larger catches of adults, as well as higher mortality of juveniles because longlines do not discriminate between adult and juvenile swordfish. The increased mortality in both age groups resulted in decreased numbers of swordfish, reduced catch size, and smaller swordfish being sold in the market. This campaign resulted in over eight hundred chefs removing swordfish from their menus (Knecht 2006). This NSMD pressure resulted in President Clinton banning the sale and import of North Atlantic swordfish smaller than 33-lbs on 12 June 1998. This Presidential ban was followed by the National Marine Fisheries Service's (NMFS) ban on the importation of swordfish under 33-lbs, and support from 78 members of Congress in the form of a letter to Secretary of Commerce William Daley on 12 March 1999 asking for stronger government protection of swordfish. This culminated with the NMFS finalizing and revising a swordfish recovery plan in 1999 and 2000. Additionally, this attracted the interest of the International Commission for the Conservation of Atlantic Tunas (ICCAT), which adopted quotas during its 1999 Rio de Janeiro meeting for a three year period that could substantially contribute to the recovery of the population. The campaign proved successful, as the ICCAT scientific committee estimated in 2002 that the North Atlantic swordfish population had reached 94% of its full recovery (SeaWeb 2002, SeaWeb, no date).

These examples show that NSMD governance systems are often able to achieve their ends. Specifically, doing what states are unwilling or incapable of doing. This, however, obviously comes with risks. For instance, such governance structures are

largely unaccountable and can result in higher prices for goods with all of the stratification consequences that this implies. Furthermore, actions resulting from private governance processes can be based on poorly done scientific research or no science at all.

Evaluation of Actually Existing Global Fisheries Institutions

We began with a discussion of key intergovernmental organizations operating in the fisheries regime. The examples we used illustrated both the positive and negative aspects of actually existing global fisheries institutions. Below we summarize the key limitations and strengths that our discussions of these institutions revealed.

The WTO and the FAO are both actively engaged in addressing the critical and contentious issue of fisheries subsidies, but, to date, they have merely set the stage for the hard decisions. Were they to identify certain subsidies as clear interferences with free trade and thus violations of the GATT, they could provide NGOs and other interested parties with the potential for cases to be brought against the offending countries. We are, however, not there yet. Furthermore, as the FAO operates within even greater constraints of the state-centric world, its major contribution so far has been soft law. This is due to FAO's member states' unwillingness to agree to a legally binding fisheries code of conduct.

The huge resource base of the World Bank means that its impending return as a major actor in fisheries governance could be quite significant. Those resources, of course, mean that the World Bank is less beholden to member state pressures than are other organizations. This is especially true as the IBRD's funds are raised on the world's bond markets and not contributed by member states. To date, however, the World Bank's

activities either have been "paltry," contributed to unsustainable fishing, or contributed to the expansion of aquaculture, which has its own serious challenges, including those relating to health and safety.

The EU, like the World Bank, took some time in recognizing that its policies were actually contributing to unsustainable fishing. More revealingly, however, our research has shown that the almost unique supranational organization, the EU, was not always capable of enforcing adherence to regional policies above individual state and local interests. Not simply did some member states (and individual fishers) seek to undermine EU policies that they found unfair, but these member states, as we saw in the turbot case, were able to find the EU supportive of their attempts to increase their catch, even to the point of being unsustainable.

The unwillingness of the RFBs' member states to delegate some of their authority over their fisheries, has resulted in the RFBs rarely receiving the sort of autonomy they need to be able to effectuate the policy recommendations coming from their quite able scientific advisors. Steps to empower the RFBs have been helpful, but as with international conventions they are often undermined by nonparticipants or consistent objectors. Moreover, these RFBs need to cooperate more effectively with environmental governance bodies, including the United Nations Environmental Program's (UNEP) Regional Seas Commission.

On a slightly more positive note, we have found evidence of NGOs and NSMDs trying to fill in where governments have been found wanting. Nevertheless, as of 2008, the impacts of NGOs and NSMDs have been relatively limited. While it is good that NGOs tie together fisheries bodies and environmental bodies on the national and

intergovernmental level (Riscard 2002), direct interactions would be preferable, akin to the cooperation we noted in terms of the World Bank and the IUCN.

Each of these existing global governance institutions has its own shortcomings regarding fisheries governance. They, however, also illustrate that we are moving away from solely state-centric fisheries governance institutions towards more robust, ideal global fisheries governance institutions as defined by us earlier in this chapter. The mere fact that NGOs recognize the inadequacy of the actually existing global fisheries regime, and thus search for alternative ways to obtain the desired effect that could more easily be reached through an ideal global fisheries governance institution, illustrate that people are realizing, at some conscious or subconscious level, that a holistic, integrated global governance system is needed for some fish stocks to maintain or restore their sustainability. This growing awareness should facilitate the eventual acceptance of ideal global fisheries governance institutions, which is what we explore in the next section.

Moving Toward Ideal Global Fisheries Governance

While it is fair to suggest that the dominance of states in the actually existing global fisheries governance is, in some places, on the decline. It would be naïve and unhelpful to suggest that the solution to the governance challenge is for the Westphalian state-centric system of states to come to an end. That is not in the cards, or at least not in any deck on the horizon, and it might not be welcomed in any event. More practical is the call for changes in existing global fisheries governance institutions, which while not limited to these suggestions, should include the following. First, there should be greater inclusiveness in the key governance bodies. This means the inclusion of corporate and

other private actors in decision-making arenas, including the regional fishery bodies and multilateral development banks and NGOs, truly representative of the interests of their constituents, including individual fishers. Secondly, RFBs should prioritize the development of comprehensive, binding agreements relating to sustainable and quality controlled aquaculture. This is imperative as the demand for fish is ever-increasing, while the supply of capture fisheries is stable or declining. Thirdly, efforts need to be undertaken to globalize nonstate market mechanisms like the MSC. Asian fisheries are too important to be absent from such private governance schemes. Similarly, further global attention needs to be focused on fisheries in Africa, including lobbying the European Union to minimize the impacts of European fishing fleets on West African marine resources. Furthermore, efforts need to be taken to concretize and codify what heretofore have been important soft law concepts, including the precautionary principle and sustainable fisheries. Only then can such concepts be meaningfully applied by key global governance organizations, including the WTO. Additionally, better data on catch and effort, costs, revenues, prices and employment are needed if effective policies are to be devised. Lastly, the ecosystem orientation beginning to take hold in the World Bank's PROFISH initiative needs to become pervasive, and cooperation between institutions, such as the FAO, the World Bank and the IUCN, need to become the rule rather than the exception.

Three somewhat more radical ideas are worthy of being fleshed out and warrant further consideration if not actual adoption. One is based on the assumption that the world doesn't have much more time to address the challenges of the emptying ocean. Riscard calls for building issue networks comprised of people from national

governments, international civil society and firms, whether they are part of the problem or part of the solution. These individuals would be responsible for promulgating soft law, which he considers significant because of its potential for compliance by key actors. Lacking formal regulatory authority, such a network's power and influence would depend on how the participants' reputations could be affected through exposure and disclosure of their actions by the media. His model is based on the Financial Action Task Force that was organized as a reaction of key global actors to the exposure of money laundering related to terrorist acts (Kaul et al. 1999). This need for building a issue network could also be accomplished as done by the Dublin Group, which brings together drug enforcement agencies from the EU, USA, and other countries (Kaul et al. 1999). This, of course, sounds much like the sorts of transnational advocacy networks that are described by Keck and Sikkink (1998), the transgovernmental networks described by Keohane and Nye (1974), and the government networks described by Slaughter (2004). Keck and Sikkink's networks (1998), like those called for here, involve civil society as well as governmental and intergovernmental actors. Keohane and Nye's (1998) and Slaughter's (2004) focus is more state-centric, but importantly, Slaughter underscores the key role played by judges in contemporary global governance. The relevance of this latter in fisheries governance has been noted by our earlier allusions in this chapter to the European Court of Justice and the International Court of Justice. Those, of course, are simply the pinnacle judicial actors; judges in domestic courts and arbitrators are similarly relevant.

The second suggestion, establishment of a UN Global Trusteeship Council, would take more time to implement. This idea has taken a number of forms. The Commission

on Global Governance proposed transforming the UN's moribund Trusteeship Council into an oversight body responsible for insuring that the globe's commons, including its fisheries, were protected (Commission on Global Governance 1995). Here the focus of attention would be on intergenerational issues (Kaul et al. 1999). It would also provide a forum for key global actors to be creative in the means for achieving sustainable fisheries. While the focus on intergenerational issues is valuable, it is also too limiting. Intra-generational concerns also are critical and need to be incorporated.

A third idea, that is also suggested by others, and which is similar to the suggestion by Kaul et al. (1999), consists of using the UN Global Trusteeship Council as a "think tank" of creative and committed individuals or interlocutors, rather than as a major intergovernmental organ of the UN. In their suggestion, there would be a new UN Global Trusteeship Council that would act as an honest broker on behalf of more sustainable and people-centered development (Kaul et al. 1999). Such a council's primary mandate would be to aid the UN Secretary-General in situations where individual states, acting in their own self-interest, would be unable or unwilling to implement the policies that could result in the long-term, collective benefit of all states (Kaul et al. 1999). Their idea has a lot in common with what Cox fifteen years ago saw as one of the key functions of intergovernmental organizations (Cox 1992).

The press of time suggests the need to pursue our practical agenda now, while assessing the feasibility and desirability of a UN Global Trusteeship Council, either as a major organ of the UN or as a kind of global think tank. Regardless of the selected pathway used to move closer to achieving ideal global fisheries governance, the overarching goal remains the same, sustainable use of all fisheries for the benefit of all

people.

Conclusions

Fisheries management and associated science have rapidly evolved in their understanding of the needs for the successful, sustainable management of fisheries by shifting from a species focus to an ecosystem approach. We have shown that fisheries governance has been slow to mirror a similar evolution. This delayed, although necessary shift towards a global fisheries governance is most likely due to the hesitance of countries to forego significant elements of their sovereignty.

As this chapter suggests, however, the actually existing global governance system is constantly evolving as it seeks to meet the challenges of a technologically-driven era of increased globalization. Globalization may, in some situations, have a role in terms of limiting a state's sovereignty and autonomy, and thus assisting in moving towards the ideal global fisheries governance. For instance the ability of the World Bank to include provisions about fisheries management in their poverty reduction strategies, may make economically desperate Countries agree to these fisheries provisions because of their need for assistance. Conversely, at other times and places, globalization may actually enhance the power, or at least not significantly weaken a state's sovereignty, especially in economically developed states, as seen in the case of the WTO and dolphin-free tuna. While the responses to the increasing fishing pressures have been creative, in terms of hard and soft law, NSMD mechanisms, and with major re-orientations of intergovernmental organizations, the persistence of a state-centric governance system still

seems to fall short of confronting the tragedy of the commons. The scope of the threat to fisheries resources requires a more, holistic, 'ecosystem' based governance approach, an ideal global fisheries governance. We need to move towards a global fisheries governance system that can more effectively address the needs of fisheries, especially shared fisheries and those located outside of EEZs.

This need for an ideal global fisheries governance approach extends to the need for better coordination and sharing of research findings from all levels of governance: subnational, national, intergovernmental and supranational. UN global conferences have been convened to try and address some of these gaps, linking fisheries and environmental bodies, even setting ambitious time-bounded goals such as those in Johannesburg. However, there appears to be a lack of interest by states to take the global leadership role often needed to get the UN to convene such a conference, or leadership from NGOs and media to spur this interest. Thus, we have yet to have a global *ad hoc* conference on sustainable fisheries that is on a scale comparable to those dealing with other critical global problems, such as human rights or the environment. Additionally, the UN's highly touted Millennium Development Goals seemed to overlook fisheries as much as had the African leaders when initially promulgating the New Partnership for Africa's Development (NEPAD).

The progress made towards a more global fisheries governance among the FAO's RFBs and the potential for the World Trade Organization to be a leader in banning fisheries subsidies, are only a few examples providing hope. It is, however, too soon to say whether something short of ideal global fisheries governance will be adequate to achieve sustainable fisheries. We hope so, because we do not expect that this goal of

achieving the ideal global fisheries governance will be realized in the foreseeable future.

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CHAPTER THREE

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CHAPTER THREE

Multijurisdictional Management of Lake Sturgeon in the Great Lakes and St. Lawrence River

Introduction

The presence of multiple entities with management authority of a shared natural resource, such as the lake sturgeon, can easily result in confusing and often opposing management strategies. Jurisdictional stress can also occur on a resource when there are numerous and different pressures being applied to the shared resource, resulting in the demands exceeding the capacity of the resource (Ferreri et al. 1999). These problems, however, can be minimized through integrated multijurisdictional management of the resource, which requires that the jurisdictions, whether within a country or between countries, work together to manage the resource. When a successful cooperative management of a shared resource is attained, this can improve the management of a shared fishery resource as well as achieving the most efficient and effective use of the limited fiscal and personnel resources available to each jurisdiction.

As a result of the extensive distributional range of lake sturgeon in the Great Lakes-St. Lawrence River system, numerous federal, provincial, state, and aboriginal jurisdictions have fisheries management authority for the species in the basin. Each of these jurisdictions has its own regulations and management plans for lake sturgeon, and this has resulted in differing management actions to protect the species. As a result of the multitude of management plans, lake sturgeon populations in the Great Lakes-St. Lawrence River currently support a variety of recreational fishing, aboriginal subsistence

fishing, and a limited lake sturgeon commercial harvest (Todd 1999) in which both non-aboriginal and aboriginal fishers participate while in the other areas harvest is prohibited (e.g., Lloyd Mohr, Assessment Biologist Upper Great Lakes Management Unit, Ontario Ministry of Natural Resources, Personal Communication).

Reflecting the myriad of management plans, the opinions of fisheries managers in the Great Lakes-St. Lawrence River system are divided on whether or not the lake sturgeon populations are sufficiently large to support the current recreational fishing and commercial fishing harvest levels. Nonetheless, the vast majority of managers in the Great Lakes basin do appear to share the concern that the future of lake sturgeon may be threatened by the continuation of the current harvest level. Furthermore, there is significant worry about a potential increase in harvest in response to the international demand for sturgeon products (Hoover 1999). This chapter will examine some of the regulatory features that enhanced the survival of lake sturgeon in the Great Lakes-St. Lawrence River ecosystem, the growing interest in managing lake sturgeon using an integrated, consensual, multijurisdictional approach, and the impact of the international market on this fishery and rehabilitation initiatives.

Lake Sturgeon in the Great Lakes-St. Lawrence River

The abundance of lake sturgeon in the Great Lakes-St. Lawrence River was severely depressed as a result of intense harvesting during the mid 1800's for their caviar and flesh (Scott and Crossman 1998, Ferguson and Duckworth 1997, see chapters by Saffron and Auer), and by human induced changes within the Great Lakes-St. Lawrence watershed that negatively impacted lake sturgeon populations (Scott and Crossman 1998,

Stegemann 1994, Moisan and Laflamme 1999, see chapter by Auer). With the drastic decrease in lake sturgeon abundance, most fisheries managers and ecologists believed in the early to mid 1900s that lake sturgeon would eventually disappear as a result of compounding negative pressures (Smith 1968). However, lake sturgeon in the Great Lakes proved to be more resilient than previously assumed, and despite the polluted waters, loss of habitat, and over harvesting pressures; populations of lake sturgeon persist throughout the Great Lakes and St. Lawrence River region (e. g. Houston 1987, Fortin et al. 1993, Thomas and Haas 2002).

In addition to the work undertaken by fisheries management agencies, the passage of regulations likely played an important role in enabling lake sturgeon populations to persist. These include: the enactment of federal, provincial and state laws aimed at protecting endangered species, and improvement of water quality through the International Joint Commission.

International Joint Commission

The International Joint Commission (IJC) was established by the *Boundary Waters Treaty* in 1909, to provide the principles and mechanisms to resolve and prevent disputes about water quantity and quality along the boundary between Canada and the United States, including in the Great Lakes Region (IJC 1989). The role of the IJC in restoring and maintaining the chemical, physical, and biological integrity of the waters of the Great Lakes basin ecosystem was increased significantly in 1972 and again in 1978, with the signing of the *Great Lakes Water Quality Agreement* (Beeton et al. 1999, IJC 1989).

The 1978 *Great Lakes Water Quality Agreement* (GLWQA) proposed to maintain the upper Great Lakes' higher water quality standards and to restore and enhance the water quality in the lower Great Lakes. To achieve these goals the GLWQA focused on diminishing anthropogenic eutrophication and the concentration level of toxic substances in the Great Lakes. To reduce anthropogenic eutrophication, phosphorous inputs were successfully lowered by building and improving wastewater treatment plants in Canada and United States and by reducing non-point source pollution (Beeton et al. 1999). To decrease the levels of persistent organic chemicals and heavy metals in the Great Lakes, these types of chemicals were banned from the region (Environmental Canada 1991, DeVault et al. 1994). Subsequent to these bans, the concentrations of these contaminants in the Great Lakes' biota, including fish, decreased rapidly, and markedly (DeVault et al. 1994).

Lake sturgeon, similarly to other Great Lakes biota, were impacted by the degradation of the Great Lakes habitat and water quality (Smith 1972). Lake sturgeon foraging and spawning sites most likely were negatively affected by logging, urbanization and agricultural activities that increased sediment and nutrient load input into the lakes' tributaries and into the Great Lakes. This reduction in water quality combined with the increase in sediments altered the benthic community, covered fish spawning area with silt, and led to the depletion of dissolved oxygen (Beeton et al. 1999). In addition, lake sturgeon being a long-lived benthivore with high lipid content is susceptible to the bioaccumulation of contaminants (Moisan and LaFlamme 1999). Thus, the presence of biologically toxic contaminants in the water and sediments of the Great Lakes, which cause reproductive failure and negatively affect the survival and

reproductive success of fish (IJC 1991, USEPA 1992), could have impaired lake sturgeon. Indeed, Doyon et al. (1999) found that the percentage of lake sturgeon physical deformities was higher in lake sturgeon residing in polluted waterways than in non-polluted system, and that these deformities affected the offspring of adult sturgeons living in these polluted areas. Thus, the water quality improvements likely benefited populations of the lake sturgeon in the Great Lakes-St. Lawrence River basin, by improving the quality of habitat used for spawning and foraging in addition to decreasing the level of biologically toxic chemicals and their impacts on the lake sturgeon.

Protection of Endangered/Threatened Species

The Endangered Species Act of the United States

The United States passed *the Endangered Species Act* (ESA) in 1973 (USFWS 1996, Czech and Krausman 2001), which aims to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species" (USFWS 1988). In this act, conservation refers to "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this ESA are no longer necessary" (USFWS 1996).

Presently, the ESA may be the most comprehensive and powerful species protection act worldwide (Reffalt 1991, Stanford Environmental Law Society 2001). One of the strengths of this act is that it requires all federal agencies to actively work towards

the conservation of listed species, to develop and implement conservation programs for endangered and threatened species (Stanford Environmental Law Society 2001), and to provide federal funds to States, under a cooperative agreement with the Secretary of the Interior, to establish and maintain active programs for the conservation of endangered species and threatened species (Kohm 1991, USFWS 1996). Although, the ESA currently addresses the conservation of species, many managers see the need to further increase the protection of genetically unique fish strains within a species (e.g., Lowie 2000).

In 1982, lake sturgeon were being considered as potential candidates for protection under the ESA. As such, lake sturgeon were listed in the United States Federal Notices of Review Register as a Category 2 (C2) species (Klar and Schleen 2001). This category is assigned to a species that is being considered for potential listing as either a threatened or endangered, but for which more information is needed about the species status prior to making the decision of whether or not to include the species on the list. The C2 listing of lakes sturgeon was maintained through 1994 as indicated in the 1994 Federal Notice of Review Register (vol. 59, no. 219, Dept. of Interior F. W. S. 50-CFR-part 17); but in 1995, lake sturgeon were listed as a species at risk (Klar and Schleen 2001), thus the species does not receive protection under the ESA. The decision not to list lake sturgeon was based on the assessment that there was a minimal threat to the species survival at that time (Charles Wooley, Assistant Regional Director, U.S. Fish and Wildlife Service, personal communication). Although lake sturgeon are not listed under the ESA, the inclusion of lake sturgeon in the federal notice for twelve years as a C2 species, and the resulting possibility that lake sturgeon would be listed, most likely provided the incentive for all agencies to more closely monitor the health and status of

their lake sturgeon populations, and to provide appropriate management plans for their restoration. Currently, several states list lake sturgeon as being either threatened or endangered within their jurisdiction, based on lake sturgeon's population decline and current abundance in their waters (Table 1).

Canada's COSEWIC and SARA

In Canada, the provincial and federal governments both have responsibility for the fish and the fisheries within all inland water bodies such as the Great Lakes-St. Lawrence River (Thompson 1974). The provincial government of Ontario and Quebec have the authority to regulate the licensing of fishing within their province (Thompson 1974), as outlined by the Ontario Fish Licensing Regulations (Fish and Wildlife Conservation Act, 1997, Ontario regulation 664/98, *amended to o. reg. 546/00,* fish licensing), and the Québec Fishing Activities Regulation (An Act respecting the Conservation and Development of Wildlife, R. S. Q. C-61. 1; Fishing Activities Regulation, R. R. Q. C-61. 1,r. 0. 00001. 1). The Canadian federal government regulates the fishery for its conservation and protection through the Federal Fisheries Act. Generally, however, the provinces of Ontario and Quebec, on behalf of the federal government will enforce the provisions of the Fisheries Act within their territory. Nonetheless, even though the provincial and federal governments share the responsibility for inland fish and fisheries, the federal law can override the provincial law if the federal government believes that the health of the Great Lakes-St. Lawrence River fishery is threatened by the existing provincial law (Dochoda 1999).

In 1977, the federal government established the Committee on the Status of Endangered Wildlife (COSEWIC) in Canada to aid in the protection of the fauna and flora (Rishikof 1997, COSEWIC 2002a,b, Egan 2002). This committee has the responsibility of assessing "the status of wild Canadian species, subspecies, and separate populations suspected of being at risk...[based on] the best up-to-date scientific information and Aboriginal traditional knowledge available" (COSEWIC 2002a), and lists species that it assesses as being at risk in terms of its survival within Canada (Freedman et al. 2001). Listing of species by COSEWIC is based on several criteria including that the species must be native to Canada, its abundance, and how dependent the species' survival is on habitat located within Canada (COSEWIC 2003). In addition, the Canadian Wildlife Service (CWS), to assist with the efforts of protecting the species listed by COSEWIC, created an endangered species unit in 1978 (Bocking 2001), and then enacted the Recovery of Nationally Endangered Wildlife (RENEW) program in 1988 (CWS n. d., Freedman et al. 2001). The RENEW program was implemented to coordinate the recovery efforts between federal and provincial government agencies and non-governmental organizations, for the species listed by COSEWIC (Bocking 2001).

More recently, after many failed attempts, the federal Bill C-5, named the *Species at Risk Act* (SARA), passed through the Canadian House of Commons in 2002 (HC 2002), with two-thirds of SARA being in effect by 5 June 2003 and with a projected date of 1 June 2004 for the entirety of SARA to come in effect (http://www.sararegistry.gc.ca/gen_info/HTML/approach_e cfm, Environmental Canada 2002). SARA is an act "respecting the protection of wildlife species at risk in Canada" (HC 2002) and "to protect wildlife at risk from becoming extinct or lost from the wild,

with the ultimate objective of helping their numbers to recover" (CWS 2002). The endangered species to be listed under SARA consist of species recommended by the COSEWIC, but will not necessarily include all species listed by COSEWIC prior to the enactment of SARA. Once a species is listed under SARA, a scientific assessment of the species is mandatory, including the identification and protection of the species' habitat, developing recovery strategies, and management plans.

On a provincial level, the COSEWIC list does not have legal standing (Freedman et al. 2001, Rideout and Ritter 2002) such that provincial governments are not obligated to recognize the listing (Lindgren 2001, COSEWIC 2002a,b). Instead of adopting the COSEWIC list, most provinces have developed their own lists (Lindgren 2001, Freedman et al. 2001), and have enacted their own laws for endangered species. In the case of Ontario and Québec, these provinces have each enacted an act that protects both the critical habitat and the listed species, which are, respectively, the 1971 *Ontario Endangered Species Act* and the 1989 Québec *Act Respecting Threatened or Vulnerable Species*. In addition to these acts, both provinces have other rules and programs that could also apply to endangered species (Gauthier and Wiken 2001).

Currently, lake sturgeon populations within the Canadian jurisdiction of the Great Lakes-St. Lawrence River are not on the federal COSEWIC list, because COSEWIC does not believe the species to be at risk. Similarly, neither Ontario nor Quebec has assigned a special status to lake sturgeon under their provincial legislation. Although not included on the federal and provincial lists, the lake sturgeon does fall under the Canadian Federal Fisheries Act and Provincial Fishery Regulations. Thus this species receives some

protection through these fisheries acts, which manages and protects fish species through the use of fishing permits, harvest quotas and fishing season (Houston 1987).

The possibility does exist that lake sturgeon residing within the Great Lakes-St. Lawrence River may eventually be assigned a status in these two provinces. Québec is currently considering listing lake sturgeon as either a threatened or vulnerable species (Moisan and Laflamme 1999, SFPQ 2001). Whereas, in the Ontario waters of Lake Huron some sections are considered by fisheries managers to have rare or threatened lake sturgeon populations but these populations not currently assigned an official status (Fielder et al. 2003). If lake sturgeon were to be included under the current Ontario and Québec lists pertaining to endangered species, this would allow for: 1) the protection, restoration, or creation of new habitat for the species 2) enforcement of the act in order to protect the species and its habitat by the respective ministry, and additionally, under the Quebec Act: 3) allow for agreements to be made between the provincial government, and either, individuals or other government in order to attain the objective of protecting the listed species, 4) allow for research to be conducted on the species, and 5) provide for mitigation of damage to the species and its habitat. Although the provinces are presently investing some effort in protecting and managing the lake sturgeon, officially listing the lake sturgeon may augment the provinces' effort, such as by modifying harvest as needed, increasing the provinces' incentive to protect or expand the amount of habitat available, and increasing our knowledge of the species and its ecological needs.

Successes of Cooperative Management for Lake Sturgeon

When a resource is shared between multiple jurisdictions conflicting viewpoints and resource uses may arise. Under integrated, multijurisdictional management these types of counterproductive actions can be eliminated or at least modified to assure that the overall goals are met. An example of an ongoing cooperative venture is the work being done to address the negative impacts of dams on migrating sturgeons. For example the USFWS and its partners are developing sturgeon fishways to bypass dams; the National Fish Passage Program is being implemented to remove unnecessary dams and/or installing fishways to decrease the impact of existing dams on migrating fish species; and the GLFC and its partners aim to reduce the impact of the sea lamprey control program on sturgeon.

Barriers and Fishways

Multiple stakeholders, such as wildlife populations, humans and industries often share streams, rivers and lakes, thus, resulting in the overlap of jurisdictions between agencies and organizations that are trying to meet these various needs. An example of conflicting use between lake sturgeon and other stakeholders is the construction of dams for reservoirs, flood control, water retention, hydroelectric power, and recreational purposes. These dams, in addition to affecting water levels and quality, generally pose formidable obstacles to migratory aquatic species, and in the case of the lake sturgeon block migrating lake sturgeon from reaching upstream spawning sites. A wide variety of fish ladders or fishways have been installed to allow fish migration over these obstacles (Scheidegger 2002). These fishways, however, have been primarily designed to

accommodate jumping species such as salmon (Gowans et al. 1999, Laine et al. 2002, Bunt et al. 1999, Bunt et al. 2000). As such, fishways have not been very effective in facilitating upstream migration of lake sturgeon above dams (Great Lakes Basin Ecosystem Team Lakes Sturgeon Committee n. d., USFWS-Green Bay n. d.). However, research is being conducted to investigate how fishway designs can be modified to better accommodate lake sturgeon (Peake et al. 1997). A spiral fishway design for lake sturgeon is being tested at the S. O. Conte Anadromous Fish Research Center-USGS (Kynard et al. 2003), and the USFWS hopes to try out a prototype of this fishway in 2005 at the White Rapids Hydroelectric Project on the Menominee River (Janet Smith, Field Supervisor, USFWS Green Bay ES Field Office, Personal Communication). Through cooperation, the impact of dams may be reduced or eliminated for some lake sturgeon populations and thus be less of an impediment to the lake sturgeon rehabilitation and management effort.

Sea Lamprey Control Program

The implementation of the sea lamprey control program by the GLFC and its partners, while positive in regards to reducing the impact of sea lamprey induced mortality, can have the potential to negatively impact lake sturgeon. For instance, the sea lamprey control program uses low-head barriers to prevent migrating sea lamprey from reaching spawning grounds, the release of sterilized males to decrease the reproductive success, and the application of the specific chemical lampricide 3-trifluoromethyl-4-nitrophenol (TFM) in Great Lakes tributaries to kill sea lamprey larvae (Weisser 2000, GLFC 2002). Some of these techniques, while effective in reducing sea lamprey abundance, can negatively affect the spawning success of lake sturgeon by blocking

Table 1: Lake sturgeon status by jurisdiction

United States		**Canada**		**Global**	
Jurisdiction	*Status*	*Jurisdiction*	*Status*	*Jurisdiction*	*Status*
Federal level (USFWS)	Species of concern*	Federal level (COSEWIC)	Not at risk	CITES	Listed in Appendix II**
Pennsylvania	Endangered	Ontario	Not listed		
New York State	Threatened	Québec	Not listed		
Michigan	Threatened				
Illinois	Threatened				
Indiana	Endangered				
Ohio	Endangered				
Wisconsin	Not listed				
Minnesota	Special concern				

**Species of Concern* - an informal term indicating that the United States Fish and Wildlife Service has some degree of concern for the future well-being of the taxon, but the taxon does not receive any protection under the *Endangered Species Act.*

***Appendix II*-lists species that could become rare or endangered if the international trade is not regulated.

migrating lake sturgeon from reaching upstream spawning grounds, and by killing larval lake sturgeon through the application of TFM. The GLFC and its partners have worked hard at ensuring that these potential impacts be minimized or eliminated. As such the GLFC and its partners have expended considerable effort to investigate ways to minimize the impact of sea lamprey control, such as ensuring improved fish passage over the lamprey barriers (GLFC 2000a), and implementing TFM treatment protocols which contain less chemical and are not applied during lake sturgeon spawning migration and incubation times (Hay-Chmielewski and Whelan 1997, Weisser 2000, Auer 2002). Therefore, the sea lamprey management program is a good example of how two potentially opposing management actions, that of reducing sea lamprey populations while

protecting, and enhancing lake sturgeon population, can be fulfilled through cooperation among all Parties and holistic fishery management.

Current Management of Lake Sturgeon

Jurisdictions with management responsibilities for lake sturgeon in the Great Lakes-St. Lawrence River are multifold, including two countries, Canada and the United States, eight states, two provinces, and two aboriginal authorities (Table 2). Lake sturgeon are known to move across jurisdictional boundaries (Thomas and Haas 2002, Fielder et al. 2003), and although some of the agencies are beginning to cooperate under the auspice of the Lake Committees of the Great Lakes Fishery Commission, the multiple entities vested in managing lake sturgeon are largely, still making their final management decisions independently from the other entities. This jurisdictional network has lead to the development of numerous plans, and as shown in Table 3, regulations with seemingly opposing objectives that may prevent the fulfilment of basin-wide lake sturgeon management goals.

Table 2: Federal, state, provincial, and aboriginal entity with authority over lake sturgeon in the Great Lakes-St. Lawrence River basin.

Jurisdiction		**Entity**
Federal	U.S. A.	United States Fish and Wildlife Service United States Geological Service – Biological Resource Division
	Canada	Department of Fisheries and Ocean
States	Illinois	Illinois Dept. of Natural Resources
	Indiana	Indiana Dept. of Natural Resources
	Michigan	Michigan Dept. of Natural Resources
	Minnesota	Minnesota Dept. of Natural Resources
	New York	NY Dept. Environmental Conservation
	Ohio	Ohio Dept. of Natural Resources – Lake Erie Unit
	Pennsylvania	Fish and Boat Commission
	Wisconsin	Wisconsin Depart. Natural Resources
Provinces	Ontario	Ontario Ministry of Natural Resource
	Québec	Société de la faune et parcs du Québec
Aboriginal	United States	CORA and member tribes which are the Bay Mills Indian Community, Sault Ste. Marie Tribe of Chippewa Indians, Grand Traverse Band of Ottawa and Chippewa Indians, Little River Band of Ottawa Indians and Little Traverse Bay Bands of Odawa Indians. GLIFWC and member tribes which are Bay Mills Indian Community, Keweenaw Bay Indian Community, Lac Vieux Desert band, Bad River, Lac Courte Oreilles, Lac du Flambeau, Mole Lake/Sokaogon, Red Cliff, St. Croix bands, Fond du Lac and Mille Lacs bands.
	Canada	Various First Nation tribes in the Great Lakes-St. Lawrence River basin but involvement is in the early stages as aboriginal rights are being defined in courts.

Table 3: Recreational fishing and commercial fishing regulations for each state and province located along the Great Lakes-St. Lawrence River. Tribal fishing regulations may differ from State fishing regulations. Official state and provincial abbreviations are used. Status is indicated as SC for special concern, Th for threatened, and E for endangered.

			Recreational fishing			Commercial fishing		
State / Prov.	**Status**	**Lake**	**Open season**	**Catch limit**	**Size regula-tions**	**Open season**	**Catch limit**	**Size regula-tions**
MN	SC	Lake Superior	None	N/A	N/A	None	N/A	N/A
WI	None	Lake Superior	None	N/A	N/A	None	N/A	N/A
		Lake Michigan	None	N/A	N/A	None	N/A	N/A
IL	Th	Lake Michigan	None	N/A	N/A	None	N/A	N/A
IN	E	Lake Michigan	None	N/A	N/A	None	N/A	N/A
OH	E	Lake Erie	None	N/A	N/A	None	N/A	N/A
PA	E	Lake Erie	None	N/A	N/A	None	N/A	N/A
NY	Th	Lake Erie	None	N/A	N/A	None	N/A	N/A
		Lake Ontario	None	N/A	N/A	None	N/A	N/A
MI	Th	Lake Superior	July 16 to Nov 30	Catch & release	N/A	None	N/A	N/A
		Lake Michigan	July 16 to Nov 30	Catch & release	N/A	None	N/A	N/A
		Lake Erie	July 16 To Nov 30	Catch & release	N/A	None	N/A	N/A
		Lake Huron	July 16 to Nov 30	Catch & release	N/A	None	N/A	N/A
		Lake St. Clair	July 16 to Sept. 30	1 per license yr	>42" - < 50"	None	N/A	N/A

Table 3 (cont'd).

			Recreational fishing			Commercial fishing		
State / Prov.	**Status**	**Lake**	**Open season**	**Catch limit**	**Size regula-tions**	**Open season**	**Catch limit**	**Size regula-tions**
ON	None	Lake Superior	All year	1 per day	114 cm	None		
		Lake Erie	All year	1 per day	114 cm	None		
		Lake Huron	All year	1 per day	114 cm	All year		
		Lake Ontario	None	N/A	N/A	None	N/A	N/A
		Lake St. Clair	All year	1 per day	114 cm	None		
		Upper St. Lawrence River	None	N/A	N/A	None	N/A	N/A
QC	None	Upper St. Lawrence River	Depends on zone	1 per day	>45 cm	May 1 to Oct 15 depends on zone	Varies e.g., 12147 sturgeon taken in 2002	>45 cm

*The province of Ontario is considering changing the lake sturgeon recreational fishing quota to one fish per year for 2004 (David M. Reid, Lake Management Supervisor - Lake Huron, Upper Great Lakes Management Unit, Ontario Ministry of Natural Resources, Personal Communication)

**In the Province of Ontario all fishery can be closed by the middle of December, but generally are kept open year round

***In the province of Ontario Lake St. Clair has one remaining commercial fisher, fishing with 2 licenses that will be appropriated with the fisher's retirement from the industry. These 2 licenses permit the fisher to use setlines (baited hooks) to harvest 2200 lbs annually with no size restriction. Approximately 35-50 fish per year are harvested.

One of the potential outcomes of having each jurisdiction managing lake sturgeon in isolation of the other jurisdiction is that the eight states and the two provinces may differ in their decisions, for example there are differences in the status of lake sturgeon assigned by the province of Ontario and the eight states, even for lake sturgeon populations residing within the same lake. A possible explanation for this discrepancy may be that some lake sturgeon stocks of the Great Lakes may have access to more and healthier habitat than others and thus do not require as stringent regulations to maintain the population. Conversely, these discrepancies may arise due to lack of information on the population that prevents managers from estimating the population size, differences in opinion as to what population size requires protective action, or may be related to the differing cultural and historic significance of lake sturgeon among the inhabitants of the basin. For instance, lake sturgeon are listed in seven of the eight Great Lakes states as being endangered, threatened, or of special concern; whereas lake sturgeon are not listed by the provinces as being at risk (Table 1). In addition, commercial fishing of lake sturgeon is not allowed in the United States, whereas in Canada, a limited commercial fishing is allowed within sections of the Ontario and Québec waters (Table 3). There is also a discrepancy between the state and provincial recreational fishing regulations for lake sturgeon. In provincial waters of the Great Lakes, recreational fishing of lake sturgeon is *only prohibited* in Lake Ontario; in the State waters of the Great Lakes recreational fishing is *only allowed* in Lake St. Clair (Table 3, tributaries of the Great Lakes may differ in their regulations). Even in lakes where recreational fishing is allowed by both the states and the provinces the quotas differ greatly, with the states having a

highly restricted fishing limit, with one sturgeon per license quota, and the provinces currently having a one sturgeon per day quota.

Further, in 2003 the United States stated that it would not engage in the commercial harvest or export of lake sturgeon from the Great Lakes and St. Lawrence River drainage, whereas Canada stated its expectation of commercial catch and export of lake sturgeon meat to be over a 100t from the Great Lakes-St. Lawrence River drainage (CITES 2003a). The United States is managing most lake sturgeon populations as a threatened, endangered or species of concern, whereas Canada assumes that most populations are viable for a limited commercial harvest. These opposing views and actions will likely decrease the effectiveness of the actions taken by the United States to protect the species, and potentially lead to conflict between Great Lakes fisheries agencies in the future. However, with increasing knowledge of lake sturgeon population, sharing of data between jurisdictions such as recapture data on tagged sturgeon individuals that is used for population estimates, these discrepancies in status and management plans may diminish or be resolved.

The Potential for Multijurisdictional Management of Lake Sturgeon

The majority of lake sturgeon fisheries managers appear to believe that, given the habitat requirements, movements and life history of lake sturgeon, this species may be best managed using an ecosystem or basin-wide approach rather than the jurisdictional approach. The implementation of this approach would result in decisions being based not on individual jurisdictional opinions but on what all involved Parties believe is best for the shared resource (Ferreri et al. 1999). The growing interest among lake sturgeon

managers in the Great Lakes-St. Lawrence River to expand cooperation throughout the basin, have led, in recent years, to an increase in the number of cooperative efforts being formed, such as the Central Great Lakes Bi-National Lake Sturgeon Group (McClain 1997, Hill and McClain 2002, USFWS 2003), the partnerships instigated by the United States Fish and Wildlife Service (USFWS n. d.), the Great Lakes lake sturgeon website (http://midwest.fws.gov/sturgeon/default2.htm), and the National Paddlefish and Sturgeon Committee 1993, Holey et al. 2000, Fielder et al. 2003). In addition, this effort has been reflected in the agenda of the GLFC through the Lake Committees by the inclusion of lake sturgeon within the Lake Committees' Fish Community Objectives.

The GLFC facilitates the implementation of *A Joint Strategic Plan for Management of Great Lakes Fisheries* (Joint Strategic Plan) through the Lake Committees, to which the eight Great Lakes States, the Province of Ontario, two aboriginal fisheries agencies and the federal governments of Canada and the United States are signatory agencies (GLFC 1997). The Joint Strategic Plan is generally recognized as one of the most effective vehicles for cooperative, international fisheries management in the world (GLFC 2000b). The Joint Strategic Plan provides the framework for fisheries management decision-making based on sound science and consensus (GLFC 2000b), and is based on the philosophy that each of the Great lakes fisheries management agencies has a share in the Great Lakes ecosystem and that in the interest of the "common good," fisheries management authority must be cooperative, rather than unilateral. The strength of the Joint Strategic Plan lies in its implementation through the Lake Committees. These committees have been established for each of the Great Lakes, including the upper portion of the St. Lawrence River, and consist of

representatives from each of the state, provincial, and aboriginal agencies with management authority on each lake. Within the Lake Committees, fisheries management decisions, including the desired fish community structures, stocking strategies, law enforcement activities, and harvest rates, are determined collectively by consensus. Each management agency then reports to the Committee for implementing the shared decisions within its own jurisdiction. To help the Lake Committees in reaching a decision based on a common, scientific, knowledge of the status of the fisheries resources, the Lake Committees established Technical Sub-Committees, which adopted common fisheries assessment and analysis protocols, share fisheries assessment, research information, and databases. Each Lake Committee reports to the Council of Lake Committees, which is comprised of representatives from each of the Lake Committees, to resolve basin-wide Great Lakes fisheries issues.

The Joint Strategic Plan is beginning to be applied to rehabilitate and manage lake sturgeon within the Great Lakes-St. Lawrence River, as such the lake sturgeon is now included in the Lake Committees' Fish Community Objectives, and depending on the Lake Committee, these Committees are at various stages of implementing joint management decisions for lake sturgeon. For instance, as of 2003, the Lake Michigan Committee has established a lake sturgeon task force (LMC 2003); the Lake Huron Committee is in the process of developing a lake sturgeon management plan (LHC 2003); and the Lake Superior Committee and its Technical Committee, formed the Lake Sturgeon Subcommittee in 1994 to evaluate the status of lake sturgeon, and in 2002 developed a rehabilitation plan for lake sturgeon in Lake Superior (Auer 2002).

Thus, if the current endeavours to initiate joint management of lake sturgeon prove successful and favourable to all the Parties of the Joint Strategic Plan, then the Lake Committees and the Council for Lake Committees, under the organizational structure of the GLFC, may become the forum for basin-wide, cooperative management of lake sturgeon within the Great Lakes. However, ideally, to encompass the entire range of lake sturgeon in the Great Lakes-St. Lawrence River, an agreement with the Province of Québec would need to be signed to include the province within the cooperative effort. The inclusion of the Province of Québec would allow management of lake sturgeon migrating between the Québec section of the St. Lawrence River into the Ontario-New York section of the river.

International Perspective on Lake Sturgeon

The survival and health of lake sturgeon in North America is no longer simply affected by the local or national demand for caviar and flesh, but also by a global demand. This demand for lake sturgeon products is increasing, as other sturgeon stocks in the northern hemisphere, such as the sturgeon species from the Caspian Sea, become depleted and lake sturgeon products are viewed as an acceptable alternative source. Currently, Russia and Iran are the main exporters of caviar from the Caspian Sea area, with nearly 80% of all caviar exports being supplied by these two countries (WWF 2002). The sturgeon stocks found within these countries, including the stellate sturgeon, Russian sturgeon, and *Huso huso*, have been decreasing. As in the Great Lakes, the decline in sturgeon populations from the Caspian Sea area has been blamed on a combination of habitat destruction, water pollution, and over fishing, the latter having

been exacerbated by intensified poaching activities on these stocks for the caviar trade (CITES 2001). With the disintegration of the Union of Soviet Socialist Republics, the level of poaching in the former Soviet republics has increased to 10 to 12 times the amount of the current legal catch (CITES 2001). Should the Caspian Sea caviar export supply collapse, a gap between demand and supply would be created, which would likely increase the pressure for North American sturgeon and paddlefish products (Graham and Rasmussen 1997).

Managing a Threatened and Endangered Species Globally

The *Convention on International Trade of Endangered Species* (CITES), is based on the voluntary participation of numerous countries, and is currently the best option for the protection of species on a global level. The CITES was implemented in 1975 (Wijnstekers 2001), and as of 2003 there are 162 member countries (CITES 2003b). This convention was enacted to respond to the threat imposed by international trade on threatened or endangered species (Stanford Environmental Law Society 2001, Wijnstekers 2001). CITES lists species into three Appendices. Species listed in Appendix I are considered to be threatened with extinction; Appendix II species are not threatened with extinction but uncontrolled trade might threatened their existence; and species in Appendix III are currently being protected by at least one country which has requested the aid of CITES Parties in controlling the species trade (CITES 2003c).

CITES monitors the trade of species listed in the appendices through a system of export and import permits (Wijnstekers 2001). The use of these permits allows CITES to monitor the trade demand, to detect illegal shipments, and make adjustments to better

protect the species if necessary, such as changing the trade quota for the species which are usually set by individual Parties or by the Conference of Parties (Wijnstekers 2001). The enforcement of CITES's permits and quotas, due to the nature of the agreement, lies on the signatory countries (list of signatory countries available on the CITES website www.cites.org; Wijnstekers 2001, Le Prestre and Stoett 2001). In the United States, CITES is implemented through the *Endangered Species Act* and the United States Fish and Wildlife Service is the designated management authority for CITES in the United States (Stanford Environmental Law Society 2001). In Canada, CITES is implemented through *The Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act* (WAPPRIITA). The Canadian Wildlife Service, Department of Environment is the management and scientific Authority for CITES in Canada (CITES Secretariat 2003).

In April of 1998, all sturgeon and paddlefish species (Acipenseriformes) were listed in Appendix I or II of the CITES (Wijnstekers 2001, Raymakers and Hoover 2002). In listing all Acipenseriformes under Appendix I or II, this required that participating countries enforce the use of permits and certifications for all international trade involving these species. In addition to the usual CITES permits, the Parties agreed to several other aspects that they believed necessary for the conservation of Acipenseriformes, including the Conservation of Sturgeons, Resolution Conf. 10.12 (Wijnstekers 2001). This later agreement states that the fishery and other management initiatives for protection of Acipenseriformes should include the necessary national legislative improvements, the need for regional agreements, the development of a universal marking system for all fish parts to aid in tracking the origin of the products, the role of aquaculture, and the need to

focus on decreasing/eradicating illegal trade of Acipenseriformes (Wijnstekers 2001). CITES also stipulated in decision 11.58, that to help protect Acipenseriformes, countries which share a common stock, such as the lake sturgeon in the Great Lakes, need to consult and agree on the annual catch and export quota for international trade for that shared stock (Meffe and Carroll 1994, Wijnstekers 2001).

Although CITES is an agreement among signatory countries that does not have enforcement authority, the signatory countries can cooperate together to employ tactics, such as economic incentives, to pressure a member country that is not properly managing a listed species, to address the conservation issues occurring within that country's jurisdiction. An example of this is when the members of the CITES agreement became concerned about the dwindling Caspian Sea sturgeon stocks in June 2001. In an attempt to force the countries surrounding the Caspian Sea to address the declining stock abundance, the CITES Standing Committee recommended that imports of sturgeon products from these stocks be suspended in 2002, unless these countries took action in accord with the approved resolution (CITES 2003d). This tactic appeared to be successful for the Caspian region as the Russian, Azerbaijan and Kazakhstan governments announced on 21 July 2001 a temporary ban on commercial fishing of sturgeon in the Caspian Sea, in response to international pressure (Anonymous 2001). This type of tactic, however, only works well if the main importing countries are CITES members and if the loss of their market demand results in a significant decrease in demand for those products or alternative products are available.

Future Outlook

Lake sturgeon is a truly unique and important fish in the Great Lakes ecosystem. While its numbers have dwindled due to decades of pollution, habitat alterations, and over harvesting, the renewed commitment of fishery managers, aboriginal tribes, and other stakeholders to its restoration in the Great Lakes-St. Lawrence River makes the outlook for lake sturgeon rehabilitation very positive. With an increase in our understanding of the ecology of this species, along with habitat improvements, rehabilitative stocking, and strict harvesting regulations; these populations should rebound from their reduced numbers basin-wide. The Winnebago Lake system lake sturgeon population in Wisconsin, USA is an example of a lake sturgeon population that has responded well to targeted management actions, including limited fishing season, habitat management, increased enforcement, particularly during the spawning season, and increased public awareness, while continuing to maintain a recreational winter spear fishery (Bruch 1999a).

Currently, in the Great Lakes-St. Lawrence River system, there is a move toward appreciation of the need for ecosystem management and co-management activities. Even so, some of the jurisdictions in the Great Lakes basin that govern lake sturgeon, currently allow for the commercial trade of parts or live fish, and for the recreational fishing harvest of lake sturgeon, while other jurisdictions do not. The lack of a coordinated management approach for lake sturgeon throughout the Great Lakes-St. Lawrence River makes it easier for illegally harvested sturgeon to be sold into the legal market (Bruch 1999b). The Law Enforcement Committee under GLFC has recognized the potential ease of infractions as a result of the mosaic of rules, and the committee is investigating

possible recommendations to prevent and reduce infractions between the jurisdictions. One method being employed to address this threat is the use of combined enforcement teams (CET) in the Lake St Clair and the St Mary's River, which have already proven successful in other parts of the Great Lakes. CETs involve the participation of conservation officers from multiple state, provincial, federal, tribal agencies, from the United States and Canada, with law enforcement authority in the Great Lakes to enforce Great Lakes fishery regulations. The success of these teams arises from having representatives of each jurisdiction present during the apprehension of an individual committing an offence outside of his home jurisdiction (Kirshman and Leonard 2003). Nonetheless, the disparate status and management actions being taken by the various jurisdictions need to be addressed if effective coordinated management of the lake sturgeon is to be achieved.

Presently, in addition to the need for coordinated management and regulations in the Great Lakes, there is an urgent need to further increase understanding of the life history, migratory patterns, and population status of unique genetic lake sturgeon stocks in the Great Lakes-St. Lawrence River. Until the status and ecological needs of the lake sturgeon in the Great Lakes-St. Lawrence River is better understood, the fisheries management agencies should err on the side of caution, using the precautionary principle, so as to not lose this opportunity to rehabilitate this important and unique species. The first step that must be addressed is the need for a common management goal amongst fisheries authorities, which is reflected in the fishing regulations for lake sturgeon throughout the entire Great Lakes-St. Lawrence River. This will require the establishment of an official cooperative effort, such as the Joint Strategic Plan and its implementation

through the Lake Committees structure and the Council for Lake Committee under GLFC. This effort will need support and representation by Canadian and American entities with management authority on lake sturgeon, assured funding for programs, and accountability by the members for implementing joint decisions. Additionally, this cooperative effort should include the Province of Québec to ensure the protection of lake sturgeon throughout the Great Lakes-St. Lawrence basin. Secondly, the cooperative effort should have as mandate the joint cooperative management of populations within the Great Lakes-St. Lawrence River for the preservation, restoration, and enhancement of lake sturgeon. Data and information sharing will be needed for partners to agree on the status and best management for lake sturgeon throughout the basin on a stock/population level versus a jurisdictional management. Thirdly, the cooperative effort should investigate methods for protecting wild lake sturgeon from the sturgeon flesh and caviar market demand, and encourage research and application of alternative ways of providing for the demand of sturgeon meat and caviar. Lastly, effective enforcement of lake sturgeon regulations on the national, international, and global level, such as CITES, is imperative to the success of any management plan.

The future of lake sturgeon in the Great Lakes-St. Lawrence River will depend greatly on the development of a cooperative relationship between jurisdictions to manage this shared fish resource. The extensive geographic and jurisdictional area inhabited by lake sturgeon, further validate the need to have a coordinated management plan among agencies sharing a common stock to ensure that the financial and human resources will be utilized effectively. This coordination across agencies will facilitate management planning and resource allocations, and fulfil the basin-wide/ecosystem level common

goal of achieving healthy lake sturgeon stocks. The Joint Strategic Plan currently brings agencies together to engage in this type of cooperation within the Great Lakes basin, and with the Lake Committees already listing lake sturgeon within their Fish Committee Objectives for each Great Lake, the Lake Committees and the Council for Lake Committees under the organizational structure of GLFC would seem to provide the ideal forum under which the lake sturgeon management jurisdictions could meet. Having such a forum will provide in the future an integrated, multijurisdictional management program for lake sturgeon populations, which will enhance the chance for a viable, genetically diverse, sustainable commercial and recreational fishery of lake sturgeon in the Great Lakes-St. Lawrence River.

The growing demand for lake sturgeon on an international level and the impact of globalisation (Lechner and Boli 1999, Friedman 2000, Raymakers and Hoover 2002), however, will require that the cooperative group keep abreast of the global market demand and global agreements that may affect lake sturgeon populations in North America. This rising demand and trade potential will increasingly require an active monitoring of Acipenseriform stocks worldwide, and as a result, it will be progressively more important to assure strict enforcement of existing federal, provincial, state, and tribal regulations and CITES to assure the conservation of our Great Lakes lake sturgeon.

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CHAPTER FOUR

Role of Social Network Structure and Social Ties on the Effectiveness of *A Joint Strategic Plan for Management of Great Lakes Fisheries*

Introduction

Governance[10] of transboundary fish stocks increasingly relies on a cooperative approach that engages professionals and stakeholders with diverse expertise, representing different jurisdictions, each with their own expectations regarding these stocks (e.g., Halibut Commission, Whaling Commission). To effectively[11] work together, these individuals need to establish and maintain social ties, which are the relationships that bond individuals together, such as friendship or sharing a common affiliation or membership (Wasserman and Faust 1994). These social ties are an essential component to collaborative decision-making (Penner 1995, Jones and George 1998, Foster-Fishman et al. 2001, Newell and Swan 2000), as they affect the collective decision-making process (Newell and Swan 2000, Yang and Tang 2004), which in turn impacts the effectiveness of the governance institution.

It has been demonstrated that social ties, which links individuals together, affect the process and thereby effectiveness of group decision-making. In the organizational and sociological literature, much research has been conducted to investigate the role of social

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[10] Governance is a broad term that encompasses all actors involved in the policy making-process and who share the associated responsibilities and power (Rosenau 1995, Sissenweine and Mace 2003). Governance includes a variety of institutions consisting of governmental, nonstate, hard law, soft law, formal rules, informal rules, and private governance institutions such as market mechanisms (Schechter and Leonard 2008)

[11] The term 'effectively' in this chapter is used as the Merriam-Webster Dictionary defines the word 'effective', "producing a decided, decisive, or desired effect" (Merriam-Webster 1974).

ties, both within and among subgroups[12], on the overall group effectiveness. The sociological studies have found, among other things, that social ties determine what resources an individual will have access to, such as information about sturgeon harvest, how quickly these resources will be available to the individual, whether a new idea will be accepted by individuals within a group, and potentially the amount of influence each individual exerts on group decision (Granovetter 1973, Burt 1992, Wasserman and Faust 1994, Abrahamsom and Rosenkopf 1997, Frank et al. 2004). Organizational studies have shown that resource exchange occurs when there is trust among individuals, that face-to-face interactions facilitate problem-solving among individuals, that it is important that individuals are aware of who to contact for given information, and that the loss of key individuals from the group can disrupt the flow of resources within the entire group (Newell and Swan 2000, Cross et al. 2001).

Understanding how the social ties among individuals and the social network structure, which consists of all individuals within a group and the social ties linking them together, impact the effectiveness and efficiency of governance institutions for transboundary fish stocks may reveal why some institutions appear to be more effective and efficient in making and implementing decisions than others. For instance, a well connected and integrated network structure may allow for more effective and efficient institutions, because resources can flow through the network to all individuals than a

[12] Subgroups are a subset of individuals connected by social ties that belong to a larger social network group (Wasserman and Faust 1994). Defining the subset of individuals that form subgroups can be based on formal positions, such as occupations, or on the pattern of their social interactions such that individuals more frequently interacting together in comparison to with other individuals in the network group are placed within the same subgroup (Frank 1995). For detailed explanation on the statistical analysis used to identify subgroups based on the pattern of social interactions consult *Identifying cohesive subgroups* by Frank (1995).

network that is less well connected and composed of isolated subgroups (Figure 5; Wasserman and Faust 1994). A network structure that is composed of subgroups, however, may permit adequate resource flow, if all individuals can gain access to resources, such as through individuals who bridge the subgroups and therefore can provide access to resources (Figure 6; Wasserman and Faust 1994). In this situation the individuals bridging the subgroups would allow for adequate exchange of information between subgroups while reducing the redundancies of having unnecessary individuals transmitting the same resource. Understanding of the role of social ties and social network structure among individuals engaged in these governance institutions should assist in improving governance for transboundary fish stocks (Schechter et al. 2008).

Enhancing the effectiveness and efficiency of governance institutions for transboundary fish stocks is critical, as new challenges, such as climate change, will increasingly require an approach that transcends boundaries to address these challenges. Failure to recognize and understand the role of social network structure and social ties in governance institutions could lead to ineffective governance resulting in the waste of scarce human and financial resources, as well as policies resulting in actions that negatively impact the resource.

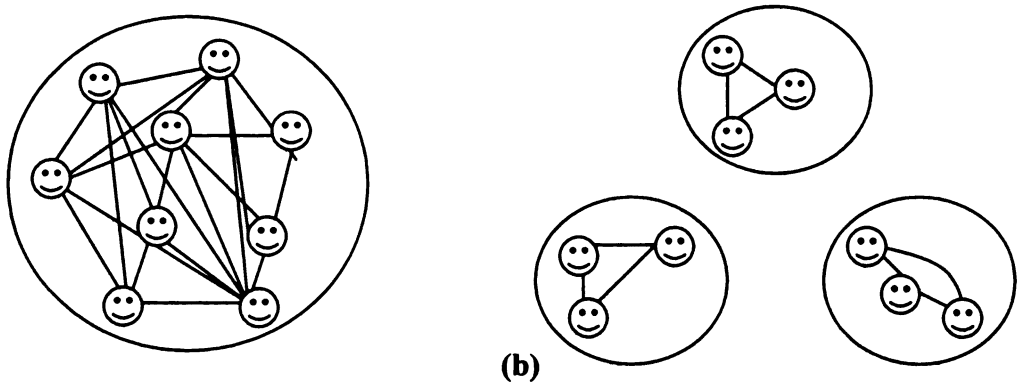

Figure 5: Simplified example of two social network structures with (a) showing a well-connected network in which individuals are all directly connected to one another without subgroups being present; and (b) a network where individuals are well-connected within their subgroup, but isolated from the other subgroups. Individuals are denoted by 'smiley face' and connections by solid lines.

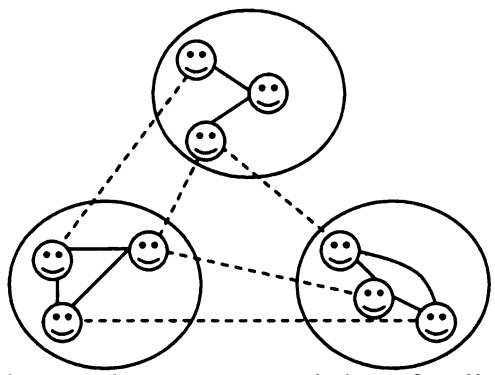

Figure 6: Simplified social network structure consisting of well-connected individuals forming three subgroups. Individuals within subgroups are connected to the other subgroups by individuals that bridge one or more subgroups. Individuals are denoted by 'smiley face', connections within a subgroup by solid lines, and connections between subgroups by dashed lines.

In this chapter I explore how the presence of social ties and the related social network structure contribute to the governance institution for transboundary fish stocks in the Great Lakes, *A Joint Strategic Plan for Management of Great Lakes Fisheries* (Joint Strategic Plan) (GLFC 1997). Many authors believe the Joint Strategic Plan to be an effective institution for the governance of transboundary fish stocks in the Great Lakes, such as walleye (*Sander vitreus*), yellow perch (*Perca flavescens*), lake sturgeon

(*Acipenser fulvescens*), lake whitefish (*Coregonus clupeaformis*) and salmonids (GLFC 1997, Stein and Goddard 2008). The Joint Strategic Plan is perceived as being effective partially because it has clear a goal[13] and objectives, participants communicate management decisions, they have been able to achieve consensus on fishery management decisions, have rarely needed third party mediation, although when needed, mediation has proven successful in resolving disagreements, and because it allows signatory agencies to access each others resources, such as expertise, to implement coordinated management activities (Gaden 2007). This effectiveness may be enhanced because of to the social ties, and hence the social network structure, that bonds Joint Strategic Plan participants together. The intent of my study was to determine if social ties and social network structure exists among individuals implementing the Joint Strategic Plan and how these may affect the Joint Strategic Plan's effectiveness. Further, to determine how respondents representing Joint Strategic Plan perceived governance of transboundary fish stocks in the Great Lakes, I used two types of information exchange to test for the presence of social ties and social network structure among the Joint Strategic Plan participants, general information about Great Lakes fish stocks, and information about lake sturgeon in the Great Lakes. Implications of social ties and social network structure on the effectives of this governance institution for transboundary fish stocks in the Great Lakes, the Joint Strategic Plan, are discussed.

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[13] The Joint Strategic Plan's goal statement is "to secure fish communities, based on foundations of stable self-sustaining stocks, supplemented by judicious plantings of hatchery-reared fish, and provide from these communities an optimum contribution of fish, fishing opportunities and associated benefits to meet needs identified by society for: wholesome food, recreation, cultural heritage, employment and income, and a healthy aquatic ecosystem" (GLFC 1997).

Methods

Case Study Group

I selected as my case study the governance of the Laurentian Great Lakes transboundary fish stocks as implemented through *A Joint Strategic Plan for Management of Great Lakes Fisheries* (Joint Strategic Plan). I selected the Joint Strategic Plan for two reasons (1) its perceived effectiveness for the governance of Great Lakes transboundary fish stocks (GLFC 1997, Gaden 2007, Stein and Goddard 2008), and (2) the diversity of participants involved in the implementation of Joint Strategic Plan.

In the Great Lakes, eight American states, one Canadian province, and two tribal organizations with fisheries management authority are signatory to the Joint Strategic Plan (GLFC 1997, Dochoda 1999, Gaden 2007, Stein and Goddard 2008). Four federal agencies that do not have fisheries management authority in the Great Lakes are also signatories to the Joint Strategic Plan because of their role in protecting Great Lakes fish stocks, such as through the Endangered Species Act (Table 4.) The Joint Strategic Plan serves to coordinate governance of transboundary fish stocks in the Great Lakes. The Joint Strategic Plan's is implemented through the organizational structure of the Great Lakes Fishery Commission (GLFC)[14], specifically through its Agency-Appointed committees, and facilitated by the GLFC (Figure 7; GLFC 1997). As part of the strategic procedures for achieving the Joint Strategic Plan's goal, each of the Agency-Appointed lake committees must develop fish community objectives that assess progress made towards achieving the desired structure for each Great Lakes fish communities (GLFC

[14] The Great Lakes Fishery Commission was established during 1955 through the enactment of the treaty *the Convention on Great Lakes Fisheries* (U.S. Department of State) signed on 10 September 1945 by Canada and the United States.

1997). The collaborative development of these Fish Community Objectives contributes to the attainment of consensus among participants when making fishery management decisions, as decisions are based on a common set of objectives jointly developed by all parties.

There are also individuals that do not belong to a signatory agency (hereon referred to as non-signatory participants) that participate in the implementation of the Joint Strategic Plan. These non-signatory participants represent individuals from academia, non-governmental organizations, the private sector, commercial fishers, and recreational fishers that provide input through invited expert presentations, advisory groups, and technical subcommittees. Representing diverse agencies and stakeholders with differing policies and cultures, coupled with their personal perception, values, and expertise, this variety among participants affects how they interact in making decisions (Shaw and Barrett-Power 1998). Furthermore, these individuals vary in how long they have been participants, how frequently they interact with other participants, how long they have known other participants, and their perspective on the fisheries issues. This variability adds to the challenge of working together to reach consensus on the governance of transboundary fish stocks. To effectively work together, these individuals need to have a certain level of trust and respect for one another (Jones and George 1998, Newell and Swan 2000, Grafton 2005), which in turn contributes to the formation of social ties that facilitates the decision-making process (Shaw and Barrett-Power 1998).

Table 4: Signatory agencies to *A Joint Strategic Plan for Management of Great Lakes Fisheries*. The federal agencies, although not having fisheries management authority in the Great Lakes, are signatory to the Joint Strategic Plan primarily because of the role they have in protecting, rehabilitating, and conserving the Great Lakes fish stocks.

Federal
Canada Department of Fisheries and Oceans
National Oceanic and Atmospheric Administration - Fisheries
United States Fish and Wildlife Service
United States Geological Survey – Biological Resources Division
State
Illinois Department of Conservation
Indiana Department of Natural Resources
Michigan Department of Natural Resources
Minnesota Department of Natural Resources
New York State Department of Environmental Conservation
Ohio Department of Natural Resources
Pennsylvania Fish and Boat Commission
Wisconsin Department of Natural Resources
Tribal
Chippewa-Ottawa Resource Authority
Great Lakes Indian Fish and Wildlife Commission
Provincial
Ontario Ministry of Natural Resources

Survey Respondents

During a three-month period from 25 January 2006 to 19 April 2006, I surveyed 423 individuals that participated in the Great Lakes Fishery Commission (GLFC) Agency-Appointed committees (Figure 7). The individuals surveyed were selected based on two sets of criteria. The first included all individuals that were Great Lakes Fishery Commission secretariat staff, United States and Canadian Commissioners, United States and Canadian Advisors or official members of Great Lakes Agency-Appointed committees (Figure 7, Table 5). The second included all individuals that had attended any

of the Agency-Appointed committee meetings during 2005, both representatives of signatory agencies and non-signatory participants. To capture individuals that might be regular attendees, but missed the 2005 meetings, the study population also included any individual that attended meetings during 2004, in addition to having attended at least one other meeting in 2000, 2001, 2002 and 2003 period. These criteria eliminated individuals from the study population that were either not very active or no longer active in the Joint Strategic Plan process.

The Executive Secretary of the Great Lakes Fishery Commission sent a letter on 10 January 2006, copied to the Commissioners, informing the selected individuals about the upcoming survey and the commission's support of this research project (Appendix A). On 25 January 2006, I sent an email invitation to all selected individuals explaining the purpose of the research project and providing instructions about how to access the online survey (Appendix B). Individuals that were selected and who had not yet completed the online survey received a reminder email on 16 February 2006 (reminder 1). A second reminder email was sent on 8 March 2006 (reminder 2), with the final reminder sent on 28 March 2006 (Appendix C). Two-percent (8 individuals) of the selected individuals received the printed booklet version of the survey and completed the survey by hand rather than online. The survey booklet contained the same questions, in the same order as the web-based survey, and included branching instructions to guide the individuals through the survey. Recipients of the survey booklet received the same support letter from the Great Lakes Fishery Commission's Executive Secretary, the letter of invitation describing the purpose of the survey, and the 3 reminder letters (Appendices A, B, and C). I did not expect that the survey media, online versus booklet, used by the

respondent to complete the survey would affect responses, because several studies conducted to compare the effect of different survey media on responses did not find significant difference among responses received from paper-based surveys compared to internet-based surveys and compared to computer-based surveys (e.g., Knapp and Kirk 2003, Donovan et al. 2000, Potosky and Bobko 1997).

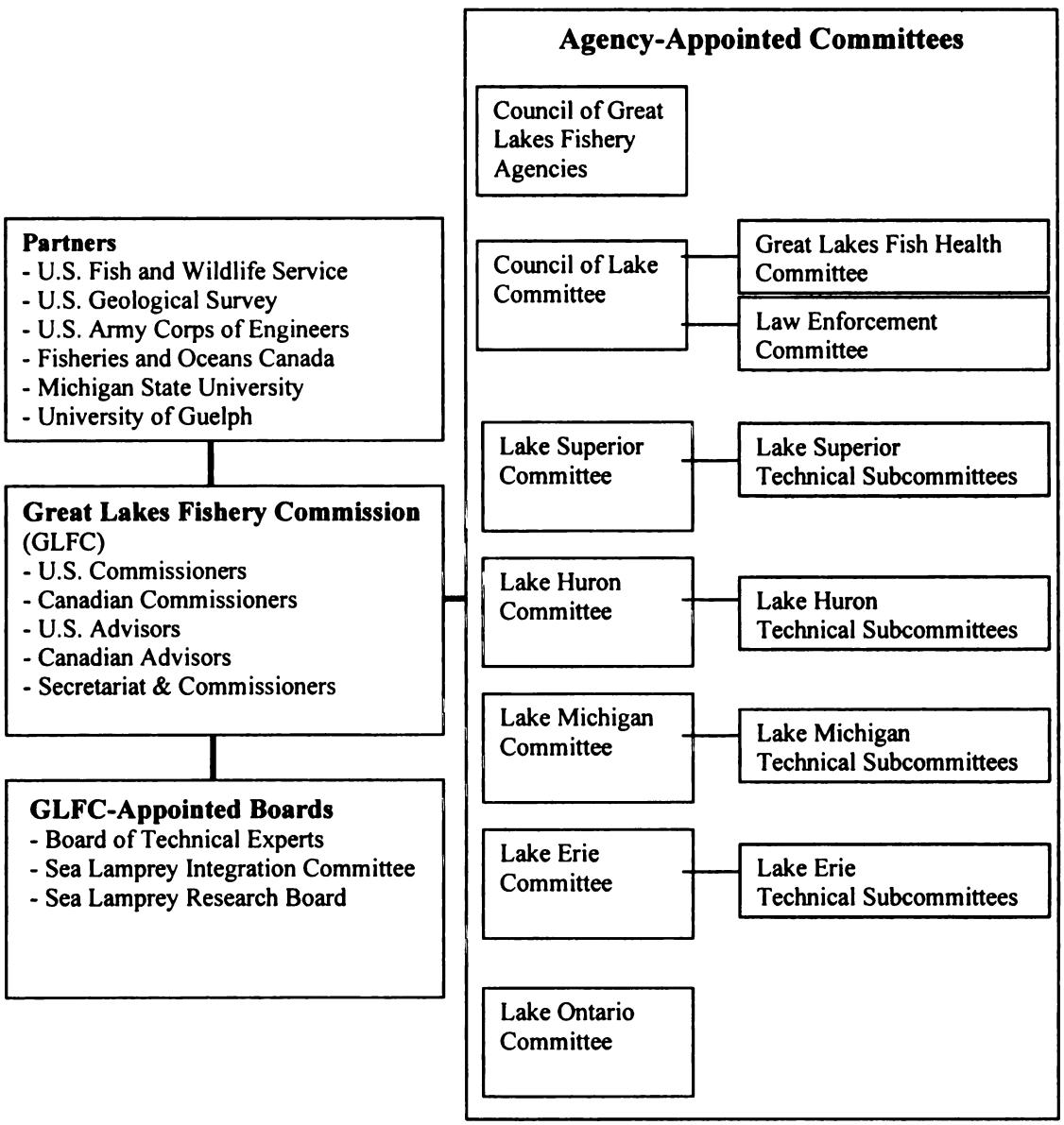


Figure 7: Organizational structure of the Great Lakes Fishery Commission.

Table 5: Committees and groups involved in the implementation of *A Joint Strategic Plan for Management of Great Lakes Fisheries* (Joint Strategic Plan), either directly through the Agency-Appointed committees, or indirectly as part of the support provided by the Great Lakes Fishery Commission organizational structure. Unmarked institution names signify that they are both members of committees and signatory agencies of the Joint Strategic Plan. A '*' identifies institutions that are only signatory agencies of the Joint Strategic Plan, not official members of the committees. A '**" indicates institutions that only are an official member of the committees. Other participants of this governance process but that are neither Joint Strategic Plan signatory agencies nor official members of committees are identified with a '***'.

Council of Great Lakes Fishery Agencies	• U.S. Fisheries and Wildlife* • U.S. Geological Service – Biological Resources Division* • Dept. Fisheries and Oceans Canada* • National Oceanic and Atmospheric Administration* • Michigan Dept. Natural Resources • Indiana Dept. Natural Resources	• Minnesota Dept. of Natural Resources • Wisconsin Dept. Natural Resources • Illinois Dept. of Conservation • Chippewa-Ottawa Resource Authority • Great Lakes Indian Fish and Wildlife Commission • Ontario Ministry of Natural Resources • GLFC Secretariat staff liaison and support***
Council of Lake Committees	• Ontario Ministry of Natural Resources • Michigan Dept of Natural Resources • Indiana Dept. Natural Resources • Wisconsin Dept. Natural Resources • Illinois Dept. of Conservation • Minnesota Dept. of Natural Resources	• New York State Dept. of Environmental Conservation • Pennsylvania Fish and Boat Commission • Ohio Dept. Natural Resources • Chippewa-Ottawa Resource Authority • Great Lakes Indian Fish and Wildlife Commission • GLFC Secretariat staff liaison and support***
Law Enforcement Committee	• Ontario Ministry of Natural Resources • Michigan Dept of Natural Resources • Indiana Dept. Natural Resources • Wisconsin Dept. Natural Resources • Illinois Dept. of Conservation • Minnesota Dept. of Natural Resources • New York State Dept. of Environmental Conservation	• Pennsylvania Fish and Boat Commission • Ohio Dept. Natural Resources • Chippewa-Ottawa Resource Authority • Dept. Fisheries and Oceans Canada* • National Oceanic and Atmospheric Administration* • U.S. Coast Guard** • GLFC Secretariat staff liaison and support***

Table 5 (cont'd).

Lake Ontario Committee	• Ontario Ministry of Natural Resources • New York State Dept. of Environmental Conservation	• GLFC Secretariat staff liaison and support***
Lake Erie Committee	• Ohio Dept. Natural Resources • Ontario Ministry of Natural Resources • New York State Dept. of Environmental Conservation	• Pennsylvania Fish and Boat Commission • Michigan Dept of Natural Resources • GLFC Secretariat staff liaison and support***
Lake Michigan Committee	• Michigan Dept. Natural Resources • Indiana Dept. Natural Resources • Wisconsin Dept. Natural Resources	• Chippewa-Ottawa Resource Authority • Illinois Dept. of Conservation • GLFC Secretariat staff liaison and support***
Lake Huron Committee	• Ontario Ministry of Natural Resources • Michigan Dept of Natural Resources • Chippewa-Ottawa Resource Authority	• GLFC Secretariat staff liaison and support***
Lake Superior Committee	• Michigan Dept. Natural Resources • Ontario Ministry of Natural Resources • Great Lakes Indian Fish and Wildlife Commission • Chippewa-Ottawa Resource Authority	• Minnesota Dept. of Natural Resources • Wisconsin Dept. Natural Resources • GLFC Secretariat staff liaison and support***
Great Lakes Fishery Commission	• Secretariat staff*** • Four Canadian Commissioners*** • Four American Commissioners, and one alternate Commissioner***	
Canadian Advisors	• Recreational fishing *** • Commercial fishing*** • Academia***	• Aboriginal community*** • Environmental*** • Public At Large
US Advisors	• Recreational fishing*** • Commercial fishing***	• Public at large*** • State agencies
Invitees	• Academia*** • Consulting firms*** • Other provincial agencies***	• Other state agencies*** • Other federal agencies***

Survey Design

The Web-based survey consisted of two parts (Appendix D and E). The first part was created using the online SurveyZ! program (Qualtrics 2006). Part two of the web-based survey was created using the online QuestionPro program (QuestionPro 2007; Appendix E). Part one consisted of five sections (Appendix D):

- Section 1: Your Great Lakes Committee;
- Section 2: You, Your Committee, and Your Organization;
- Section 3: Management and Enforcement of Great Lakes Fisheries;
- Section 4: Great Lakes Lake Sturgeon; and
- Section 5: Personal Information.

The data collected from the 'Personal Information' section was used to describe the average attributes of respondents and assess that they were representative of the individuals participating in the Joint Strategic Plan based on personal observation of meeting attendees between 2003 and 2006. This information was also used to detect whether individuals' perceptions were related to their attributes, such as which employer type they represented, and whether social network subgroups differed in the member attributes (Table 6).

Table 6: Attribute information requested from respondents.

• Employer type • Years associated with Great Lakes Fishery Commission and related boards, committees, sub-committees • Committee or other Joint Strategic Plan and GLFC related group you consider yourself to be a member or regular participant	• Gender • Age • Race • Highest level of education completed • Country of residence

The data collected from respondents from sections 1, 3, and 4, 'Your Great Lakes Committee', 'Management and Enforcement of Great Lakes Fisheries', and 'Great Lakes Lake Sturgeon', were used to describe the average perception of respondents, as well as to detect whether respondents belonging to a specific social network subgroup, described below, differed in their perceptions on fisheries and governance issues. To describe and detect difference among respondents' perception about the usefulness of having activities related to coordinated governance of transboundary fish stocks, I analyzed the data collected from 'Your Great Lakes Committee' section that is related to perception of the value of attending committee meetings and information learned during the meetings. To more specifically assess respondents' perceptions about the usefulness and effectiveness of the Joint Strategic Plan and GLFC organizational structure that accommodates its implementation, I used data collected from the 'Management and Enforcement of Great Lakes Fisheries' section that is related to multi-jurisdictional management of transboundary fish stocks in the Great Lakes and the perceived function and effectiveness of GLFC-institution's components. Lastly, to obtain specific information about respondents' perception of governance of transboundary lake sturgeon stocks in the Great Lakes, I analyzed data from the 'Great Lakes Lake Sturgeon' section which collected data on respondents' perception of the need for coordinated governance and the effectiveness of the Joint Strategic Plan and its implementation through the GLFC organizational structure as related to management of lake sturgeon (Table 7).

To collect the social network data required to depict the social ties among respondents, as well as with other participants of the Joint Strategic Plan, I used information from Part two of the survey. Part two asked questions about who the

respondent knew, which identified the individuals that were part of the respondent's social network. The respondent was asked to select names from eight name rosters compiled from the list of individuals selected to participate in the survey. The list of individuals was divided into the eight rosters based on which Joint Strategic Plan related Agency-Appointed committee, or other group involved in the implementation of the Joint Strategic Plan, that they were members of or had attended its meetings between 2000 and 2005. The rosters consisted of:

- GLFC Commissioners, Secretariat, and Advisors (GLFC-Core)
- Council of Great Lakes Fishery Agencies and Council of Lake Committees (GLFC-Committees)
- Law Enforcement Committee (LAW)
- Lake Ontario Committee (LOC)
- Lake Erie Committee (LEC)
- Lake Michigan Committee (LMC)
- Lake Huron Committee (LHC)
- Lake Superior Committee (LSC)

There were redundancies among these rosters, as many individuals belonged to more than one committee, and thus, were listed on more than one roster. I chose to keep this redundancy due to the possibility that respondents would search for a given individual based on the roster, i.e., committee meetings or GLFC related group, which they associated with that individual. The rosters consisted of 82, 50, 61, 109, 51, 96, 75, 64 (total 588) names, respectively for GLFC-Core, GLFC-Committees, LAW, LOC, LEC, LMC, LHC, and LSC. When omitting redundancies (160 instances of repeats) the

combined rosters consisted of 428 unique names from which respondents could select who they knew and with whom they shared information.

Respondents provided information about who they knew from the names listed in all of the eight rosters (GLFC-Core, GLFC-Committees, LAW, LOC, LEC, LMC, LHC, and LSC). Respondent were asked to select up to 10-individuals per roster for which to provide more detailed information on their social ties, although respondents could provide information for more than 10–individuals if they chose to do so. Respondents were asked to provided additional information about their social ties with individuals by selecting the best answer choice provided regarding frequency of interactions during the last 12-months, how long they have known the individuals, how much they value the fisheries information gained from discussions with each individual, and what percentage of their discussions pertained to lake sturgeon.

To verify that most of the individuals with which a respondent interacted for these issues were listed in the rosters in Part Two, I asked in the section 'You, Your Committee, and Your Organization' and 'Great Lakes Lake Sturgeon' of Part One of the survey, that respondents write the names and affiliation of the top five individuals with whom they have discussions on Great Lakes fisheries and with whom they have discussions on lake sturgeon, respectively. This allowed me to verify that most of the individuals that the respondents engaged with for these types of discussions were available for respondents to select from the rosters.

Table 7: Information regarding respondents' perceptions towards activities related to coordinated governance of transboundary fish stocks, the effectiveness of *A Joint Strategic Plan for Management of Great Lakes Fisheries* and its implementation through the Great Lakes Fishery Commission organizational structure.

Coordinated governance of transboundary fish stocks. • Value of attending meetings for learning new information through interactions during the informal portions such as organized coffee breaks and socials. • Value of attending meetings for learning new information through interactions during the formal portions such as presentations. • Usefulness of information learned through interactions during informal versus formal portions of meetings. • Value of knowing about current Great Lakes fisheries issues occurring outside of their jurisdictional responsibilities. • Value of having interactions with fisheries biologists from other jurisdictions. • Value of having interactions with fisheries law enforcement officers from other jurisdictions.
A Joint Strategic Plan for Management of Great Lakes Fisheries, its implementing Committees and objectives, as well as the structure facilitating its implementation • Amount of unijurisdictional versus multijurisdictional management needed to assure sustainability of Great Lakes fisheries. • How you perceive the committee balances unijurisdictional with lake-wide perspectives when deciding fisheries issues. • How important is your Great Lake committee's role in assuring sustainability of lake-wide fisheries. • How effective is your committee in achieving inter-jurisdictional cooperation among participants. • How effective is the Joint Strategic Plan in achieving inter-jurisdictional coordinated fishery management in the Great Lakes? • How valuable is the combined role of the boards, committees, and partners under the GLFC organizational structure in assuring sustainability of Great Lakes shared fisheries. • How effective are Fish Community Objectives as a tool for guiding the committee's effort in achieving its desired fish community structure.
Coordinated governance of transboundary lake sturgeon stocks and related topics. • Amount of unijurisdictional versus multijurisdictional management needed to assure sustainability of Great Lakes lake sturgeon fishery. • How would you describe the status of Great Lakes lake sturgeon population found within your committee's jurisdiction? • In your opinion, what amount of effort would be needed to rehabilitate threatened /endangered lake sturgeon in the Great Lakes. • What priority level is given by your committee to lake sturgeon fishery. • How would you qualify the priority level given by your committee to lake sturgeon fishery. • What priority level is given by your organization to Great Lakes lake sturgeon fishery. • How would you qualify the priority level given by your organization to lake sturgeon fishery. • What percentage of your work involves lake sturgeon in the Great Lakes.

Analysis of Respondents' Attributes and Perceptions

Respondent Attributes

I collected information about the respondents' personal attributes for two reasons. The first was to assess whether the respondents were representative of the Joint Strategic Plan participants, and therefore, the data collected can be assumed to be representative of the Joint Strategic Plan participants. Second, to provide information that may serve to explain the existence of subgroups, if any are detected, within the social network structure.

I calculated the percentage of responses selected by respondents with respect to attribute related questions (Table 6). These included gender, age, level of education, employer type, race, country of residence, years associated with the Great Lakes Fishery Commission and related institutions, and membership of participants in the Joint Strategic Plan or other Great Lakes Fishery Commission group. Membership to Joint Strategic Plan or Great Lakes Fishery Commission group such as Advisor, Commissioner, and Secretariat Staff was assigned based on the respondent holding an official position within the committee or group, or by the respondent self-assigning him or herself to a group within the survey. Whether the respondents' distribution in terms of their gender, age class, and race was representative of the actual participants was based on my personal observation of participants attending Agency-Appointed committee meetings and GLFC annual meetings between 2003 and 2006. The attribute information was also used to determine whether significant social network subgroups detected to be significant (described below) different based on their attributes.

A Kruskall-Wallace analysis (Sheskin 2007) using SAS (SAS 2003) was used to determine any significant difference between members of significant subgroups with respect to their attributes (Table 6). This non-parametric test was used due to the categorical nature of the data (Sheskin 2007). For significant differences, I then tested which pairs of subgroups differed significantly from each other using the Scheffé test on the ranked data (Sheskin 2007) using SAS (SAS Institute 2003). This test adjusts the p-value for the total number of pairwise comparisons. This analysis was undertaken to determine which pairs of subgroups differed in their members' attributes. The mean, standard deviation, and median value of answers were reported in the results. All three values were reported for information purposes although the mean value is generally used for reporting results on interval or ratio data and not categorical data (Sheskin 2007).

Respondent Perception to Coordinated Governance of Great Lakes Transboundary Fish Stocks and Transboundary Lake Sturgeon Stocks

I determined the majority, based on percentage per answer choice, of respondents' perception about coordinated governance for transboundary fish stocks, such as valuing information exchanges with fishery professionals from other jurisdictions. As well as about the effectiveness or value of their committee, the Joint Strategic Plan, and the Great Lakes Fishery Commission's boards and committees in coordinating governance of Great Lakes fish stocks and assuring sustainability of transboundary fish stocks (see Table 7 for more details on questions, and Appendix D). I also calculated the percentage of responses selected for each answer choice provided for questions related to coordinated governance of transboundary fish stocks in general as well as specifically for transboundary lake

sturgeon stocks (see Table 7 for details) to determine which response was selected by the majority of respondents. This provided a basic understanding of the perceptions about the value or need for coordinated governance for transboundary fish stocks, as well as whether differences in perceptions may contribute to the formation of subgroups within the social network structure, if any significant subgroups were detected.

For significant social network subgroups, as detected by the methods described in the next section, I conducted a Kruskall-Wallace analysis (Sheskin 2007) using SAS (SAS 2003) to determine significant difference between members of the subgroups with respect to their perceptions about coordinated governance of transboundary fish stocks and of transboundary lake sturgeon stocks (question topics outlined in Table 7). This non-parametric test was used due to the categorical nature of the data (Sheskin 2007). I then tested which pairs of subgroups differed significantly using the Scheffé test on the ranked data (Sheskin 2007) using SAS (SAS Institute 2003). This test adjusts the p-value for the total number of pairwise comparisons. This analysis was done to determine if social network subgroups differed in their members' perceptions. The mean, standard deviation, and median value of answers were reported in the results. All three values were reported for information purposes although the mean value is generally used for reporting results on interval or ratio data and not categorical data (Sheskin 2007).

Analysis of Significant Social Network Subgroups

I constructed the social network structure for the respondents based on two different types of information exchange, general information about Great Lakes fish stocks, Fish Stocks Information Exchange, and information on lake sturgeon stocks, Lake

Sturgeon Information Exchange. I selected these two different types of information exchange from which to construct social networks for the following reasons. Using the flow of general Great Lakes fish stocks information revealed the social ties respondents utilized to access any fish stock information of interest to them. Using the flow of information pertaining to lake sturgeon showed how respondents may alter their social ties to access specific Joint Strategic Plan participants they perceived as having the lake sturgeon information that they seek, i.e., participants that work on lake sturgeon or have other related expertise. The use of two different types of information, Fish stocks and lake sturgeon, should reveal two different social network structures (Bolland and Wilson 1994, Foster-Fishman et al. 2001).

I depicted, using a sociogram, the social network structure of respondents based on these two different types of information exchange, Fish Stocks Information Exchange and Lake Sturgeon Information Exchange. If significant subgroups were detected, I examined how respondents aligned in those different subgroups, based on their attributes and perceptions towards governance of transboundary fish stocks.

The analysis for significant subgroups was conducted on the weighted social ties among individuals. To weight the social ties among individuals in the Fish Stocks Information Exchange, I used the frequency of interactions within a 12-month period as the weight for their social ties. The five answer choices for frequency of interactions from which respondents could select consisted of: '1-3 times a year', '4-6 times a year', '1-3 times a week', 'daily' or 'no interactions'. These categories of frequency of interactions were converted to a numeric frequency of interaction consisting of, respectively, 2, 5, 52, and 260 days. For the Lake Sturgeon Information Exchange, I used as weight for the

social ties the frequency of interaction during a twelve-month period (2, 5, 52, and 260 days as described above) multiplied by the proportion of their conversation about lake sturgeon. I used numerical value to correspond to each answer choice regarding proportion of their conversation pertaining to lake sturgeon:

'none of my discussions' = 0%;

'few' = 16.7%

'less than half' = 33.4% ;

'about half' = 50%;

'more than half' = 66.7%;

'almost all'= 83.4%; and,

'all of my discussions' = 100%.

For respondents that reported having none of their discussions with a given person pertaining to lake sturgeon, that pair of interactions was omitted from the network.

I used the program KliqueFinder (Frank 1995, 1996) to identify potential social network subgroups within the Fish Stocks Information Exchange network data and Lake Sturgeon Information Exchange network data collected in Part Two of the survey. KliqueFinder has two limitations that needed to be addressed when calculating the weights of social ties; (1) sensitivity to extreme weights, and (2) weights need to be integers. The weights for the two information networks were log-transformed to avoid the undesirable influence of extreme weights on the KliqueFinder program (Dr. Ken Frank, Measurement and Quantitative Methods Counseling, Educational Psychology and Special Education and the Department of Fisheries and Wildlife, Michigan State University, personal communication). Furthermore, due to the restriction of the KliqueFinder program to use

whole integers (Dr. Ken Frank, Measurement and Quantitative Methods Counseling, Educational Psychology and Special Education and the Department of Fisheries and Wildlife, Michigan State University, personal communication), I multiplied the log-transformed value by ten to capture the first decimal as part of the whole integer number for the weight. This multiplication was needed, otherwise the majority of the weights would be interpreted by KliqueFinder as being the same due to the log-transformed interaction weights all starting with the value of '1'.

The KliqueFinder program iteratively assigns individuals to subgroups until it maximizes the occurrence of weighted social ties within subgroups versus between subgroups. The program uses odd ratios to maximize the odds that weighted social ties are occurring among individuals within subgroups versus between subgroups. Hence, KliqueFinder maximizes the occurrence of A and D (Equation 1; for more detail see Krause et al. 2003; Krause 2004). The odds ratios being calculated are described in Equation 1.

Equation 1: [(A*D)/(B*C)] where:

A=individuals without social ties are in different subgroups;

B=individuals without social ties are in the same subgroups;

C=individuals with social ties are in different subgroups; and

D=individuals with social ties are in the same subgroups.

Once KliqueFinder identifies subgroups among respondents, using the same weights of social ties, I ran a Monte-Carlo simulation 500 times to detect whether the

subgroups identified by KliqueFinder were significantly different from random at the alpha value of 0.05 (Dr. Ann Krause, Department of Environmental Sciences, University of Toledo, Personal Communication). In this Monte-Carlo simulation I kept the number of social ties per respondent constant so that the simulation and the original data had the same total number of respondents, same number of social ties per respondent, and same total number of social ties. The KliqueFinder program then calculated the odds ratio for each of the 500 simulations. These odds ratios provided a sampling distribution that compared to the original data's odd ratio for significance. I performed the above analysis to detect network subgroups and to test for the significance (alpha=0.05) of these subgroups for both the General Fish Stocks Information Exchanges and the Lake Sturgeon Information Exchanges network.

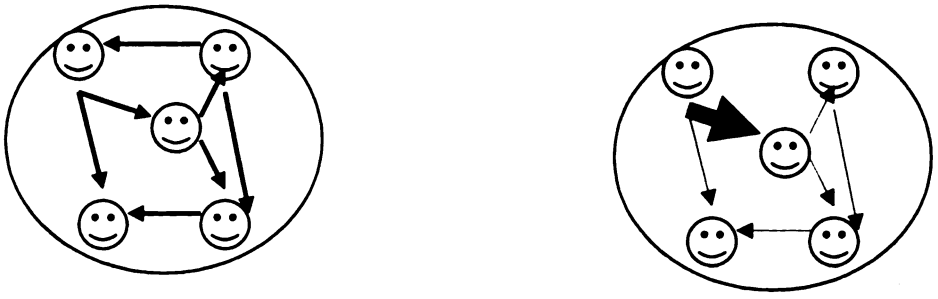
Using the SAS program's GPLOT procedure (SAS Institute 2003) I generated a figure, called a sociogram, illustrating the location of individuals and their subgroups within the Fish Stocks Information Exchange network and for the Lake Sturgeon Information Exchange network (Frank and Yasumoto 1998). This sociogram illustrates the location, with respect to others, of individuals within a network subgroup as well as where each subgroup is located with respect to others. The further individuals and subgroups are from the others the weaker the tie connecting them. The location, which is defined by both dimension and coordinate, of individuals and groups was determined by using a nested multidimensional scaling using the weighted social ties density within and between subgroups (Frank 1996, Krause 2004).

Social Network Evenness of Information Flow and Density of Social Ties

The flow of information resources within a network depends on the actual number of social ties between individuals in the network, as well as on the weight of these social ties. To understand how information flows through the Fish Stocks Information Exchange network and Lake Sturgeon Information Exchange network, I calculated the Evenness of Information Flow measures (Krause 2004, Krause and Frank in prep, Krause et al. submitted). These measures are based on the original equations of the Shannon measures that describe flow of information, based on having directional and weighted flows, along communication pathways (Shannon 1948, Krause 2004, Krause and Frank in prep., Krause et al. submitted).

Evenness of Information Flow measures provides insight on how evenly distributed is the probabilities of resource flow based on the weights of the social ties within a network (Krause and Frank in prep.). The probabilities of resource flow, such as flow of information, is used to assess the evenness of distribution for weighted social ties within the network for all pairs of respondents and the individuals with whom they interact within a network, referred to as chosen, H(x,y), as well as the flow along weighted social ties across all respondents, H(x), and along weighted social ties across all chosen, H(y). These measures facilitate understanding if the information within the network flows evenly across all social ties or if the information flow is dominated by certain respondents and chosen (Figure 8). The flow of information based on the weight of social ties, for instance, can be evenly distributed among all social ties within the network (Figure 8, Network A) or may be dominated by certain social ties (Figure 8, Network B). The interpretation of information from the evenness of flow measures also

allows for assessing the density of ties within the network. If there are few weighted social ties in the network, then the density of ties is low and there is indication for specialization within the network, meaning that the information flows along specific of social ties.



Network A Network B

Figure 8: Illustrating the flow of information through two different network structures (simplified from illustration in Krause and Frank in prep). Network A illustrates an even flow of information within the network, as the weight of social ties is the same among all individuals (same thickness of line). Network B illustrates an uneven flow of information, with one social tie being thicker and dominating the flow of information. The thicker social tie in Network B, in this scenario, also indicates that the flow of information is specialized between that respondent and the chosen receiving the information, as that chosen receives all his/her information from that respondent.

In calculating the Evenness of Information Flow measures I used the same weighted social ties used in defining the social network structure for the Fish Stocks Information Exchange network and Lake Sturgeon Information Exchange network. To calculate the Evenness of Information Flow measures based on weighted social ties I used Equation 2, which was then normalized, per Krause and Frank (in prep., Krause et al. submitted), by taking the exponential value of H(x,y), natural logarithmic, and dividing by the actual number of weighted social ties in the network. Hence, the normalized H(x,y) is now a proportion with values ranging from zero to one, with values

closer to one indicating a more evenly distributed flow of information in the network. When the value is close to one this indicates an evenly distributed flow, because the flow of information is occurring through all possible social ties in the network, hence, the flow of information is not being dominated by any respondents or chosen.

Equation 2: Evenness of Information Flow measure for entire network

$$H(x,y) = -\sum_{i,j} p(i,j) \log p(i,j)$$

Where $$p(i,j) = \frac{w_{i,j}}{\sum_{i,j} w_{i,j}}$$

H(x,y) is the measure of the evenness in the probabilities of the joint events (i,j) across all pairs of respondent (x) and chosen (y) with a weighted social tie.

P(i, j) is the evenness of probabilities of the information flow between pairs of respondents (i) and chosen (j) in a network that are linked by a weighted social tie.

Wi,j is the weight of social ties for each pair of linked respondents (i)-chosen (j) in the network.

To gain more detailed insight on the flow of information I used Shannon's modification of Equation 2 to calculate the evenness in the probabilities of information

flow across respondents (Equation 3) and the evenness in the probabilities of information flowing across chosen (Equation 4; see Krause and Frank in prep., Krause et al. submitted for more details on the equation). Both of these measures were also normalized as described for H(x,y) above, except that instead of dividing by the total number of weighted social ties in the network, measures from Equations 2 and 3 were divided by the total number of respondents and chosen with weighted social ties in the network, respectively. For these measures, Equation 3 and 4, values close to one indicate a more even flow of information across respondents and chosen, respectively.

Equation 3: Evenness of Information Flow measure across all respondents in the social network.

$$H(x) = -\sum_{i,j} p(i,j) \log \sum_{j} p(i,j)$$

Where $$p(i,j) = \frac{w_{i,j}}{\sum_{i,j} w_{i,j}}$$

H(x) is the measure of the evenness in the probabilities associated with all respondents (x).

P(i, j) is the evenness of probabilities of the information flow between pairs of respondents (i) and chosen (j).

Wi,j is the weight of social ties for a given social network for each pair of respondents (i) –chosen (j).

Equation 4: Evenness of Information Flow measure across all chosen in the social network.

$$H(y) = -\sum_{i,j} p(i,j) \log \sum_{i} p(i,j)$$

Where $$p(i,j) = \frac{w_{i,j}}{\sum_{i,j} w_{i,j}}$$

H(y) is the measure of the evenness of the probabilities associated with all chosen (y).

P(i, j) is the evenness of probabilities of the information flow between pairs of respondents (i) and chosen (j).

Wi,j is the weight of social ties for a given social network for each pair of respondents-chosen.

I also calculated a measure of Density, which assesses how dense the social ties are in the network, using the Evenness of Information Flow measures from equations two to four, (Equation 5; Krause and Frank in prep., Krause et al. submitted). If the value for the density of social ties in the network, Density measure, is close to zero then the flow of information, as based on the weight of social ties, is specialized to flow through a specific social ties within the network, meaning that information from a respondent always flows to a specific chosen. If the value for the Density measure is close to one, this is

interpreted as meaning that the flow of information within the network is fairly evenly distributed across the social ties, the information is more random in terms of which ties it flows through and, hence, is not specialized to flow between a given respondent and chosen.

Equation 5: Density measure for the entire network

$$\exp\{H(x,y)-[H(x)+H(y)]\}$$

H(x,y) is the measure of the evenness in the probabilities of the joint events (i,j) across all pairs of respondent (x) and chosen (y) with a weighted social tie. H(x) is the measure of the evenness in the probabilities associated with all respondents (x). H(y) is the measure of the evenness of the probabilities associated with all chosen (y). Consult Equations 2, 3, and 4 for H(x,y), H(x) and H(y) calculations.

The Evenness of Flow of Information measures and the Density measure, Equations 2 to 5, were also calculated for significant subgroups detected within a social network. This allowed for increased understanding of the evenness of the distribution flow of information, such as whether the flow is evenly distributed or dominated and whether it is random or specialized, across the weighted social ties within each of the subgroups.

In interpreting the measures of Evenness of Flow of Information across social ties within the network, across respondents, and across chosen, as well as the interpretation of the density of social ties within the network, Density measure, the potential stability of the network, i.e., resistance to disturbance (Krause and Frank in prep.) can be assessed. Basing the assessment of network stability on indicators used in an ecological system (McCann 2000, Krause and Frank in prep.), I would expect that a network that had evenness of measures nearer to one versus nearer to zero would be more resilient to disturbances as many pathways to access information is available, i.e., there are no individuals dominating the flow of information. To be an efficient network, however, there also needs to be a level of specialization in the flow of information between respondents and chosen, so that the network is not inefficient due to excess amounts of redundancies. The ideal balance between having a stable network with multiple pathways to access information and being efficient by having some level of specialization in the flow of information among respondents and chosen is, however, not explicitly defined. Thus, Evenness of Flow measures and Density measure can only be used at this time to conjecture at the potential resilience and efficiency of the social network structure.

Results

Survey Response Rate

I invited 423 individuals to participate in my survey. The number of respondents that started and completed the last section of Part One of the survey was 299 individuals (70.7% response rate). As respondents were allowed to skip questions if they did not

know the answer or did not want to provide an answer in Part One of the survey, the total number of responses per questions was fewer than 299 for some questions.

The response rate for Part Two of the survey, which consisted of the eight rosters and questions related to the respondents' social ties with the individuals they knew from each roster, was slightly lower than in Part One, with 277 respondents providing information about their social ties, a 65.5% response rate. The information about social ties was used in determining the Fish Stocks Information Exchange network. All but one of these individuals, 276 respondents, provided information on sturgeon related social ties, which was used for determining the Lake Sturgeon Information Exchange network.

Analysis of Respondents' Attributes and Perceptions

Respondent Attributes

Among respondents that provided information to the attribute questions in Part One, 76.3% reside in the USA, 23.3% reside in Canada, and fewer than 1% currently reside outside of North America (N=266). The majority of respondents were over the age of 45 (64%, N=264; Figure 9), white and male (94. 8% white, N=251; 88.3% males, N=265; Figure 10). Most respondents had a graduate degree (65.5%, N=264; Figure 11), employed by a government agency (66.9%, N=299; Figure 12), and had been involved with the Great Lake Fishery Commission and related committees and boards for more than 6 years (70%, N=253; Figure 13).

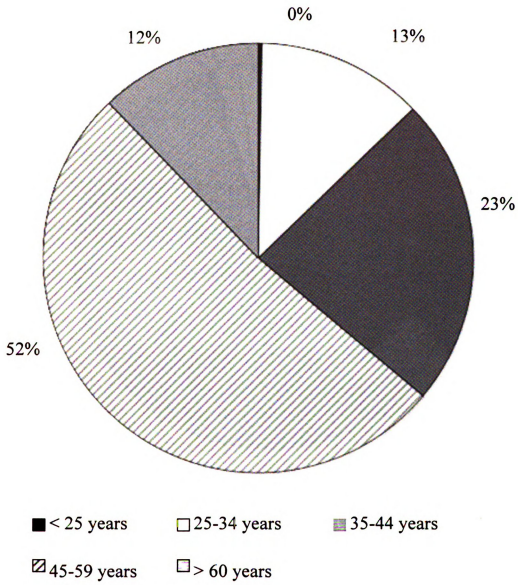


Figure 9: Pie chart illustrating the percentage of respondents being of a certain age category.

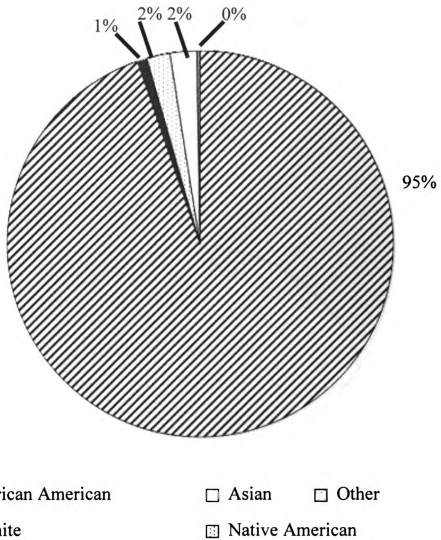


Figure 10: Pie charts illustrating the percentage of respondents being of a certain race category.

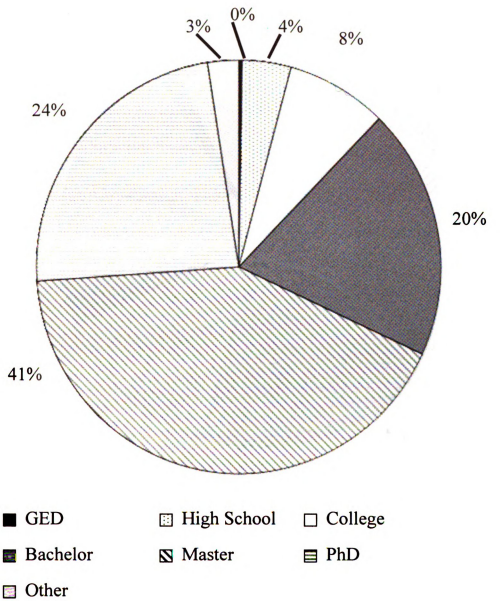


Figure 11: Pie charts illustrating the percentage of respondents having a certain level of education.

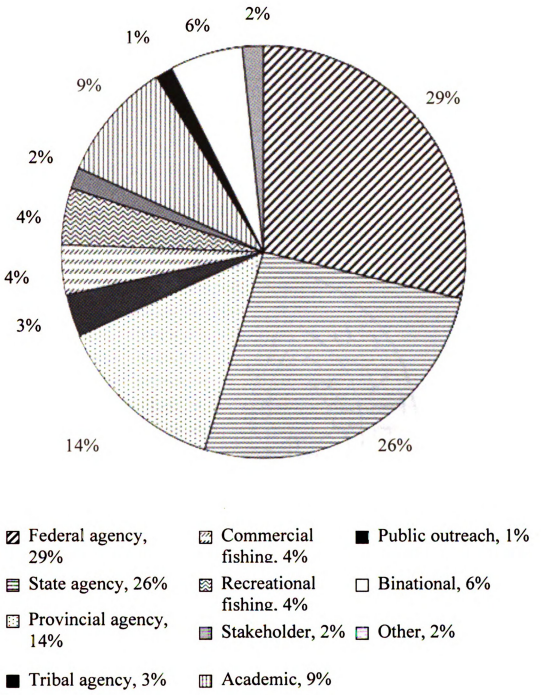


Figure 12: Pie charts illustrating the percentage of respondents employed by a given employer type.

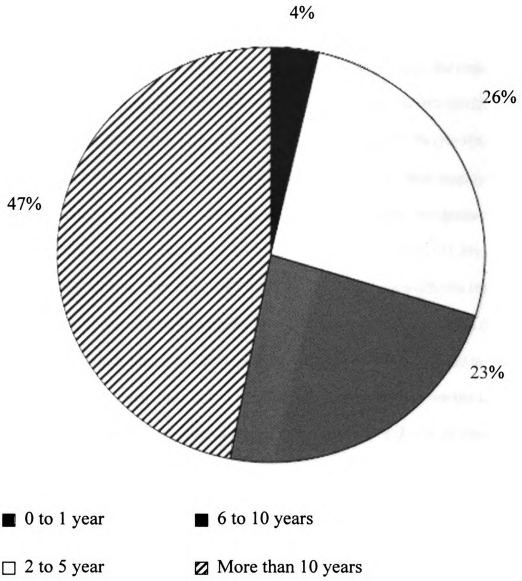


Figure 13: Pie charts illustrating the percentage of respondents that have been associated with the Great Lakes Fishery Commission and related committees and boards for a given range of years.

Respondent Perception Towards Coordinated Governance of Great Lakes Transboundary Fish Stocks and Transboundary Lake Sturgeon Stocks

The majority of survey respondents reported that they 'frequently' or 'always learned' new information, generally related to Great Lakes fish stocks, during both the

formal (91.6%, N=262) and informal (85.7%, N=287) portions of committee meetings. When comparing how respondents perceived the usefulness of the information they learned during informal and formal portions of the committee meetings, the majority found the information from either forum to be 'equally important', 72.8% (N=283).

Respondents generally placed a 'moderate to high' value, 95.7% (N=186) in knowing about fisheries issues occurring in Great Lakes external to their employment-based jurisdictional responsibilities. This was similar to respondents' 'moderate to high' valuation of interacting with fisheries biologists from other jurisdictions (91.5%, N=296). When assigning a value to interacting with fisheries law enforcement officers from other jurisdictions, 69.1% placed a 'low to moderate' value to this type of interaction (N=296). This may be related to having a low proportion of respondents being involved in fisheries related law enforcement activities: only 12% of respondents identified with the Law Enforcement Committee and its subcommittees; 12% stated that their job involved harvest regulations while 16% said their job involved fisheries regulations, no differentiation was made as to whether this involved developing or implementing regulations.

The majority of respondents perceived the need for a 'mostly' or 'only' transboundary approach to management to assure the sustainability[15] of shared[16] fish stocks in the Great Lakes (53.5% and 9.3% respectively, N=269, Figure 11). When asked the same question for lake sturgeon management, there was a very slight, non-significant

[15] Sustainability was defined within the survey instrument (Appendix D) for respondents as "... using a fishery resource, and the ecosystem that supports the fishery resource, in such a way to assure that the fishery maintains a healthy population size"
[16] Shared was defined within the survey instrument (Appendix D) for respondents as "[crossing] jurisdictional boundaries, thus having more than one jurisdiction with management and enforcement authority ..."

shift from perceiving a need for 'mostly' to a need for 'only' transboundary management approach among respondents (48.3%, and 12.4% respectively, N=267, Figure 14).

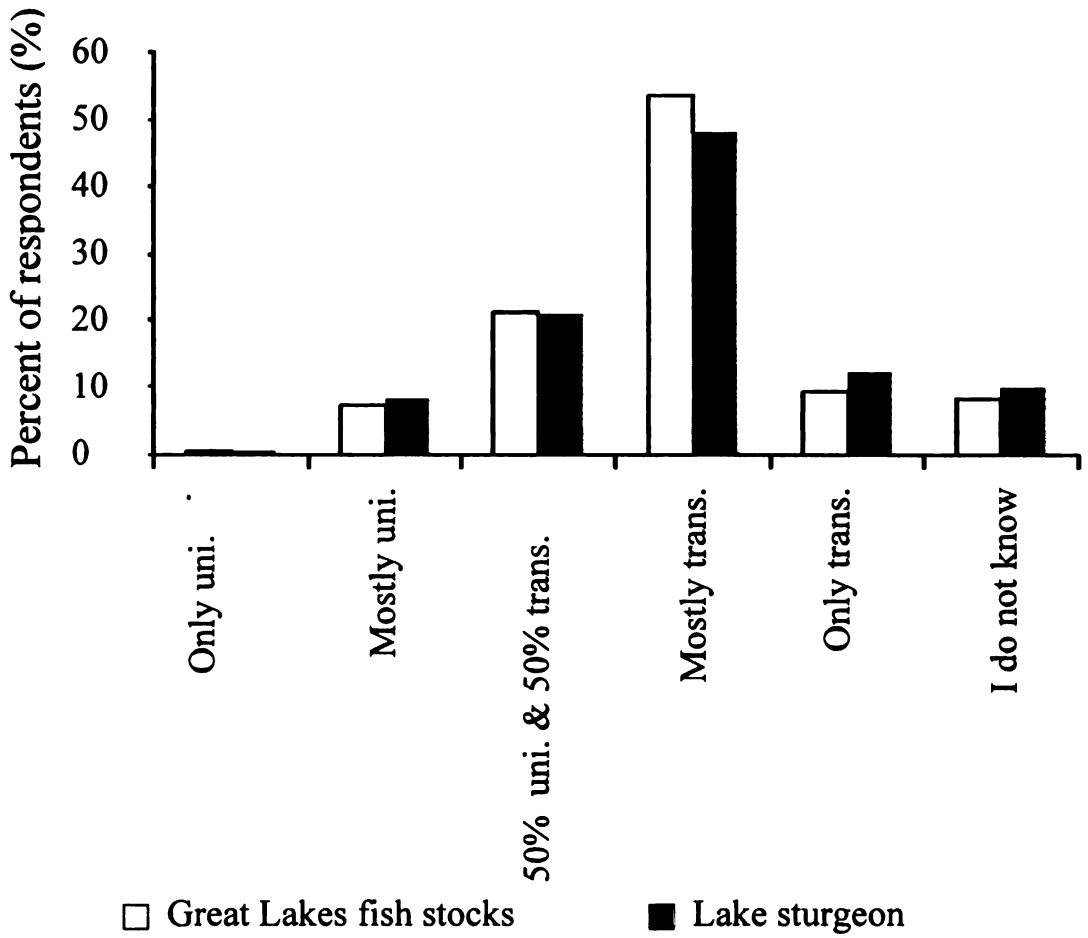


Figure 14: Percent of respondents that perceive the need for a unijurisdictional (uni.) management approach versus a transboundary (trans.) management approach to assure the sustainability of transboundary fish stocks and of lake sturgeon in the Great Lakes.

The perception of respondents towards their committee's role in governance of transboundary Great Lakes fish stocks, were generally positive with 90.1% of respondents perceiving their committee as having a 'moderate to high' level of importance in assuring sustainability of shared fish stocks (N=183). The majority of respondents also perceived their committee as being effective in achieving inter-

jurisdictional cooperation among participants (55.8% moderately effective and 14.9% completely effective, the two highest level of effectiveness that respondents could select, N=181). Respondents, however, seemed to be less consistent in how they perceive their committee balancing the perspectives of individual jurisdictions with the committee (lake-wide) perspectives when making decisions on fisheries related issues; with only 35.9% (N=184) of respondents perceiving their committee making decisions based on the committee-wide perspective of a fishery related issues rather than an individual jurisdiction's perspective on a fishery issue (Figure 15).

Respondents' in general perceived the effectiveness[17] of *A Joint Strategic Plan for Management of Great Lakes Fisheries* to be 'moderately' effective in achieving inter-jurisdictional coordinated fishery management in the Great Lakes (52.1%, N=267; Figure 13). Similarly, respondents perceived the effectiveness of their committee's Fish Community Objectives to achieve desired fish community structure as being moderately effective (53.7%, N=216; Figure 16). Respondents had a stronger positive perception of the value of Great Lakes Fishery Commission and its related boards, committees, and partners in assuring the sustainability of shared Great Lakes fish stocks, with 86.3% assigning a moderate to high value of which 46.7% assigned a high value (N=270).

[17] The term 'effectively' in this chapter is used as the Merriam-Webster Dictionary defines the word 'effective', "producing a decided, decisive, or desired effect (Merriam-Webster 1974).

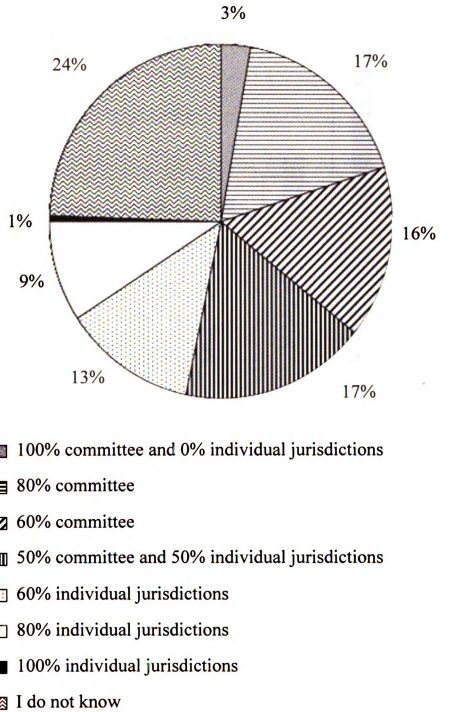


Figure 15: Percent of respondents that perceive their committee as balancing the committee's, or lake-wide, perspective versus the individual jurisdictions' perspective when making a decision on fisheries issues. Respondents could select from an answer scale starting with decisions made by their committee being based 100% on the committee's perspective to being based 100% on individual jurisdiction's perspective.

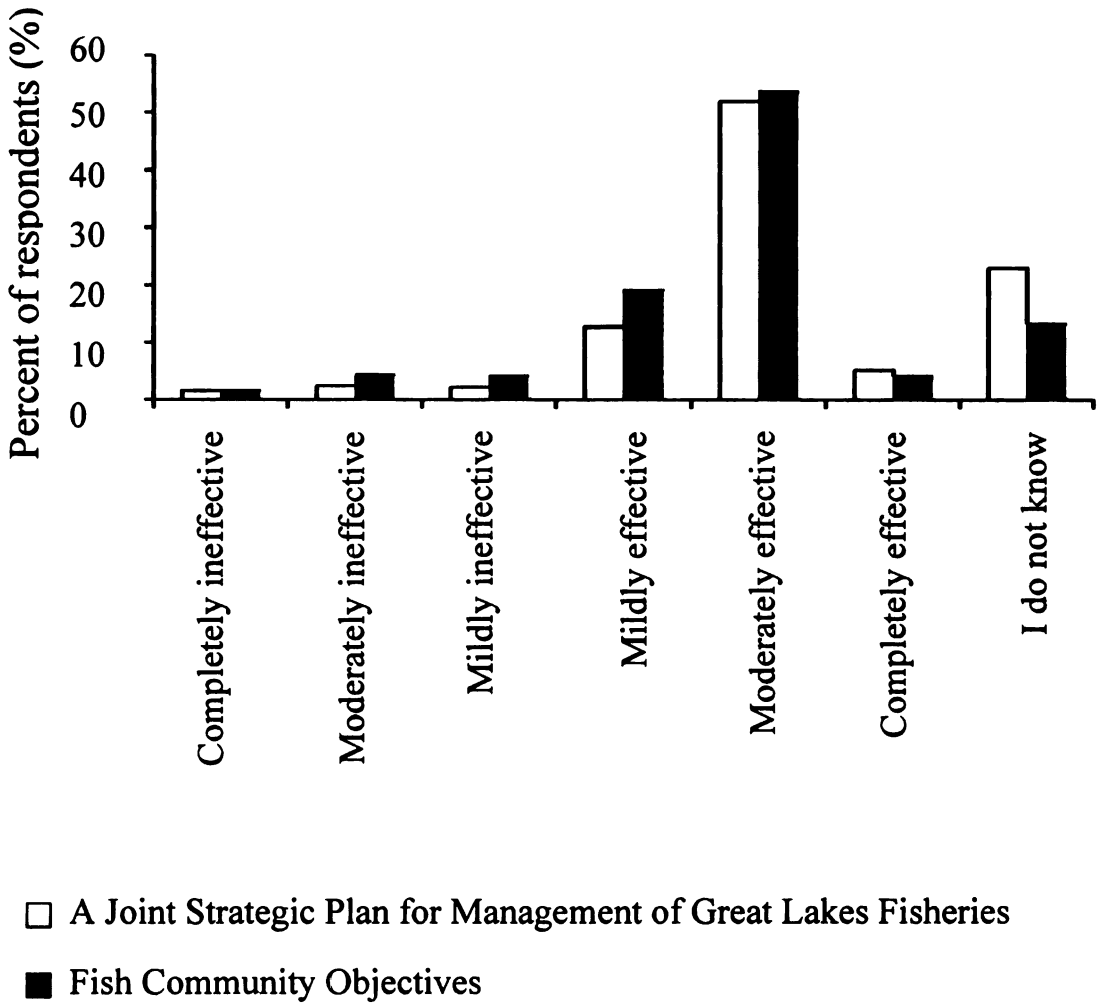


Figure 16: Respondents' perception on the effectiveness of *A Joint Strategic Plan for Management of Great Lakes Fisheries* in achieving inter-jurisdictional coordinated fishery management in the Great Lakes are presented as percentage per answer choice (white bars). Respondents' perception on the effectiveness of their committee's Fish Community Objectives in attaining the desired fish community structure is presented as a percentage per answer choice (dark bars).

On average, respondents perceived that the lake sturgeon stocks (or population(s) as used in the survey question) within the jurisdiction of their committee to be threatened (51.1%) with the next most frequently selected category of status being 'Moderate, healthy population, that can support a limited recreational and/or commercial harvest' (20.7%, N=218; Figure 17). Respondents, 71.7%, perceived that a 'high' to 'an incredible

high amount' of effort would be needed to rehabilitate threatened and endangered lake sturgeon populations in the Great Lakes (N=218). The majority of respondents stated that lake sturgeon were not part of their work (33.9%) or consisted of less than 10% of their work (50%, N=304). Only 2.9% of respondents reported that 50% or more of their work (i.e., enforcement, policy, management, research, outreach) consisted of lake sturgeon related work.

When asked what priority level they perceived their committee and their organization as assigning to lake sturgeon fishery issues, only 21% (N=303) of the respondents selected 'moderately high' for their committee, and only 21.5% (N=303) selected 'moderately high' for their organization (Figure 17). When asked how they would qualify the priority level assigned by their committee and organization to lake sturgeon, in terms of being sufficient or not, responses were highly variable with the 'some what high' (21.1%, N=328) choice for their committee, and 'high' choice for their organization being the categories selected most frequently (16.5%, N=303), although by a small subset of the respondents (Figure 18). For both committee and organization many respondents did not believe that they knew the priority level assigned to lake sturgeon (14.1% and 12.7%, respectively, Figure 18) or how they would qualify that level in terms of being adequate or inadequate (28.8% and 32.9%, respectively, Figure 19).

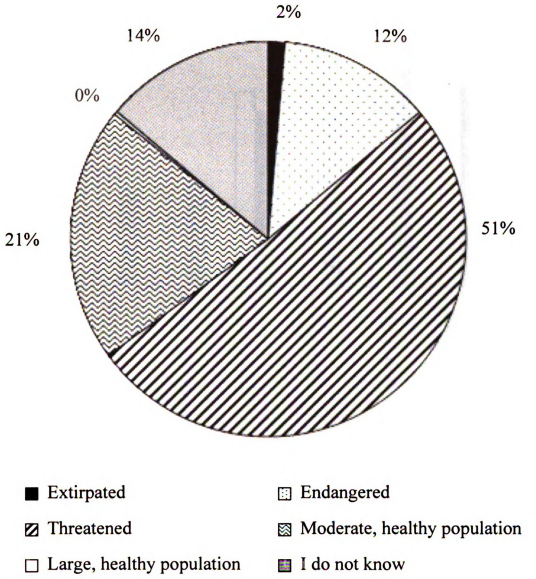


Figure 17: Respondent's perception of lake sturgeon population status within their committee's jurisdiction. Percentage of respondents selecting each answer choice is shown.

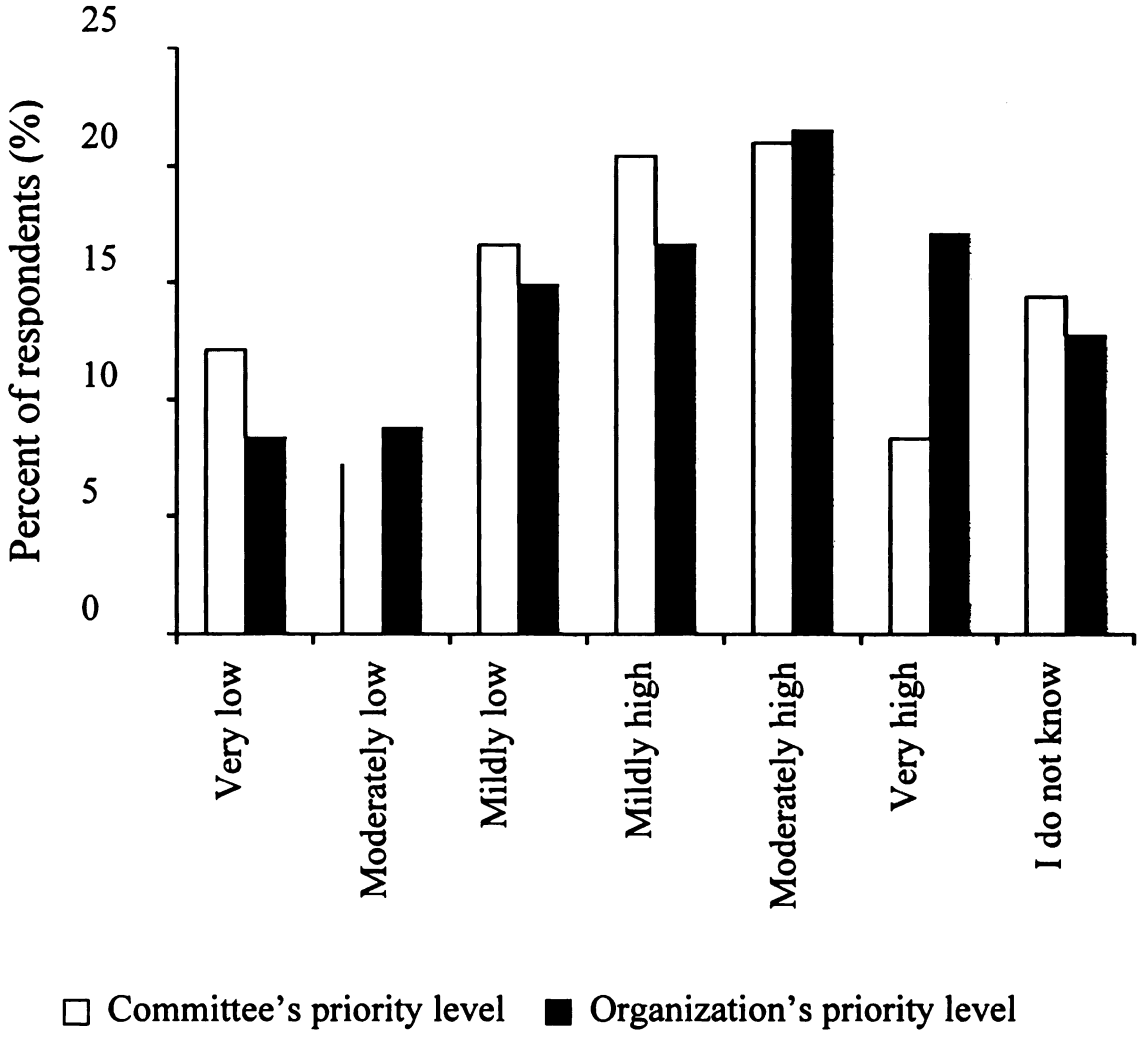


Figure 18: The priority level that respondents perceive is given by their lake committee and their organization, dark bars, to lake sturgeon related issues, white bars.

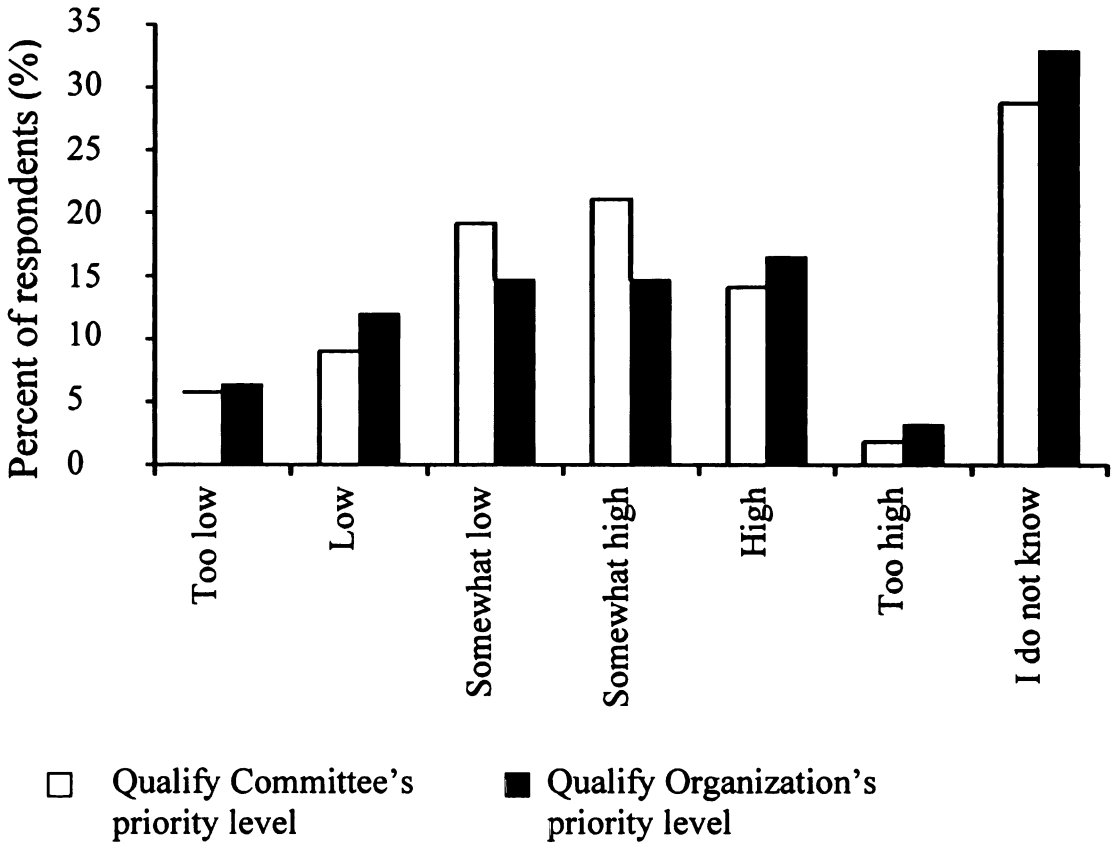


Figure 19: How respondents perceive the adequacy of the priority level that they perceive is given by their lake committee, white bars, and their organization, dark bars, to lake sturgeon related issues.

Analysis of Significant Social Network Subgroups

To be confident that most individuals involved in the two information exchange networks (1) General Fish Stock Information Exchange network, and (2) Lake Sturgeon Information Exchange network, are included in the eight rosters, I compared the roster names to the names provided by respondents in Part One of the survey. In Part One of the survey, I asked the respondents to list up to five names of people, either internal or external to the Great Lakes Agency-Appointed committees, with whom they discuss

important Great Lakes fishery issues, and five names of people with whom they discuss Great Lakes lake sturgeon issues. The combined names obtained from Part One matched the names provided in the rosters, with the exception of 10 names. These 10 names represented individuals from private organizations, universities, agencies at the federal, provincial and state level, among which five where located outside Great Lakes political jurisdictions. Hence, of the 428 unique names provided in the rosters, only 10 additional names were provided from the open-ended network question, representing 2.1%. With this information, I was confident that almost all (~98%) individuals involved in these two information exchange networks are listed in the eight rosters.

Fish Stocks Information Exchange Network

A total of 276 respondents provided social tie information based on their frequency of interactions with a total of 401 individuals. This provided information on the social ties pertaining to exchange of information related to general Great Lakes fish stocks for a total network size of 455 unique individuals, with a total of 274 of the 276 respondents actual making a weighted connection with others. Each respondent provided information for a different total number of individuals (median=46 individuals, min-max range of 1-202 individuals), which was used to weight their social tie with these individuals.

The KliqueFinder program (Frank 1995, 1996) identified 14 separate subgroups, ranging from 21 to 46 individuals, in the Fish Stocks Information Exchange network, based on using the frequency of interaction over 12-months as the weights for the social ties linking individuals (Figure 17). These subgroups, however, were found to be

insignificantly different from random assignment, based on a alpha-value of 0.05 ($\theta_{network}$=1.2098; total number of simulated runs with $\theta_{simulated} < \theta_{network}$ =114; p-value=[number of $\theta_{simulated} < \theta_{network}$ / total number of simulated runs]=114/500=0.228) when compared to the Monte-Carlos simulated distribution based on 500 simulations. Hence, the social network structure based on the flow of information pertaining to general Great Lakes fish stocks issues of interest to participants is well integrated, i.e., not subdivided into subgroups.

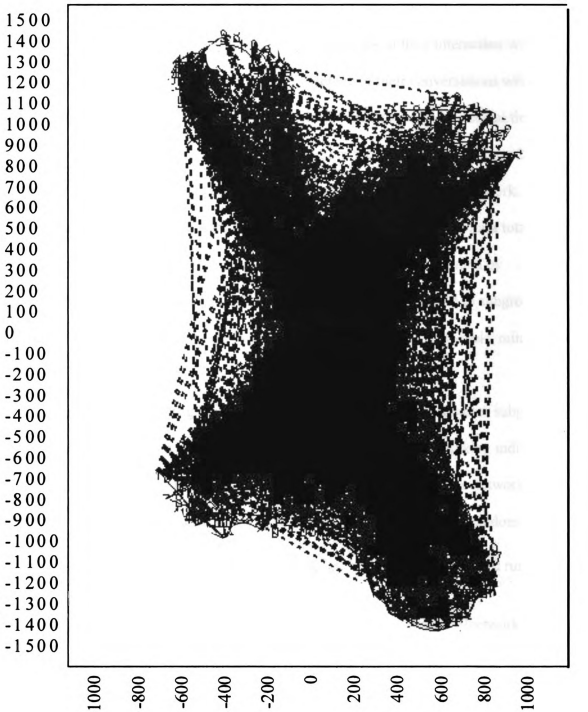


Figure 20: Sociogram for the Fish Stocks Information Exchange network, depicting flow of information (lines) among individuals. A total of 276 respondents provided information, of which 274 made weighted connections with others in the network. There are a total of 455 unique individuals in this network. Distances between individual are interpreted relative to one another and are unit-less.

Lake Sturgeon Information Exchange Network

A total of 274 respondents provided information about their interaction with selected individuals from the rosters and the percentage of their conversations with these individuals that pertained to lake sturgeon, which was used to weight the social ties between respondents and the individuals selected from the rosters. Among these 274 respondents, 234 actually made weighted connections with others in the network. The respondents selected a total of 399 individuals listed on the eight rosters, for a total network size of 366 unique individuals. The number of individuals selected by respondents varied but this does not affect how individuals are assigned to subgroups, if significant subgroups are found within the network (median 34.5 individuals, min-max of 1-183 individuals).

The KliqueFinder program (Frank 1995, 1996) identified 12 separate subgroups, ranging from 23 to 59 individuals, based on the weights of social ties linking individuals (Figure 18 and 19). Unlike the General Fish Stock Information Exchange network's subgroups, these subgroups were found to be significantly different from random assignment based on a alpha-value of 0.05, ($\theta_{network}$=1.2438; total simulated runs with $\theta_{simulated} < \theta_{network}$ =3; p-value= p-value=[number of $\theta_{simulated} < \theta_{network}$ / total number of simulated runs]=3/500=0.006), when compared to the Monte-Carlos simulated distribution based on 500 simulations.

I tested whether the subgroups differed in the attributes of their members (list of attributes tested are in Table 6). I found that the subgroups did differ significantly with respect to employer type (Kruskall-Wallace: N=279, Chisqr=70.62, df=11, p<0. 0001)

and committee membership (Kruskall-Wallace: N=279, ChiSqr=64.44, df=11, p<0.0001). I used the Scheffé test on ranked data to detect subgroup pairs that significantly differed from each other with respect to employer type (Table 8). I found that subgroup 3 differed significantly from several other subgroups with respect to employer type. Subgroup 3 had as the highest percentage of employer type Binational organization (38%), which differed from the highest percentage of employer type of subgroups 2 (73%, p=0.002), 6 (76%, p=0.002), and 9 (90%, p<0. 001) which were federal agencies, and subgroup 8 which has state agencies as its highest percentage of employer type (78%, p=0.04). Subgroup 9, which had as highest percentage of employer type of federal agency (90%), differed from subgroups 1 (61%, p=0.001) which had provincial agency, and from subgroups 10 (45%, p=0.04) and 7 (42%, p=0.001), which had state agency as its highest percentage of employer type state agencies.

I used the Scheffé test on ranked data to detect subgroup pairs that significantly differed from each other with respect to committee membership (see Figure 7 illustrating the GLFC organizational structure depicting the committees, Table 5 describing the Joint Strategic Plan member agencies represented on the committees, and Table 9 for the statistically significant subgroups). Subgroup 11, which had Lake Ontario Committee as its highest percentage of committee membership (64%) differed significantly in committee membership from subgroups 3 (57%, p<0.0001) and 6 which had as highest percentage of committee members the 'GLFC-Core and GLFC-Committees' (41%, p=0.003), and from subgroup 7 which has Lake Michigan Committee as its highest percentage of membership (42%, p=0.001).

The subgroups, although some pairs significantly differed as to which employer and committee membership dominated the subgroups, still had representation from the different employer types and committees. This representation of different employers and committees within a subgroup indicates that the Lake Sturgeon Information Exchange network participants are somewhat integrated and not strictly subdivided along any particular attribute that I tested.

Table 8: Codes used to represent committee membership and employer type in the statistical analysis. This information can be used to interpret the median value for the results of the committee membership and employer type dominating the subgroups based on the median values reported in Table 9 and 10.

Committee membership	Code
Lake Ontario Committee	1
Lake Erie Committee	6
Lake Huron Committee	14
Lake Michigan Committee	18
Lake Superior Committee	22
Law Enforcement Committee	25
No committee	31
GLFC-core and GLFC-committees	40
Advisor	50

Employer type	Code
Federal agency	1
State agency	2
Provincial agency	3
Tribal/First nations agency	4
Commercial fishery organization	5
Recreational fishery organization	6
Stakeholder organization	7
Academic institution	8
Public outreach organization	9
Binational organization	10
Other	11

Table 9: Employer type per each subgroup. The dominating employer type, based on frequency of occurrence (percent), within each subgroup is identified by "*", and is placed first with others placed in decreasing frequency of occurrence (percent). The sample size (N), mean and stand deviation (s.d.) and the median values for each subgroups are also provided.

Subgroup (N)	Mean±s.d.	Median	Employer type (percentage)
1 (26)	3.6 ± 1.4	3	Provincial agency (prov.; 61%)* commercial fishery organization (commerc.; 23%), federal agency (fed.; 8%), recreational fishery organization (recreat.; 4%), and stakeholder organization (stakeh.; 4%)
2 (15)	2.3 ± 3.1	1	Federal agency* (73%) State agency (state; 13%)), Public Outreach organization (publ.; 7%), other (7%).
3 (37)	6.7 ± 3.7	8	Binational organization (binational; 38%)* Academia (22%), fed. (19%), state (8%), prov. (3%), tribal agency (tribe; 3%), recreat.(3%), stake. (3%), other (3%).
4 (21)	3.0 ±2.3	2	State agency (71%)* Fed. (5%), Prov. (5%), Recreat. (5%), Stake. (5%), Academia (5%), Publ. (5%)
5 (18)	3.5 ± 2.2	3.5	Federal agency (28%)* Prov. (22%), tribe (22%), commerc. (17%), academia (11%)
6 (17)	2.6 ± 3.1	1	Federal agency (76%)* Academia (12%), recreat. (6%), binational (6%)
7 (24)	4.3 ± 3.0	2	State agency (42%)* Recreat. (21%), academia (21%), fed. (12%), other (4%)
8 (14)	1.8 ± 0.4	2	State agency (78%)* Fed. (21%)
9 (20)	1.5 ± 2.0	1	Federal agency (90%)* State (5%), binational (5%)
10 (44)	3.4 ± 2.7	2	State agency (45%)* Fed. (12%), academia (11%), tribe (9%), recreat. (4%), prov. (2%), commerc. (2%), stake. (2%), publ. (2%), other (2%)
11 (28)	2.8 ± 1.7	3	Provincial agency (53%)* Fed. (21%), state (14%), academia (7%), commerc. (3%)
12 (15)	3.9 ± 3.3	2	State agency (47%)* Fed. (20%), recreat. (7%), stake. (7%), academia (7%), publ. (7%), other (7%)

Table 10: Committee membership per each subgroup. The dominating committee membership, based on frequency of occurrence (percent), within each subgroup is identified by "*", and is placed first with others placed in decreasing frequency of occurrence (percent). The sample size (N), mean and stand deviation (s.d.) and the median values for each subgroups are also provided.

Subgroup (N)	**Mean± s.d.**	**Median**	**Committee membership**
1 (26)	21.5 ± 15.6	25	Lake Erie Committee (LEC; 35%)* No committee (None; 23%), Law Enforcement Committee (LAW; 15%), Advisor (Adv.; 11%), Lake Huron Committee (LHC; 8%), GLFC-Core and GLFC-Committees (GLFC; 4%), Lake Ontario Committee (LOC; 4%))
2 (15)	25.4 ± 11.9	22	Lake Superior Committee (LSC; 33%)* Lake Michigan Committee (LMC; 27%), LHC (13%), Adv. (13%), GLFC (7%), None (7%).
3 (37)	33.7 ± 9.5	40	GLFC-Core and GLFC-Committees (57%)* None (13%), LAW (11%), LSC (8%), LEC (3%), Adv. (3%), LHC (3%), LMC (3%).
4 (21)	20.9 ± 15	25	Law Enforcement Committee (38%)* LEC (28%), LOC (9%), None (9%), Adv. (9%), GLFC (5%).
5 (18)	23.8 ±7.2	22	Lake Superior Committee (78%)* LAW (5%), None (5%), Adv. (5%), LHC (5%)
6 (17)	30 ± 13.2	31	GLFC-Core and GLFC-Committees (41%)* None (18%), LHC (12%), LMC (12%), LOC (6%), LSC (6%), Adv. (6%)
7 (24)	30.1 ±13.8	22	Lake Michigan Committee (42%)* Adv. (25%), GLFC (12%), LSC (12%), None (4%), LAW (4%)
8 (14)	18.7 ±10.5	21	Law Enforcement Committee (36%)* LMC (28%), LOC (21%), none (14%)
9 (20)	19.6 ± 11.8	20	No committee (30%)* LMC (20%), LSC (15%), LOC (15%), LEC (10%), LHC (5%), GLFC (5%)
10 (44)	22.9 ± 12.3	18	Lake Huron Committee (27%)* LMC (25%), none (15%), Adv. (11%), LAW (7%), LEC (7%), LSC (4%), GLFC (2%)
11 (28)	2.8 ± 1.7	1	Lake Ontario Committee (64%)* LAW (18%), LEC (11%), None (3%), GLFC (3%)
12 (15)	17.1 ± 17.3	6	Lake Erie Committee* Adv., LAW, none, GLFC

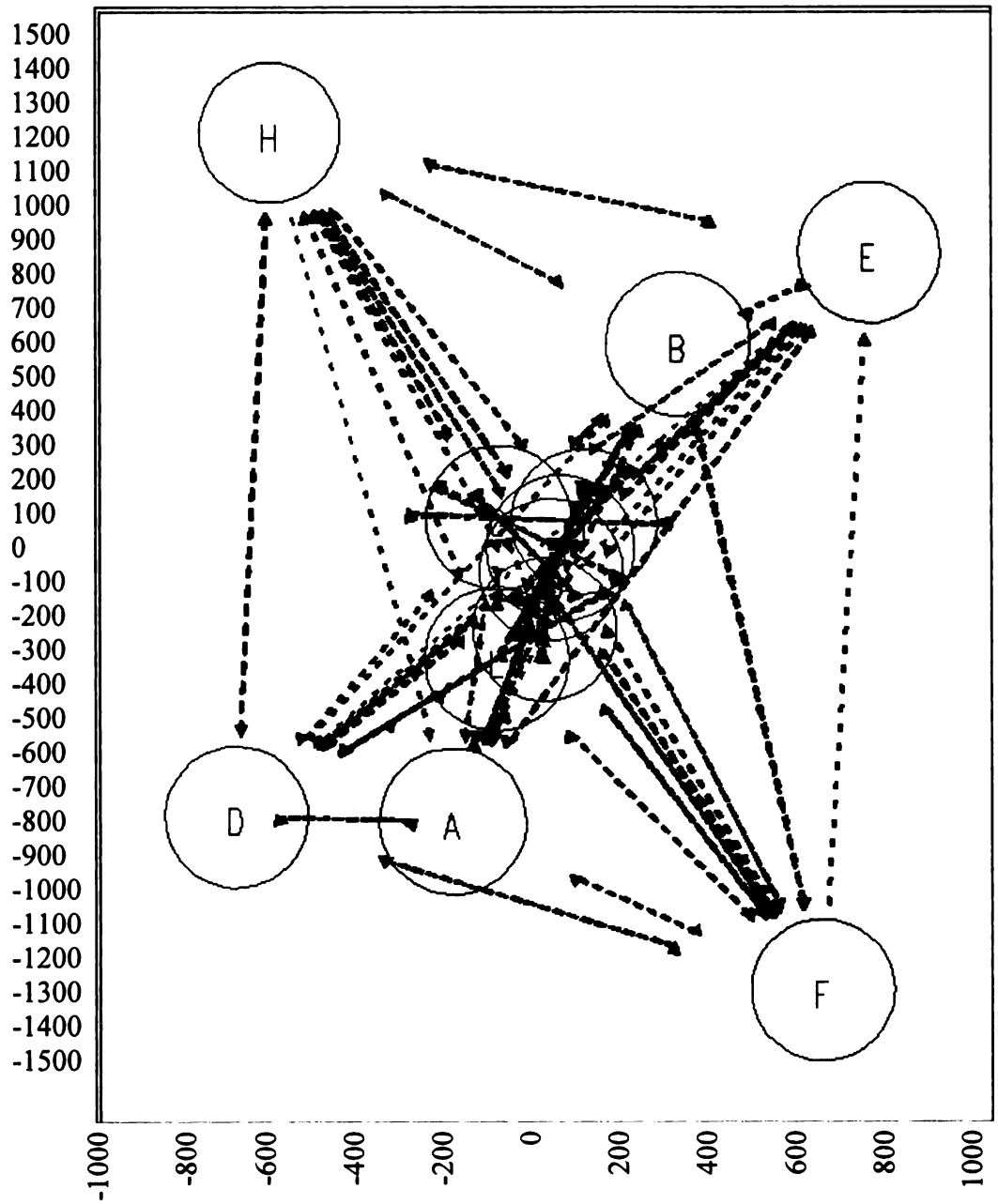


Figure 21: Sociogram for the Lake Sturgeon Information Exchange network, depicting flow of information (lines) among the significant subgroups of individuals (circles) identified by the KliqueFinder program. There are 366 unique individuals in this network. A total of 274 respondents provided information, of which 234 actually made a weighted social tie with others in the network. Distances between subgroups are to be interpreted relative to one another and are unit-less. Subgroups A to L in the sociogram refer to subgroups 1 to 12 in the text, respectively.

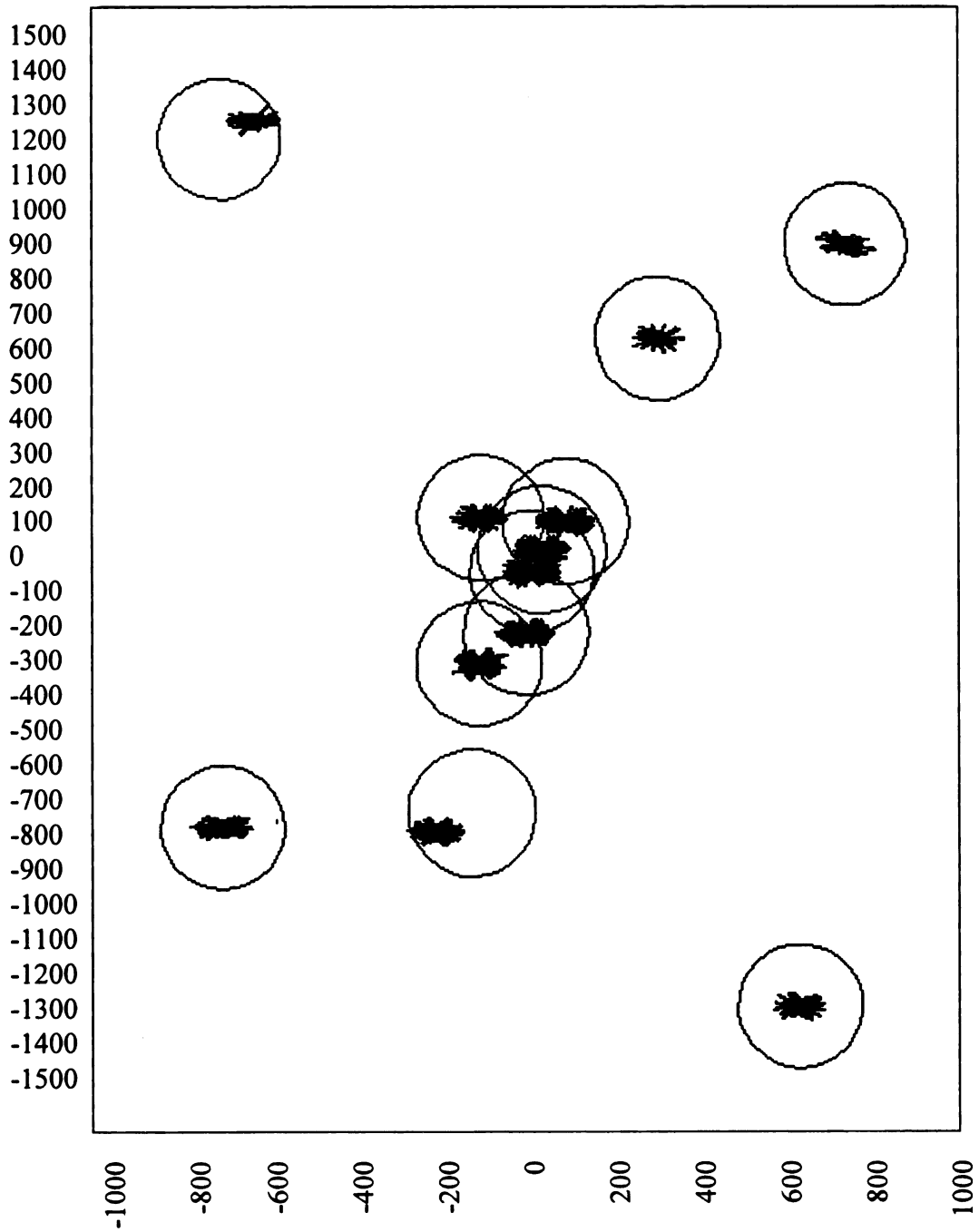


Figure 22: Sociogram of within subgroups flow of information for the Lake Sturgeon Information Exchange network. Lines depict flow of information among individuals within the 12 subgroups (circles) as identified by the KliqueFinder program. There are a total of 366 unique individuals in this network. Distances between subgroups are to be interpreted relative to one another and are unit-less.

I also tested, using the non-parametric Kruskall-Wallace and Scheffé test for multiple comparisons on ranked data, whether the members of the 12 subgroups differed in their perception related to the coordinated governance of transboundary fish stocks and lake sturgeon. I found that the subgroups significantly differed in their members' perceptions (Table 10):

- the value of the information gained from formal and informal portions of committee meetings,
- how their committee balances individual jurisdictions' perspectives and committee (i.e., lake-wide) perspectives when making fisheries related decision,
- how they value interaction with fisheries biologists from other jurisdictions,
- the status of lake sturgeon in their committee's jurisdiction,
- the adequacy of the priority level given lake sturgeon fishery issues by their committee, and
- the percentage of their work involving lake sturgeon.

These differences, however, were not significant after adjusting for multiple comparisons using the Scheffé test on ranked data.

Table 11: Comparison of Lake Sturgeon Information Exchange network's subgroups' perception to topics related to the coordination of governance of transboundary fish stocks. Kruskall Wallace (KW) test was used to detect significant difference among all subgroups. Non-significant differences indicated by 'ns'.

Variable	N	KW Chi-square	df	Pr > Chi-square	Scheffé test
How you perceive the committee balances unijurisdictional with lake-wide perspectives when deciding fisheries issues	172	21.82	11	0.02	ns
How would you rate the usefulness of the information you learn from the informal versus formal portions of the committee meetings	266	20.09	11	0.04	ns
Value assigned to having interactions between yourself and fisheries biologists from other jurisdictions	176	30.51	11	0.001	ns
How would you describe the current status of Great Lakes lake sturgeon population found within your committee's jurisdiction?	247	33.98	11	0.0004	ns
How would you qualify the priority level given by your committee to lake sturgeon fishery issues	148	21.57	11	0.03	ns
What percentage of your work involves Great Lakes lake sturgeon	169	30.23	11	0.001	ns

Social Network Evenness of Information Flow and Density of Social Ties

I calculated the Evenness of Flow of Information measures and the Density measure based on the weighted social ties for both the Fish Stocks Information Exchange network (Figure 17), and Lake Sturgeon Information Exchange network (Figure 18 and 19). The Fish Stocks Information Exchange network has a fairly even flow of information associated with all pairs of respondents and chosen within the network (Normalized $H(x,y) = 0.74$; Table 11), and associated with all respondents (Normalized $H(x) = 0.77$; Table 11), meaning that the flow of information within the network is not dominated by the weighted social ties of respondents-chosen pairs or by respondents' social ties. The

evenness of the flow of information associated with all chosen was slightly lower, 0.66, than for respondents, indicating that there may be some dominance associated with chosen's weighted social ties but not substantially smaller to indicate a high level of dominance among chosen, i.e., information flow dominated to a subset of chosen. In general, there does not appear to be any dominance of pairs, respondents, or of chosen individuals within the network, thus information on general Great Lakes fish stocks flows well throughout the network, i.e., not dominated by a subset of individuals. The overall density of the network was fairly low, D=0.15, indicating that there was some amount of specialization occurring in the flow of information within the network. As such, the general fish information exchange network may be sufficiently resilient to disturbances, meaning that the flow of information will not be negatively disrupted with the loss of a few individuals, as the network is not strongly dominated by any specific individual or pairs of individuals, nor highly specialized in its flow of information within the network.

Table 12: Evenness of Flow of Information measures and Density of social ties measure for the Fish Stocks Information Exchange network. The evenness of information flow based on weighted social ties for the entire network, H(x,y), across respondents, H(x), and across chosen, H(y) is reported in the table (for calculations see equations two to four in the methods section). The H(x,y), H(x), and H(y) values are normalized by taking the exponential value, natural log, and dividing by the total number of social ties, number of respondents, and number of chosen, respectively. The closer the normalized value is to zero the less even the flow of information, meaning that the flow of information is being dominated. The Density measure for the entire network, Density, is calculated using the non-normalized values of H(x,y), H(x), and H(y) as described in equation five in the methods section. The closer the Density value is to zero the less even the flow of information, meaning the more specialized the flow.

H (x,y)	**H (x)**	**H (y)**	**# chosen**	**# respondents**	**# social ties**	**N-Exp [H(x,y)]**	**N-Exp [H(x)]**	**N-Exp [H(y)]**	**D**
9.04	5.36	5.58	401	276	11349	0.74	0.77	0.66	0.15

The Lake Sturgeon Information Exchange network had a similar trend in the evenness of information flow to that of the Fish Stocks Information Exchange network, although values for H(x,y) were higher and the H(x), H(y) and Density values were lower in the Lake Sturgeon Information Exchange network (Table 12). Overall, a fairly even flow of information exists across all pairs of respondents and chosen within the Lake Sturgeon Information Exchange network (Normalized H(x,y) = 0.86; Table 12), and across all respondents (Normalized H(x) = 0.68; Table 12). The evenness of the flow of information across all chosen was slightly lower, 0.59, than for respondents, indicating that there may be a smaller subset of chosen that dominates the flow of information received but not substantially smaller to indicate a high level of dominance among chosen. In general, there does not appear to be any strong dominance of pairs, or of respondents, or of chosen within the network, hence the flow of information pertaining to lake sturgeon is fairly evenly distributed. The overall density of social ties in the network was fairly low, D=0.09, indicating that there is some amount of specialization occurring in the flow of information within the network (Table 12). The Lake Sturgeon Information Exchange network may be sufficiently resilient to disturbances, meaning that the flow of information will not be negatively disrupted with the loss of a few individuals, as the network is not strongly dominated by any specific individual or pairs. The low Density value, however, indicates that some level of specialization may exist which may reduce the redundancy in social ties within the network while maintaining a fairly even flow of information throughout the network.

Table 13: Evenness of Flow of Information measures and Density of social ties measure for the Lake Sturgeon Information Exchange network. The evenness of information flow based on weighted social ties for the entire network, H(x,y), across respondents, H(x), and across chosen, H(y) is reported in the table (for calculations see equations two to four in the methods section). The H(x,y), H(x), and H(y) values are normalized by taking the exponential value, natural log, and dividing by the total number of social ties, number of respondents, and number of chosen, respectively. The closer the normalized value is to zero the less even the flow of information, meaning that the flow of information is being dominated. The Density measure for the entire network, Density, is calculated using the non-normalized values of H(x,y), H(x), and H(y) as described in equation five in the methods section. The closer the Density value is to zero the less even the flow of information, meaning the more specialized the flow.

H (x,y)	**H (x)**	**H (y)**	**# chosen**	**# respondents**	**# social ties**	**N-Exp [H(x,y)]**	**N-Exp [H(x)]**	**N-Exp [H(y)]**	**D**
8.14	5.12	5.37	362	247	4010	0.86	0.68	0.59	0.09

The Lake Sturgeon Information Exchange network had significant subgroups for which the Evenness of Flow of Information measures and Density measure based on the weighted social ties were calculated (Table 13). In general, all subgroups had a similar trend in the normalized values of H(x,y), H(x), and H(y) as the overall Lake Sturgeon Information Exchange network, with a fairly even flow of information occurring across all pairs of respondents and chosen within the sturgeon information exchange network (Normalized H(x,y) ranges from 0.84 to 0.89; Table 13), across all respondents (Normalized H(x) ranges 0.68 to 0.83; Table 13), and chosen (Normalized H(y) ranges 0.63 to 0.80); Table 13). In general, there does not appear to be any strong dominance of pairs, or of respondents, or of chosen within the network. The overall density of social ties within each subgroup networks ranged from 0.25 to 0.51, which does not indicate any strong specialization occurring among pairs of respondents and chosen within the network. The Lake Sturgeon Information Exchange network and its subgroups may be resilient to disturbances, meaning that the flow of information will not be negatively

disrupted with the lost of a few individuals, as the network is not strongly dominated by any specific individual or pairs.

Table 14: Evenness of Flow of Information measures and Density of social ties measure for the Lake Sturgeon Information Exchange network's subgroups. The evenness of information flow based on weighted social ties for the entire network, H(x,y), across respondents, H(x), and across chosen, H(y) is reported in the table (for calculations see equations two to four in the methods section). The H(x,y), H(x), and H(y) values are normalized by taking the exponential value, natural log, and dividing by the total number of social ties, number of respondents, and number of chosen, respectively. The closer the normalized value is to zero the less even the flow of information, meaning that the flow of information is being dominated. The Density measure for the entire network, Density, is calculated using the non-normalized values of H(x,y), H(x), and H(y) as described in equation five in the methods section. The closer the Density value is to zero the less even the flow of information, meaning the more specialized the flow.

Sub-group	H (x,y)	H (x)	H (y)	# chosen	# respon-dents	# social ties	N-Exp [H(x,y)]	N-Exp [H(x)]	N-Exp [H(y)]	D
1	4.66	2.76	2.81	25	20	120	0.88	0.79	0.67	0.40
2	3.58	2.21	2.61	17	11	43	0.84	0.83	0.80	0.29
3	5.19	3.22	2.99	31	35	207	0.87	0.72	0.64	0.36
4	4.59	2.71	3.22	36	20	115	0.86	0.75	0.70	0.26
5	4.02	2.65	2.71	22	17	65	0.86	0.83	0.68	0.26
6	4.02	2.47	2.53	19	16	65	0.86	0.74	0.66	0.38
7	4.30	2.81	2.86	26	21	87	0.85	0.79	0.67	0.25
8	3.90	2.09	2.74	23	11	57	0.87	0.74	0.67	0.39
9	4.91	2.64	2.94	24	18	157	0.87	0.78	0.79	0.51
10	6.13	3.39	3.70	55	39	529	0.87	0.76	0.73	0.38
11	4.86	2.71	3.34	44	19	147	0.88	0.79	0.65	0.30
12	4.08	2.01	2.91	29	11	67	0.89	0.68	0.63	0.43

In summary, I found that the respondents were fairly similar in their attributes and in their perceptions of coordinated governance of transboundary fish stocks in the Great Lakes. In general, respondents believed that the Joint Strategic Plan, as well as the Fish Community Objectives, and the related GLFC committees and boards that facilitate the implementation of the Joint Strategic Plan, are effective and are needed to assure the sustainability of transboundary fish stocks in the Great Lakes.

Two different network structures were detected, the exchange of Fish Stocks information in the Great Lakes, and the other for information exchange on lake sturgeon in the Great Lakes. The Fish Stocks Information Exchange network did not have significant subgroups and the participants were well connected with one another as indicated by individuals being connected with individuals throughout the network. The presence of significant subgroups in the Lake Sturgeon Information Exchange network, which differed based on their members' dominant employer type and committee, still appeared to be integrated given the representation of multiple employer types and committees within a given subgroup (Alma and Moore 1978). The integrated nature of both networks was substantiated by the measures of the Evenness of Information Flow. These measures corroborated that both networks had a fairly well distributed flow of information across the network, as well as within subgroups for the Lake Sturgeon Information Exchange network, hence the flow of information was not dominated by any individual(s) or given pair of individuals. The two social network structures existing in the implementation of the Joint Strategic Plan, Fish Stocks Information Exchange network and the Lake Sturgeon Information Exchange network, have a good flow of information throughout the network structures which should enhance the Joint Strategic Plan's implementation because participants are well-connected and information should be easily accessible. For instance, if an emerging fish disease is detected in Lake Erie among lake sturgeon, information about how to detect and perhaps prevent or cure the disease could easily be made know to all fisheries professionals participating in the Joint Strategic Plan network.

Discussion

The process for facilitating cooperation among agencies with authority for the governance of Great Lakes fish stocks has evolved from having Agency-Appointed committee meetings perceived by participants as being dominated by each jurisdiction's perspective and as having a limited value for participants, to being a process consisting of a committee-wide (or lake-wide) perspective that is highly valued by its participants (Gaden 2007). This evolution resulted in the formal adoption of the Joint Strategic Plan as the governance institution for coordinating management of transboundary fish stocks in the Great Lakes, which is now perceived by some as an effective institution (GLFC 1997, Gaden 2007, Stein and Goddard 2008). This perceived effectiveness is based on several factors; including that its signatory agencies achieve consensus on fishery management decision, the signatory agencies share information, and implement coordinated management activities (Gaden 2007).

In this chapter I aimed to understand how the interactions among participants involved in *A Joint Strategic Plan for Management of Great Lakes Fisheries* (Joint Strategic Plan) contribute to the effectiveness of the Joint Strategic Plan. I assessed two features of the participants involved in the Joint Strategic Plan. The first is how participants, on average, perceived governance of transboundary fish stocks in the Great Lakes and the second, the role of social network structure on the implementation of the Joint Strategic Plan.

I found that most respondents were white males, over the age of 45, with a graduate degree, who are employed by a government agency, and have been involved with the Great Lakes Fishery Commission and its related committees and boards for more

than six-years (47% have been involved for more than 10 years). This demographic distribution appeared to be representative based on my personal observation of Agency-Appointed committee meeting attendees between 2003 and 2006. The findings of this study can therefore, be interpreted as being representative of the majority of the participants of the Joint Strategic Plan.

In general, respondents positively perceived the need for governance of transboundary fish stocks in the Great Lakes, as well as the current implementation of governance of transboundary fish stocks in the Great Lakes through the Joint Strategic Plan. The majority of respondents participating, whether unofficially or as an official representative of a Joint Strategic Plan signatory agency, perceived that there is a need for a 'mostly' transboundary approach to management to assure the sustainability[18] of shared[19] fish stocks in the Great Lakes, versus having only a unijurisdictional[20] approach in management of shared fish stocks. This positive perception for a coordinated governance approach to the management of Great Lakes transboundary fish stocks is also noted by other researchers (Gaden 2007, Roseman et al. 2008, Schechter and Leonard 2008, Taylor and Dobson 2008). Respondents mostly perceived the Great Lakes Fishery Commission and its related committees, boards, and partners as having a 'moderate to high' value in assuring the sustainability of the Great Lakes fish stocks. When asked

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[18] Sustainability was defined within the survey instrument for respondents as "... using a fishery resource, and the ecosystem that supports the fishery resource, in such a way to assure that the fishery maintains a healthy population size"

[19] Shared was defined within the survey instrument for respondents as "[crossing] jurisdictional boundaries, thus having more than one jurisdiction with management and enforcement authority ..."

[20] unijurisdictional approach in management refers to only one jurisdiction making management decisions, where as a transboundary approach refers to multiple jurisdictions jointly making management decisions.

more specifically about the Joint Strategic Plan and the Fish Community Objectives (FCO), which serves as guidance for management decisions in implementing the Joint Strategic Plan, the majority of respondents perceived these to be 'moderately' effective in assuring the sustainability of Great Lakes fish stocks. This response choice, 'moderately' effective, is the second to highest answer that could be selected among the answer choices provided in this survey for perceived effectiveness. I would expect this positive perception of the Joint Strategic Plan and FCO given that the majority, 70%, of respondents have participated for over six-years in some aspect of the Joint Strategic Plan implementation, and with such a long-tenure I would expect respondents to be supportive of the Joint Strategic Plan and its associated implementation tools. This positive perception of the Joint Strategic Plan and the FCO is also reflected in the interview-based information gathered by Gaden from participants of the Great Lakes Fishery Commission, its boards and committees, as well as the Joint Strategic Plan process (2007).

Regarding the role of their committee in implementing governance of transboundary fish stocks, the majority of respondents perceived their committee as having a 'moderate to high' level of importance in assuring the sustainability of shared fish stocks in the Great Lakes, and being 'moderately' effective in achieving inter-jurisdictional cooperation among participants. Respondents, however, were unsure and quite disparate regarding how they perceived their committee balancing the committee's perspective and the individual jurisdiction's perspective when making fisheries related decisions. I surmise that the variance in responses may be related to individuals perceiving decisions made by the committee differently depending on their interest in the

outcome, or perhaps due to the occurrence of fishery-related decisions being made that are more relevant to a subset of jurisdictions and not being a lake-wide, or committee-wide, fishery issue of concern.

When asked more specific questions regarding committee meetings and interactions with individuals from other jurisdictions, respondents in general placed a positive value on these activities. The majority of respondents perceived attending committee meetings as being beneficial to them, because they frequently or always learned useful information that was generally related to Great Lakes fish stocks, during both the formal and informal portion of the meetings, such as formal topic presentations versus social receptions. The recognition by most respondents of the equal usefulness of information learned during the informal portions of the committee meetings was interesting as it serves to validate the importance of unstructured social interaction times during these meetings. This social interaction during meetings, although perceived as a waste of time by some as they have other pressing engagements, also contributes to strengthening social network ties by providing interaction time among individuals (Granovetter 1973):

> "the strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie"

Studies discussing factors contributing to the development of social ties have recognized the usefulness of having in-person interactions in developing social ties among individuals. For instance, Cross et al. (2001) found that it was important to have in-person interactions, such as informal brown bag lunches, to create new relationships

between people that then facilitated people interacting with one another at a later time to gain access to needed information (2001). The current use of planned informal social interaction time periods during Joint Strategic Plan related Agency-Appointed committee meetings, such as: coffee breaks, having meetings that span a night resulting in interactions over dinner, as well as having concurrent Agency-Appointed committee meetings which allows for participants of different committees to interact (personal observation based on my attendance of Agency-Appointed committee meetings from 2003 to 2007), most likely has an important role in the establishment and nurturing of social ties among Joint Strategic Plan participants.

The 'moderate to high' value placed by the majority of respondents on knowing about fisheries issues occurring outside their jurisdictional responsibilities, as well as interacting with fisheries professionals (referred to as fisheries biologists in the survey questions) from other jurisdictions further substantiates the interests of participants in engaging in cross-jurisdictional discussions and contributes to the development of social ties among participants, within the same committee and the other Agency-Appointed committees. The 'low to moderate' value assigned to interacting with fisheries law enforcement officers from other jurisdictions by most respondents, however, most likely indicates information that is obtainable from fisheries law enforcement officers outside of the respondents' jurisdiction is not perceived as being as relevant to the respondents' work as information obtained from fisheries professionals from other jurisdictions. This difference in valuation of information received from fisheries professionals versus law enforcement officers from other jurisdictions, may perhaps be related to the fact that most respondents, approximately 84%, are not involved in fisheries law enforcement activities,

and hence do not perceive a need for knowing about law enforcement issues outside of their jurisdictions.

Respondents, when asked how they perceived the status of the lake sturgeon population within their committee's jurisdiction, were split with about half of the respondents perceiving lake sturgeon as having a 'threatened' status within their committee's jurisdiction. The remaining respondents perceived lake sturgeon as being a healthy population, 21%, or endangered and extinct, 14%, or reported not knowing the status of lake sturgeon, 14%. Respondents also varied in how they perceived their committee and organization prioritizing lake sturgeon topics, and as to whether this level of prioritization was adequate. The majority of respondents, however, perceived a need for a 'mostly' transboundary approach to lake sturgeon management to assure the sustainability of this transboundary Great Lakes fish stock, which is similar to their perception for transboundary Great Lakes fish stocks in general. This diversity in respondents' perception on lake sturgeon questions in comparison to the more consistent responses provided by respondents for general fish stocks in the Great Lakes, may contribute to the existence of a different social network structure for lake sturgeon information exchange versus for fish stock information exchange.

Prior to conducting the social network analysis it was necessary to consider the potential implications of having only 65.5% of the invited individuals completing Part Two of the survey (social network portion of the survey). This response rate meant that I collected direct information on social ties from 65.5% of the invited respondents and may reflect only 65% of the social ties in the social network. This creates a bias in which less well-connected individuals would be associated with less information concerning their

social ties than the more well-connected individuals. It was concluded that as long as this bias was recognized and caution was used in any interpretation related to the position of less well-connected individuals within the network, then the social network structure and significant subgroups detected in this analysis could be used for the purpose of this chapter (Dr. Ken Frank, Measurement and Quantitative Methods Counseling, Educational Psychology and Special Education and the Department of Fisheries and Wildlife, Michigan State University, Personal Communication).

The Fish Stocks Information Exchange network and the Lake Sturgeon Information Exchange network differed in their network structures. The occurrence of two different network structures among the same set of individuals is not surprising, because I depicted the flow of information among these individuals using two different types of information. The presence of two social network structures among the same set of respondents has also been reported in other studies assessing social network structures based on different resource exchanges among the same participants (Van de Ven and Ferry 1980, Bolland and Wilson 1994, Foster-Fishman et al. 2001). The difference in social network structure based on different information flow among Joint Strategic Plan participants illustrates how individuals can utilize their social ties differently to access different information, or other resources, that is needed (Haythornthwaite 1996).

The presence of two different social network structures, which differ in their structure as evident by the presence of significant subgroups only in the Lake Sturgeon Information Exchange network, illustrates that participants of the Joint Strategic Plan can alter their social network structure to meet the information needs for a specific fish stock. This indicates that participants in the Lake Sturgeon Information Exchange network have

an understanding of the varying information available from other participants, and which individuals will be willing to share the information (Cross et al. 2001). Facilitating the knowledge among participants of which individuals have access to which type of information is important in accelerating formation of issue-based social ties that might be needed for effective decision-making in the future (Cross et al. 2001). The use of formal presentations on diverse fisheries issues of interest during committee meetings is one method that contributes to creating awareness of which individuals, both long-time and new participants, may have knowledge about specific fisheries issues of interest. The planned informal social interaction opportunities throughout committee meetings further facilitates development of social ties as participants can engage in follow-up discussions with individuals they have learned have access to information of interest to them. These factors likely all contribute to the integrated social network structure detected for the Fish Stocks Information Exchange network, and likely also holds true for the Lake Sturgeon Information Exchange network even with the presence of significant subgroups.

The Fish Stocks Information Exchange network does not have any statistically significant subgroups. This may indicate that the participants in this network are integrated with one another (Foster-Fishman 2001). The lack of significant subgroups may be related to the presence of strong, as indicated in this study by frequent interactions within a 12-month period, social ties linking individuals between subgroups that contribute to integrating individuals and facilitating the exchange of information throughout the network (Wasserman and Faust 1994). The integrated nature of this network, based on the social ties extending across the entire network, should facilitate the implementation of the Joint Strategic Plan as individuals throughout the network are

exchanging information on general fish stocks. The presence of these social ties may be related to the relatively long-tenure participants have with the Joint Strategic Plan as well as with the GLFC and its associated committees and boards. This long-tenure would provide opportunities for participants of the Joint Strategic Plan to develop social ties and exchange information (Van de Ven and Ferry 1980, Foster-Fishman 2001); making it more likely for individuals to develop social ties spanning the entire Joint Strategic Plan network. The similarity among the majority of respondents in their perception of governance of transboundary fish stocks in the Great Lakes, such as the need for governance of transboundary fish stock, the effectiveness of Great Lakes Fishery Commission, Joint Strategic Plan, and FCO, may result from the enhanced information exchange throughout the network allowing for sharing of perceptions and discussions on these topics (Van de Ven and Ferry 1998). Alternatively, respondents may have already shared these similarities in perceptions before engaging in this social network because people tend to form social ties with people similar to each other (Alba and Moore 1978, Haythornthwaite 1996). Gaden's description of the Joint Strategic Plan process as nurturing a collaborative approach that "[relies] on the existence and strength of an epistemic community, an elite group of like-minded professionals [and that] gently coerces members to adhere to the norms of the community" (2008), provides support for both the assumption that participants tend to be similar prior to becoming involved, and that they also gradually become more similar through interactions with other Joint Strategic Plan participants.

The Lake Sturgeon Information Exchange network is composed of 12 statistically significant subgroups. These subgroups differed in terms of the dominant employer type

and committee membership, however, the committee membership of the 12 subgroups did not align with the existing committee structure implementing the Joint Strategic Plan. The subgroups, although dominated by a given employer type and committee membership, consisted of a representation of several other employer types and committee membership. The subgroups also significantly differed on their members' perception related to governance of transboundary fish stocks and lake sturgeon topics, however, no significantly different pairs of subgroups were detected. The presence of subgroups within the Lake Sturgeon Information Exchange network may indicate a less efficient flow of information than that which would be expected in a homogenous (no subgroups) network such as the Fish Stocks Information Exchange network (Alba and Moore 1978, Wasserman and Faust 1994). When there are several subgroups one could think that the network is fragmented, however, if these subgroups do not have strictly defined memberships based on certain attributes then the network is not fragmented (Alba and Moore 1978). The assemblage of different employer type and committee membership within each subgroup, consequently supports that the network is not fragmented into 12 isolated subgroups, but is integrated allowing for an unrestricted flow of information across the network. Similarly, the presence of social ties between subgroups also lends credibility to the assumption that the flow of information among subgroups is not restricted within a given subgroup or subgroups (Wasserman and Faust 1994). The Sturgeon Information Exchange network, although composed of significant subgroups, is still an integrated network that brings together individuals from different attributes, e.g., employer type and committee membership, and most likely provides for a good exchange of information among participants.

Using Evenness of Flow of Information measures I found that the flow of information throughout the Fish Stocks Information Exchange network and the Lake Sturgeon Information Exchange network was fairly evenly distributed within the networks and not dominated by any given weighted social ties associated with pairs of respondents-chosen, associated with respondents, and associated with chosen. Thus, there is a good exchange of information for both of these information types among participants of the Joint Strategic Plan and this should facilitate the implementation of the Joint Strategic Plan. The Density measure for the social ties within the network, however, indicated that there might be some specialization in the flow of information within the two networks, with this specialization being stronger in the Lake Sturgeon Information Exchange network. These significant subgroups also were found to have a fairly even flow of information within them, and no strong evidence for specialization based on the higher range of values for their density measures. This stronger specialization in the lake sturgeon network, which is absent within each subgroup, may be an indication that the flow of information between subgroups is specialized, allowing for knowing between which subgroups information will flow in the Lake Sturgeon Information Exchange network. The presence of subgroups within the Lake Sturgeon Information Exchange network did not appear to substantially alter the flow of information within the network, as the evenness of information flow measures were not substantially different between the two networks, Fish Stocks and Lake Sturgeon Information Exchange networks. I surmise based on the knowledge that resources exchanges, such as fishery information, can occur through individuals bridging different subgroups (Granovetter 1973,

Wasserman and Faust 2004, Grafton 2005) that the social ties connecting the subgroups are most likely adequate to contribute to an even-flow of information across the network.

The social network structure of Joint Strategic Plan participants for both the Fish Stocks Information Exchange network and the Lake Sturgeon Information Exchange network is comprised of individuals that have been participating for more than 6-years, or 10-plus years for 47% of the respondents, and have formed numerous social ties throughout the network. The fairly even flow of information in both networks most likely contributes to the effectiveness of the Joint Strategic Plan. Of concern, however, is the age structure of respondents that is strongly skewed towards individuals 45 years and older, with only 13% of respondents being under 34 years of age. It is possible that a turnover of participants due to retirements during the next 10 to 15 years could result in disruption of the social network structure (Cross et al. 2001), and thereby impact the effectiveness of the Joint Strategic Plan. It may be advantageous for the Joint Strategic Plan related committees to actively begin recruitment of younger members who can be mentored by current members to establish and develop similar social ties spanning the network. Actively grooming younger members with the assistance of current members may facilitate the establishment of social ties between younger members and current members, as current members would provide venues for the younger members to show how they can contribute to the existing network. Having this group of replacement members in place prior to a turnover of participants would assure that the network would hopefully not be rendered fragmented or dysfunctional due to the loss of several members that had numerous social ties spanning the entire network (Cross et al. 2001).

Alternatively, the current flow of information in the networks may be maintained through quasi-ties. Quasi-ties, as discussed by Frank (in press) are formed between an individual and the collective with whom the individual identifies. This quasi-tie behaves similarly to other social ties that link individuals together and that regulate the allocation of resources among individuals. Contrary to social ties, individuals that identify with the collective through a quasi-tie will share resources with all other individuals that belong to the same collective, regardless of any existing or absent social ties that may directly link individuals to one another. Individuals providing resources through the quasi-ties to the collective do not expect any specific resource in exchange but instead trusts that others will provide resources to the collective that will benefit him/her. An added advantage, as discussed by Frank (in press), of having quasi-ties that link individuals to the collective versus having numerous social ties linking all the individuals within the network is that fewer ties are needed to have exchange of resources. In a network that relies on social ties, such as the Joint Strategic Plan related social network, numerous social ties would need to be maintained for all network members to have access to the necessary resources. Whereas, when individuals are linked together by identifying with the collective through a quasi-tie, individuals would only need to maintain that quasi-tie with the collective to give and receive resources. Thus quasi-ties may be useful for large memberships or groups that cannot develop the required social ties among participants to exchange resources. The presence of quasi-ties with current and new Joint Strategic Plan participants would allow for the continuation of the current exchange of resources, such as fish stock information, even in the absence of social ties connecting the current and new participants. Future research on the presence of quasi-ties among Joint Strategic Plan

participants would contribute to assessing the vulnerability of the Joint Strategic Plan's information exchange network to change in individuals and social ties.

Conclusions

The process formalized with the Joint Strategic Plan evolved over time, becoming a governance institution perceived by some as being an effective means for governing transboundary fish stocks in the Great Lakes (GLFC 1997, Gaden 2007, Stein and Goddard 2008). The outcome of the evolving Agency-Appointed committees through which the Joint Strategic Plan is implemented, described by Gaden as "a process of interactions among like-minded professionals and to begin the development of a culture of cooperation in the region" (2007), is substantiated by the similarly in respondents' attributes, the respondent's perceptions towards coordinated governance for transboundary fish stocks, and by the integrated social network structure of the Joint Strategic Plan participants revealed in this study for both the Great Lakes Fish Stocks Information Exchange and Lake Sturgeon Information Exchange networks.

The integrated nature of the social network structures detected among participants of the Joint Strategic Plan for both types of fish stock information may be a contributing factor to the effectiveness of the Joint Strategic Plan. The integrated network structure should enhance flow of information within the social network structure, thus facilitating the decision-making process and implementation of the Joint Strategic Plan by sharing of ideas, perceptions, and resources. The current structure of committee meetings may be contributing to the development and nurturing of social network ties among participants. The formal presentations, for instance, serve to make known individuals that are sources

of certain information, whereas the informal social interactions occurring during coffee breaks and dinners serve to increase the number and strength of social ties (Cross et al. 2001). Recognition by respondents of the value of information gained through both formal and informal aspects of committee meetings also validates the continued use of both during committee meetings.

The future of the current social network structure for information exchange in the Great Lakes, however, needs to be proactively nurtured. The participants in the Joint Strategic Plan are very homogenous in their demographics, such as age, race, and level of education. The similarities in age of Joint Strategic Plan participants raises a concern that retirement of these individuals may disrupt the functioning social network structure through the loss of social ties spanning the entire network. Through the use of mentorship to facilitate incorporation of younger participants into the existing social network structure, and formal presentations given by the younger newcomers to facilitate the knowledge of their expertise and their role as a source of information for specific fisheries topics for all participants, will contribute in establishment of social ties with these newcomers (e.g., Cross et al. 2001). The goal of maintaining the positive aspects of the current social network structure and social ties that contribute to information exchanges needed in implementing the Joint Strategic Plan, hopefully will be achieved by the proactive incorporation of younger participants with relevant expertise and background that will fill the social network ties that would otherwise be lost with the retirement of well-connected older participants during the next 10 to 15 years.

The Great Lakes Fishery Commission (GLFC), as the entity facilitating the implementation of the Joint Strategic Plan through the Agency-Appointed committees,

will play an important role in conserving the aspects nurturing the formation and strengthening of social ties that makes management of Great Lakes fish stocks through the Joint Strategic Plan a highly cooperative process. The GLFC secretariat can assure the continuation of informal social interactions and concurrent Agency-Appointed committees to foster social ties among participants engaging in the same or different Agency-Appointed committee meeting. A study that would depict change in social network structure and social ties among Joint Strategic Plan participant through time would be needed to observe whether the GLFC and the Joint Strategic Plan participants will be able to maintain the well-connected social network structure. Alternatively, this study could assess whether quasi-ties may provide a means to assure the effective implementation of Joint Strategic Plan with the expected change in participants over the next decade.

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CHAPTER FIVE

Conclusions and Implications of Social Ties and Social Network Structure for Governance Institutions of Transboundary Fish Stocks in the Great Lakes

The challenge of achieving and maintaining sustainable fish stocks that are governed or harvested by more than one jurisdiction or nation (transboundary fish stock) is recognized as requiring a coordinated and collaborative approach. This recognition has increasingly become more apparent with the rapid demise of many oceanic fish stocks worldwide (Myers and Worms 2003, FAO-Fisheries 2007), which made evident the ineffectiveness of unilateral actions by individual jurisdictions in governing transboundary fish stocks. Furthermore, this ineffectiveness is also noted when, in the absence of collaboration among jurisdictions harvesting a fish stock, cross-purpose governance and management decisions are made which may nullify their intended impacts. For instance, in the lake sturgeon case study described in Chapter Three, the disparity in population status within the varying jurisdictions in the Great Lakes led to management decisions, e.g., fishing regulations, that appeared to be in complete opposition with one another. Overtime, this recognition of the need for a collaborative approach for sustainable fish populations has resulted in the evolution of the governance approach used for transboundary fish stocks today.

The governance approach for transboundary fish stocks has evolved along with the understanding that collaborative and coordinated governance and management actions were needed (Cole 2003, Kooiman et al. 2005, Schechter and Leonard 2008). Initially, governance of transboundary fish stocks consisted of individual jurisdictions

making and implementing decisions with little or no coordination with other jurisdictions. Nowadays, there is an increasing reliance on governance approaches that consists of coordination among jurisdictions that have an interest in the same fish resource, such as the Northwest Atlantic Fisheries Organization (Cole 2003, Kooiman et al. 2005, Schechter and Leonard 2008, NAFO no-date). In Chapter Two of this dissertation, I described the evolution of governance institutions for transboundary fish stocks and discussed their weaknesses and strengths. There appears, however, to be a need for further evolution of governance institutions, as several factors can impede their effectiveness, such as lack of authority to assure that members implement decisions.

The effectiveness of governance institutions for transboundary fish stocks, as discussed in Chapter Two, varies greatly (Schechter and Leonard 2008). This variability can be ascribed to numerous factors including the governance institutions' framework, the decision-making process used, such as decisions made by majority-vote or consensus, the amount of authority delegated by the jurisdictions to the governance institution, and relationships among participants (social ties). Several studies assessing the importance of these factors, with the exception of the latter one, are found in the literature (Schechter and Leonard 2008, Schechter et al. 2008). Interestingly, the latter, social ties among an institution's participants, has not received as much attention. Social ties, and the resulting social network structure, can impact the effectiveness of governance institutions by affecting group interactions and outcomes, flow of resources among participants, and participants access to resources (Granovetter 1973, Burt 1992, Wasserman and Faust 1994, Abrahamsom and Rosenkopf 1997, Jones and Georges 1998, Frank et al. 2004, Shaw and Barrett-Power 1998, Newell and Swan 2000). This dissertation aimed to

contribute to the understanding of the role which social ties and social networks among participants of transboundary fish stocks governance institutions have on the institutions' effectiveness. I selected the governance institution for transboundary fish stocks in the Great Lakes, *A Joint Strategic Plan for Management of Great Lakes Fisheries* (Joint Strategic Plan) for my study on the role of social network structure and social ties in achieving desired outcomes for these fishery resources. Specifically, I assessed how the social network structure and associated social ties impact flow of information and access to resources, such as intellectual knowledge and data on fish stocks, among participants of the Joint Strategic Plan, which in turn would impact collaborative governance of transboundary fish stocks.

The signatory parties to the Joint Strategic Plan consist of 11 agencies with fisheries management authority in the Great Lakes, and four federal agencies that contribute information on fish stocks and in the enforcement of fishery regulations (see Chapters 1 and 4 for more detail). The Joint Strategic Plan is the governance institution that serves to coordinate fisheries governance and fisheries management in the Great Lakes. The Joint Strategic Plan is implemented through the Agency-Appointed committees, of which each of the 11 Great Lakes fisheries management agencies are official members. Representatives of these agencies, as well as non-voting participants, interact together through the Agency-Appointed committees to exchange information and coordinate fisheries management decisions. In analyzing the social ties among participants, which consist of both members and non-voting participants, of the Agency-Appointed committees I found that these social ties and the resulting network structure contributed to the effectiveness of Joint Strategic Plan. The social network structure of

the Agency-Appointed participants, as detected by KliqueFinder, was well-integrated, in that participants were well-connected to one another (Chapter Four). This level of connection facilitates the flow of information throughout the network, as well as access to resources by participants. The fairly even flow of information throughout the network was substantiated by the evenness of information flow measures, which also detected a fairly even distribution of information flow not dominated by any specific social ties. Had the flow been dominated by a specific set of social ties, then only participants connected, directly or indirectly, to those social ties would have been able to access information and resources. Hence, this level of connection and the fairly even flow of information throughout the network contributes to the effectiveness of the Joint Strategic Plan, because having access to the same information should facilitate members reaching agreement on decisions more easily than if each were basing their decision on a partial subset or a different set of information.

Factors that may contribute to the well-integrated network and even flow of information include the long-tenure that most participants have with the Joint Strategic Plan, the use of committee meetings to encourage formation of social ties, and the general support for transboundary governance by participants (Chapter 4). I found that most participants of this network structure had been involved, directly or indirectly, with the Joint Strategic Plan and its supporting structure, consisting of the GLFC and related committees and boards, for an average of six or more years. In almost half of the respondents (47%), respondents stated they had been involved for 10 or more years. Furthermore, the formal and informal aspects of the Agency-Appointed committee meeting process, through which the Joint Strategic Plan has been implemented, likely has

an important role in nurturing the development and strengthening of social ties among participants (Jones and George 1998, Newell and Swan 2000, Cross et al. 2001). The formal aspects facilitated participants learning about others' expertise through presentations and formal discussions. The informal aspects, such as socials and coffee breaks, provided time needed to strengthen social ties by participants getting to know one another and, ideally, gaining trust (Jones and George 1998, Newell and Swan 2000, Cross et al. 2001). The opportunities provided by the committee meetings to form and nurture social ties contributed to the well-integrated and, therefore, fairly even flow of information within this social network. The relatively high value placed by participants' on coordinated governance for transboundary fish stocks and interacting with fisheries professional from other jurisdictions also contributed to the network being integrated. This value level likely contributed to having an integrated network, because participants would seek to interact with participants from other jurisdictions, thereby forming social ties that spanned across the entire network versus social ties limited to participants within their own jurisdiction.

The importance of social ties and social network structure in the effective coordination of management activities in the Great Lakes, as implemented through the Joint Strategic Plan, can be highlighted by the recent development in lake sturgeon status and harvest regulations. The status and harvest regulations for recreational and commercial fishing of lake sturgeon in the Great Lakes have been disparate across jurisdictions, but recently to a lesser degree. Prior to 2008, the greatest disparity existed between Ontario and the U.S. states. The Ontario Ministry of Natural Resources did not assign any special status to lake sturgeon and allowed recreational fishers to harvest one

sturgeon per day all year long in Lake Superior, Lake Erie, Lake Huron, and Lake St. Clair. Most states, however, had listed lake sturgeon as a Species of Concern, Threatened, or Endangered and did not allow any harvest for these same lakes. The Great Lakes Fishery Commission secretariat staff liaison to the Law Enforcement Committee, as well as to the Council of Lake Committees, highlighted the discrepancy between the population status and regulations on multiple occasions between 2003 and 2007 (personal observation, I presented at the Law Enforcement Committee and assisted in preparing the presentations for other committee meetings). Presentations that highlighted illegal harvest of lake sturgeon occurring in the United States' jurisdiction of the Great Lakes, as well as a presentation on the illegal caviar trade in the United States were also allocated time on the Law Enforcement Committee meeting agenda to enhance awareness of this potential threat to lake sturgeon in the Great Lakes (personal observation, I was staff liaison to the Law Enforcement Committee between 2003 and 2008). On 27 June 2008 the Ontario Ministry of Natural Resources (OMNR) released a communication entitled *Ontario moves to protect sturgeon – McGuinty Government Restricts Harvest in both Recreation and Commercial Fisheries* (OMNR 2008). This communication indicated that OMNR had decided to list lake sturgeon as a species of special concern as of 20 June 2008. This decision was based on a noted increase in the actual recreational harvest being taken in comparison to previous levels, with current levels deemed unsustainable for the lake sturgeon population. This decision was also based on a level of illegal sales in lake sturgeon parts that was determined to be a threat to the sustainability of the lake sturgeon population. As a result of listing lake sturgeon as a species of special concern, OMNR set the catch and possession limit for the recreational harvest of lake sturgeon to zero as of 1

July 2008, with only catch and release of lake sturgeon being allowed (OMNR 2008). Furthermore, OMNR stated that they would set the commercial harvest of lake sturgeon to zero in 2009 to prevent overharvesting of the lake sturgeon population within Ontario's jurisdiction (OMNR 2008). It is difficult to determine the influence that the lake sturgeon presentations, aimed at increasing awareness of the disparate status, fishing regulations, and threats from illegal harvest, had on the recent change in status and regulations by OMNR. The social ties and social network structure may have facilitated the knowledge of the potential threat to lake sturgeon in the Great Lakes from illegal harvest to meet the global demand for caviar, as well as the disparate status and regulations for lake sturgeon in the Great Lakes. Facilitating access to this information through the well-integrated social network structure of the Joint Strategic Plan participants may have assisted OMNR with detecting and recognizing a threat to lake sturgeon in the Great Lakes and tributaries within Ontario. Hence, it is likely that the social network structure of the Joint Strategic Plan facilitated the flow of information on concerns pertaining to lake sturgeon in the Great Lakes among participants. This flow of information likely contributed to OMNR's detection and recognition of the threat from the change in recreational harvest level and illegal sales on the sustainability of lake sturgeon populations.

The importance of social ties in facilitating flow of information and access to resources among the Joint Strategic Plan participants, and, thus, on the effectiveness of the Joint Strategic Plan's implementation does cause some concern for the future. Specifically, how would changes in social ties and social network structure impact the Joint Strategic Plan's effectiveness. What would occur, for instance, if individuals with

these social ties were to be lost from the network? Given that the vast majority of Joint Strategic Plan participants are within 10 to 15 years of retirement age, it is feasible that many of the social ties spanning the network could be lost to the detriment of information exchange within the network. Would the loss of these individuals and their social ties result in a fragmented social network structure? Would this fragmented social network impede flow of information and access of resources? If participants did not share the same information as facilitated by a well-connected social network structure, would participants have difficulty in achieving consensus on governance and management decisions? Would this change in social network structure decrease the effectiveness of the Joint Strategic Plan and jeopardize the sustainability of Great Lakes transboundary fish stocks? Given this potential negative impact, it would be beneficial to ensure that the well-connected social network structure of the Joint Strategic Plan participants is maintained even with a change in participants. One way to achieve this is for the Agency-Appointed committees to be proactive in recruiting younger participants, and more importantly, assisting them in establishing and nurturing social ties that span the social network structure. Having current, well-connected, participants serve as mentors may facilitate the formation and nurturing of social ties for these younger recruits. Additionally, engaging younger recruits in intellectual and social opportunities, provided by the meeting structure of the Agency-Appointed committees, could inform participants of their expertise and facilitate formation of social ties. The Great Lakes Fishery Commission secretariat, which facilitates the implementation of the Joint Strategic Plan, is exploring ways to encourage engaging younger participants. One method in use by the secretariat involves leading by example, such as by having new fisheries management

and research oriented professionals or younger secretariat staff members present during committee meetings. A more recent method being contemplated is to award scholarships to assist with travel for students to attend agency appointed committee meetings with a mentor (pers. Comm. Dr. W. W. Taylor, Department of Fisheries and Wildlife, Michigan State University, and U.S. Commissioner for the Great Lakes Fishery Commission).

This study has shown that the social network structure of a governance institution for transboundary fish stocks has an important role in the effectiveness of that institution. Social ties and the social network structure of participants involved in the implementation of the Joint Strategic Plan contributed to the effectiveness of this governance institution by facilitating flow of resources, such as information, among participants. Additionally, social ties served to facilitate access of resources by participants from each other, thus enhancing an institutions' effectiveness by making resources available that may contribute to participants making and implementing collaborative decisions. Hence, when assessing why a given governance institution for transboundary fish stock is either failing or succeeding in attaining its objectives, it remains important to examine such aspects as the institution's framework, decision-making process, and delegated authority. Social ties and social network structure, however, also need to be considered as these can impact the effectiveness of the institution by altering the flow and accessibility of resources to participants. Future studies will hopefully contribute further to understanding of the role of social network structure in these governance institutions, thereby contributing to the health of transboundary fish stocks by facilitating collaborative governance.

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APPENDICES

APPENDIX A

Letters Supporting Participating in Survey

[Place on GLFC Letterhead]

[Insert date]

[Insert recipient address]

[Insert recipient first and last name]

I am writing to ask you to participate in an online survey sponsored by the Great Lakes Fishery Commission and Michigan State University. The Great Lakes Fishery Commission is committed to supporting activities that contribute to the enhancement of cooperative fishery management among Great Lakes federal, provincial, state, and tribal management agencies. This commitment includes the commission's interest and support of research projects that contribute to improving our understanding related to the effectiveness and efficiency of the cooperative interactions among Great Lakes fisheries management agencies.

In the following weeks, you will receive an email invitation from Nancy Leonard (leonar80@msu. edu) to participate in her online survey. Nancy's doctoral research

focuses on depicting the information exchange network of Great Lakes Agency-Appointed committees. She needs the participation of both current and past participants of these committees to capture the entire network structure. Understanding this network will provide insights into ways to improve the flow of information among the Great Lakes committees; thereby enhancing their ability to cooperatively manage fisheries within the Great Lakes basin.

The commission is greatly interested in the outcome of Nancy's research project and its contribution to Great Lakes fishery management. I encourage you to participate in this study and appreciate you responding to Nancy's survey in a timely fashion.

Thank you,

C. I. Goddard

Executive Secretary

cc: G. Barnhart, Chair

P. Wallace, Vice-Chair

W. Taylor, Commissioner

APPENDIX B

Email and Letter Invitation Explaining Purpose of Survey

Email and Letter Invitation

Note: Letter version was printed on MSU letterhead, with the date and invitee's address at the top of the letter.

EMAIL FROM FIELD: Nancy Leonard <leonar80@msu. edu>

EMAIL SUBJECT FIELD: Great Lakes' Network of Information Exchange Survey

Dear [first and last name],

I am contacting both past and current participants of the Great Lakes' Agency-appointed committees to seek their participation in the completion of a survey that will identify the flow of fishery related information throughout the basin. Analysis of this information will provide greater understanding of the existing information network; thereby enhancing the ability of the Joint Strategic Plan's parties' to cooperatively manage fisheries within the Great Lakes basin.

Your participation is essential to the outcome of this research project. The success of this survey relies on the participation of all individuals that are currently or have been involved in Great Lakes' Agency Appointed committee activities. An individual's

involvement can range from being a current or past official member, invited presenter, or being present at any of the committees, sub-committees, or task groups meetings.

The online survey is separated into two parts. The first part will ask questions about your opinions on selected Great Lakes fishery topics and the flow of information throughout the committees' structure. The second part will ask more detailed questions about your information network. This survey should take about 30-minutes for the first part and 25-minutes for the second part, but the exact time will vary among respondents. I have designed the survey so that you can stop and resume the survey as often as needed to be compatible with your schedule.

When you are ready to begin the survey you can either click on the link for part one located below or copy the link into your web-browser. You will be asked to enter the case sensitive password written below. Once you are done with part one you can then click or copy into your web-browser to begin part two. Both parts of the survey require the same password for access.

Part One

Approximate time: 30 minutes depending on respondent

Web link:

Password (case sensitive): Info Exchange

Part Two

Approximate time: 25 minutes depending on respondent

Web link: http: //www. questionpro. com/akira/TakeSurvey?id=291193

Password (case sensitive): Info Exchange

Thank you, in advance, for your participation in this survey. If you have any questions please contact me at the email address below.

Nancy

Nancy Leonard

Fishery Research Associate

Michigan State University

Department of Fisheries and Wildlife

13 Natural Resource Building

East Lansing, MI 48824

Leonar80@msu. edu

APPENDIX C

Survey Reminder Emails and Letters Sent

Email and Letter for Thank-you/Reminder 1 - Sent to all respondents

Note: Letter version was printed on MSU letterhead, with the date and invitee's address at the top of the letter.

EMAIL FROM FIELD: Nancy Leonard <leonar80@msu. edu>

EMAIL SUBJECT FIELD: Great Lakes Social Network Survey

Dear [first and last name],

I would like to thank all the people that have responded to my survey. Your responses are critical to me as they contribute to the successful depiction of the Great Lakes fishery social network.

If you have not yet completed the survey, I ask that you do so as soon as possible. The online survey will ask questions regarding your opinions on selected Great Lakes fishery topics and the flow of information throughout GLFC committees' structure. Your participation is very important to the outcome of this research project, as it ensures that the data reflects the social network of the Great Lakes fishery committees.

When you are ready to begin the survey you can either click on the link below or copy the link into your web-browser. You will be asked to enter the case sensitive password written below. This survey should take no longer than 50-minutes. I have designed the survey so that you can stop and resume the survey as often as you like in order to accommodate your busy schedule.

Password: Info Exchange

<SURVEY_LINK>

Thank you in advance for participating in my survey. If you have any questions please contact me at the email address below.

Nancy

Nancy Leonard

PhD Student

Michigan State University

Department of Fisheries and Wildlife

13 Natural Resource Building

East Lansing, MI 48824

Leonar80@msu.edu

Email and Letter Reminder 2 & 3 - Sent to non-respondents only

Note: Letter version was printed on MSU letterhead, with the date and invitee's address at the top of the letter.

EMAIL FROM FIELD: Nancy Leonard <leonar80@msu. edu>

EMAIL SUBJECT FIELD: Great Lakes Social Network Survey

Dear [first and last name],

Your response to my survey is critical to ensuring that a complete and accurate social network for the Great Lakes fishery is depicted. The completeness and accuracy of the network is crucial in determining the level of understanding and usefulness of the data analysis in improving the effectiveness and efficiency of the cooperative interactions within the Great Lakes basin. Your participation in my survey is greatly appreciated.

The online survey that I have created consists of 6 sections. Depending on the individual this survey should take about 50-minutes. When you are ready to begin the survey you can either click on the link below or copy the link into your web-browser. You will be asked to enter the case sensitive password written below. I have designed the survey to take about 50-minutes and you can stop and resume the survey later as often as you need by following the instruction within the survey.

Password: Info Exchange

<SURVEY_LINK>

Thank you in advance for participating in my survey. If you have any questions please contact me at the email address below.

Nancy

Nancy Leonard

PhD Student

Michigan State University

Department of Fisheries and Wildlife

13 Natural Resource Building

East Lansing, MI 48824

Leonar80@msu.edu

APPENDIX D

Survey Questions and Answer Choices for Part One

The survey questions and answer choices are provided below without the formatting used in the online version or in the paper version survey. Most of the instructions guiding respondents to skip questions, branching instructions, have been removed. There are two main sections to this first portion of the survey instrument Part One-A and Part One-B. Respondents that answered that they were not a Great Lakes Fishery Commission Secretariat staff or commissioner (question 1.1), and that did identify a Great Lakes agency-appointed committees as one that they are currently associated with (question 1.2) completed the questions in Part One-A. Respondents that answered that they were a Great Lakes Fishery Commission Secretariat staff or commissioner (question 1.1), and that did not identify any of the Great Lakes agency-appointed committees listed below as one with which they associate (question 1.2) were branched further in the survey to complete questions in Part One-B. Both sets of respondents were asked to complete Part Two of the survey under Appendix E.

Great Lakes Fishery's Network of Information Exchanges Part One-A

Section 1: Your Great Lakes Committee

1.1 During the time period between 2003 and 2005, inclusive, were you a Great Lakes Fishery Commission (GLFC) Secretariat staff or GLFC Commissioner?

- Yes → Go to Part One-B, Question #1.3

- No → Go to next question (For all subsequent questions assume you go to the next question unless there is a branching note in color as above)

1.2 Select one of the Great Lakes agency-appointed committees, or one of the sub-committees or task groups, listed below with which you are most currently associated. The committee, subcommittee, or task group you select will be referred to as "Your Committee" in all subsequent questions. If you are equally associated with several or all committees listed below select the committee with which you are most familiar in terms of its members, attendees, and fisheries topics. If you are not associated with any of the committees or you are not familiar with any of the committees' fisheries topics please select the "I am not familiar with any of these committees" answer.

- Lake Ontario Committee (LOC)
- LOC's Standing Technical Committee
- LOC's Deepwater Ciscoe Task Group
- Lake Trout Technical Subcommittee
- Other LOC's subcommittees or taskgroups
- Lake Erie Committee (LEC)
- LEC's Standing Technical Committee
- LEC's Coldwater Task Group
- LEC's Forage Task Group
- LEC's Habitat Task Group
- LEC's Walleye Task Group
- LEC's Yellow Perch Task Group

- Other LEC's subcommittees or taskgroups
- Lake Huron Committee (LHC)
- Lake Huron Technical Committee
- LHC's Specialized Task Groups
- Other LHC's subcommittees or task groups
- Lake Michigan Committee (LMC)
- Lake Michigan Technical Committee
- LMC's Lake Sturgeon Task Group
- Other LMC's subcommittees or taskgroups
- Lake Superior Committee (LSC)
- Lake Superior Technical Committee
- Other LSC's subcommittees or taskgroups
- Law Enforcement Committee (LAW)
- LAW's Upper Lakes Committees
- LAW's Lower Lakes Committees
- Other LAW's subcommittees or taskgroups
- Council of Lake Committees
- Council of Great Lakes Fishery Agencies
- I am NOT familiar with any of these Committees → Go to Part One-B, Question #1.3

1.3 How valuable is it to you to attend your committee meetings?

Your committee refers to the committee, subcommittee, or task group that you identified in the previous question as the one with which you are most currently associated.

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value

1.4 Are there official or unofficial repercussions of which you are aware for committee members that do not attend committee meetings? *Official refers to repercussions that are written in the committee's term of reference. Unofficial refers to non-written sanctions such as how other members may react to the person that is missing committee meetings.*

- Yes, there are official repercussions of which I am aware
- Yes, there are unofficial repercussions of which I am aware
- I am not aware of any repercussions

1.5 Please briefly describe the types of formal or informal repercussions for committee members that miss committee meetings?

1.6 Do you learn anything during the formal portions of your committee meetings? *Formal portions of the meetings refers to the presentations and committee led discussions. This does not include the informal interactions and discussions among participants.*

- No, I never learn anything
- Yes, I occasionally learn something
- Yes, I frequently learn something
- Yes, I always learn something

1.7 What percentage of what you learn from your committee do you share with colleagues within your organization?

- 100% (all that you learn)
- 80%
- 60%
- 50%
- 40%
- 20%
- 0% (nothing that you learn)

1.8 Do you learn anything during the informal portions of your committee meetings? *Informal portions of the meetings refers to coffee breaks, receptions, meals, and other informal settings during which you have interactions with the committee's meetings' participants.*

- No, I never learn anything
- Yes, I occasionally learn something
- Yes, I frequently learn something
- Yes, I always learn something

1.9 How would you rate the usefulness of the information you learn from the informal (e.g., socials) portions versus the formal (e.g., presentations) portions of the meeting?

- Information from informal portions is much more useful than from the formal meeting
- Information from informal portions is more useful than from the formal meeting
- Information from informal portions is equally useful as from the formal meeting
- Information from informal portions is less useful than from the formal meeting
- Information from informal portions is much less useful than from the formal meeting

1.10 What value do the voting members of your committee assign to stakeholders' opinions when making decisions?

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value

1.11 How sufficient is the value assigned to stakeholders' opinions by the voting members of your committee?

- Completely insufficient
- Moderately insufficient
- Mildly insufficient
- Mildly sufficient
- Moderately sufficient
- Completely sufficient

1.12 Among the various groups that provide information to your committee on issues of interest, please indicate up to five groups that you believe provide, in comparison to the other groups, the most important and useful information to your committee. If there are no groups please write "none" in the first box.

These groups may include various types of anglers or their representatives, professionals from academic institutions, agency biologists/managers/conservation officers, consulting firms, individuals, media, non-governmental organizations, or any other type of group that provides information to your committee.

- Group #1:_____
- Group #2:_____
- Group #3:_____
- Group #4:_____
- Group #5:_____

Thank-you for completing Section 1!

You are about to start Section 2. Section 2 focuses on your general relationship with your committee's participants. There are a total of 5 sections in this part of the survey for you to complete. Thank-You for participating!

Section 2: You, Your Committee, and Your Organization

2.1 Please select the answer that best describes your level of knowledge for each of the following groups of people within your committee. *In the questions below "well" refers to you knowing the person's name, and having knowledge of the fisheries area in which they have expertise.* For each of the statements below select one of these answer choices: I know none of them, I know few of them well, I know some of them well, I know most of them well, I know all of them well.

- How well do you know the Executive Officers of your committee?
- How well do you know the representatives of the member agencies of your committee?
- How well do you know the other people (stakeholders, academia, guest speakers etc.) attending your committee's meetings?

2.2 Indicate your level of agreement with the following statements regarding you and people in your committee. .For each statement select among the following 6 answer choices: Completely disagree, Moderately disagree, Mildly disagree, Mildly agree Moderately agree, Completely agree.

- People on my committee and I share similar concerns for the Great Lakes fishery.
- I identify with the people who are on my committee.
- I feel that I am accepted by the people on my committee.
- People on my committee seek my assistance for Great Lakes fishery related issues.

- I care about what people on my committee think of my actions.
- I can approach any person on my committee to ask for their assistance with work related issues.
- People on my committee and I are striving for the same overall fisheries resources goals.
- People on my committee are interested in what I have to say about Great Lakes fishery related topics.
- It is valuable to me to be working with the people on my committee.

2.3 Indicate your level of agreement with the following statements regarding you and people in your organization. *If your organization is composed of sub-compartments such as departments, branches, or units answer these questions with respect to the lowest (smallest) division of your organization to which you belong.* For each statement select among the following 6 answer choices: Completely disagree, Moderately disagree, Mildly disagree, Mildly agree, Moderately agree, Completely agree.

- People within my organization and I share similar concerns for the Great Lakes fishery.
- I identify with the people who work in my organization.
- I feel that I am accepted by people within my organization.
- People within my organization seek my assistance for Great Lakes related issues.
- I care about what people within my organization think of my actions.
- I can approach any person within my organization to ask for their assistance with work related issues.

- People within my organization and I are striving for the same overall fisheries resources goals.
- People within my organization are interested in what I have to say about Great Lakes fishery related topics.
- It is valuable to me to be working with the people in my organization.

2.4 Indicate your level of agreement with the following statements regarding you, people in your committee, and people in your organization. *If your organization is composed of sub-compartments such as departments, branches, or units answer these questions with respect to the lowest (smallest) division of your organization to which you belong.* For each statement select among the following 6 answer choices: Completely disagree, Moderately disagree, Mildly disagree, Mildly agree, Moderately agree, Completely agree.

- People in my *organization* are more similar to me with respect to their fisheries related background (education, experience) than the people in my *committee*.
- I identify more with people in my organization than with people in my committee.
- The concerns that I have for fisheries resources are more similar to the concerns held by people in my *organization* than people in my *committee*.
- People in my *organization* are more interested in what I have to say about Great Lakes fishery related topics than people within my *committee*.
- I care more about what people within my *organization* think of my actions than what people in my *committee* think of my actions
- I am more willing to assist people in my *committee* than people within my *organization*.

- People in my *committee* seek out my assistance on Great Lakes fishery related issues more than people in my *organization.*
- My perspectives on fisheries related issues are more similar to the perspectives held by people in my *committee* than people in my *organization.*
- It is more valuable to me to be working with the people in my *committee* than the people in my *organization.*

2.5 Please write the full name, affiliated organization, and other relevant information in the spaces provided below for up to 5 people to whom you turn to when you want to have an important discussion on Great Lakes fisheries related topics. These people can be external to or part of the Great Lakes agency appointed committees. If you do not discuss this topic with anyone please write "none" in the first box. *The people you list below will not be contacted. They will only be included within the information exchange network that I will be analyzing. The identity of the individuals you list will not be revealed. All data pertinent to them will be anonymized and generalized.*

- First Name & Middle Initial
- Last Name Organization
- Types of Fisheries Topics Discussed?

2.6 To be able to combine the initial information you have given me in the previous question regarding your information exchange network with the more detailed information you will be providing in Part 2 of the survey I need to have your full name and affiliation. This information will also allow me to merge your information with other

respondents' networks to obtain a complete representation of the entire flow of information exchanges within and among the Great Lakes Agency Appointed Committees. I will assign a unique number to you, which will be used in the data analysis stage. Your name and other identifiable characteristics will not be shared with anyone or included in any publication. Thank you for participating in my research on the Great Lakes Fishery's Network of Information Exchanges. *This survey is confidential. Your answers will be kept confidential. We will not identify you by name or any other unique characteristic or set of characteristics in any written documents. You may contact Peter Vasilenko, Ph.D. Chairperson of UCRIHS (the human-subjects research review board) at Michigan State University (Telephone: (517) 355-2180 / Fax: 432-4503 / E-mail: ucrihs@msu.edu), in case you have concerns or questions about your rights in participating in this human-subjects research.*

- Your first and last name:_____
- Your affiliation (agency, university, tribe, organization, etc.):_____

Thank-you for completing section 2! The current section, section 3, asks about your opinion on topics related to management and enforcement of Great Lakes fisheries.

Thank-You!

Section 3: Management and Enforcement of Great Lakes Fisheries

3.1 How valuable is it for you to know about current fisheries issues that exist in the other Great Lake(s)? *Other Great Lake(s) refers to the Great Lake(s) in which you do not conduct the majority of your work.*

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value

3.2 What value would you assign to having interactions between yourself and Fisheries Biologists/Managers from other jurisdictions?

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value

3.3 What value would you assign to having interactions between yourself and Fisheries Law Enforcement Officers from other jurisdictions?

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value

3.4 How valuable is it to have Great Lakes Fisheries Biologists and Managers interact through the following platforms? Assign one of the following answer choices to each of the situations listed below: No value, Low value, Low to moderate value, Moderate value, Moderate to high value, High value.

- Biologists and Managers interacting through the Lake Committees
- Biologists and Managers interacting through the Law Committee
- Biologists and Managers interacting through the Council of Lake Committees
- Biologists and Managers interacting through the Council of Great Lakes Agencies
- Biologists and Managers interacting within their common organization
- Biologists and Managers interacting where they work, whether this be within or outside their jurisdiction, in the field or in the lab, or other forum where they both conduct their work

3.5 How valuable is it to have Great Lakes Fisheries Law Enforcement Officers and Great Lakes Fisheries Biologists/Managers interact through the following platforms? Assign one of the following answer choices to each of the situations listed below: No value, Low value, Low to moderate value, Moderate value, Moderate to high value, High value.

- Officers and Biologists/Managers interacting through the *Lake* Committees
- Officers and Biologists/Managers interacting through the *Law* Committee
- Officers and Biologists/Managers interacting through the *Council of Lake*
- Committees
- Officers and Biologists/Managers interacting through the *Council of Great Lakes*
- *Agencies*
- Officers and Biologists/Managers interacting within their common *organization*
- Officers and Biologists/Managers interacting *where they work*, whether this be within or outside their jurisdiction, in the field or in the lab, or other forum where they both conduct their work

3.6 To assure the sustainability of shared Great Lakes fisheries, what relative amount of management decisions do you think should be made by each jurisdiction independently (uni-jurisdictional) and what relative amount of management decisions should be made jointly by all involved jurisdictions (multi-jurisdictional) concerning shared fisheries? Scenarios range from: (1) all management activities pertaining to shared fisheries are implemented based only on a jurisdiction's decisions. Decisions do not take into account input from other jurisdictions (only uni-jurisdictional); (2) individual jurisdictions make

no independent management decisions for the shared fishery (only multi-jurisdictional); and (3) a combination of these two approaches. *Sustainability refers to using a fishery resource, and the ecosystem that supports the fishery resource, in such a way to assure that the fishery maintains a healthy population size. Shared fisheries refers to fisheries that cross jurisdictional boundaries, thus having more than one jurisdiction with management and enforcement authority of these fisheries.*

- Only unijurisdictional
- Mostly unijurisdictional
- Half unijurisdictional and half multijurisdictional
- Mostly multijurisdictional
- Only multijurisdictional
- I do not know

3.7 When making a decision, which of the following options best represents how your committee balances the perspectives of individual jurisdictions with committee (lake-wide) perspectives on fisheries related topics?

- 0% individual, 100% committee
- 20% individual, 80% committee
- 40% individual, 60% committee
- 50% individual, 50% committee
- 60% individual, 40% committee
- 80% individual, 20% committee
- 100% individual, 0% committee

- I do not know

3.8 How valuable is your committee's role in assuring the sustainable management of lake-wide fisheries? *Sustainable refers to using a fishery resource, and the ecosystem that supports the fishery resource, in such a way to assure that the fishery maintains a healthy population size.*

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value

3.9 How would you describe the effectiveness of your committee in achieving inter-jurisdictional cooperation among the fisheries authorities found within its Great Lake?

- Completely ineffective
- Moderately ineffective
- Mildly ineffective
- Mildly effective
- Moderately effective
- Completely effective

3.10 How effective do you believe is the Joint Strategic Plan in achieving an inter-jurisdictional coordinated fishery management in the Great Lakes? *The Joint Strategic Plan for Management of Great Lakes Fisheries was adopted in 1981 as a commitment to interjurisdictional coordinated fishery management based upon an ecosystem approach. The entire text is available online at http://www.glfc.org/fishmgmt/jsp97.htm*

- Completely ineffective
- Moderately ineffective
- Mildly ineffective
- Mildly effective
- Moderately effective
- Completely effective
- I do not know

3.11 How effective are Fish Community Objectives as a tool for guiding the Committee's effort in achieving its desired fish community structure? *Fish Community Objectives: the Lake Committees will define objectives for the structure of each of the Great Lakes fish communities and develop a means of measuring progress toward their achievement.*

- Completely ineffective
- Moderately ineffective
- Mildly ineffective
- Mildly effective
- Moderately effective
- Completely effective

- I do not know

3.12 How valuable is the combined role of the Boards, Committees, and Partners under the Great Lakes Fishery Commission umbrella in assuring the sustainability of the Great Lakes' shared fisheries? *Boards include: Board of Technical Experts; Sea Lamprey Integration Committee; and Great Lakes Fish Habitat Conservation Committee. Agency-Appointed Committees include: Council of Great Lakes Fishery Agencies; Council of Lake Committees; Law Enforcement Committee; Fish Health Committee; Lake Superior Committee; Lake Michigan Committee; Lake Huron Committee; Lake Erie Committee and Lake Ontario Committee. Partners include: Fisheries and Oceans Canada; Michigan State University; U.S. Army Corps and Engineers; U.S. Geology Survey; University of Guelph and U.S. Fish and Wildlife Service. Sustainability refers to using a fishery resource, and the ecosystem that supports the fishery resource, in such a way to assure that the fishery maintains a healthy population size. Shared fisheries refer to fisheries that cross jurisdictional boundaries, thus having more than one jurisdiction with management and enforcement authority of these fisheries.*

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value
- I do not know

You are finished with Section 3! You have only 2 more short sections (section 4 & 5) to complete before you are done with Part 1 of the survey. Section 4 focuses on your opinion about Great Lakes lake sturgeon topics. Thank-you!

Section 4: Great Lakes Lake Sturgeon

4.1 How would you describe the current Great Lakes lake sturgeon population found within your committee's jurisdiction?

- Extirpated (no longer found within your jurisdiction)
- Endangered (very few in numbers)
- Threatened (few in numbers)
- Moderate, healthy population, that can support a limited recreational and/or commercial harvest
- Large, healthy population, that can support a substantial recreational and/or commercial harvest
- I do not know

4.2 In your opinion, what amount of effort would be needed to rehabilitate threatened/endangered Great Lakes lake sturgeon populations? *Effort refers to the amount of financial and human resources invested.*

- No effort needed (population healthy)
- Very low amount of effort
- Moderately low amount of effort
- Low amount of effort

- High amount of effort
- Moderately high amount of effort
- Very high amount of effort
- An incredibly high amount of effort
- I do not know

4.3 To assure the sustainability of shared *Great Lakes lake sturgeon*, what relative amount of management decisions do you think should be made by each jurisdiction independently (uni-jurisdictional) and what relative amount of management decisions should be made jointly by all involved jurisdictions (multi- jurisdictional) concerning shared fisheries? Scenarios range from: (1) all management activities pertaining to shared fisheries are implemented based only on a jurisdiction's decisions. Decisions do not take into account input from other jurisdictions (only uni-jurisdictional); (2) individual jurisdictions make no independent management decisions for the shared fishery (only multi-jurisdictional); and (3) a combination of these two approaches. *Sustainability refers to using a fishery resource, and the ecosystem that supports the fishery resource, in such a way to assure that the fishery maintains a healthy population size. Shared fisheries refers to fisheries that cross jurisdictional boundaries, thus having more than one jurisdiction with management and enforcement authority of these fisheries.*

- Only unijurisdictional
- Mostly unijurisdictional
- Half unijurisdictional and half multijurisdictional
- Mostly multijurisdictional

- Only multijurisdictional
- I do not know

4.4 What priority level is given by your *committee* to lake sturgeon *fishery issues*?

- Very low
- Moderately low
- Mildly low
- Mildly high
- Moderately high
- Very high
- I do not know

4.5 How would you *qualify* the priority level given by your committee to lake sturgeon *fishery issues*?

- Too low
- Low
- Somewhat low
- Somewhat high
- High
- Too high

4.6 What priority level is given by your committee to lake sturgeon *stakeholder groups*?

- Very low
- Moderately low
- Mildly low
- Mildly high
- Moderately high
- Very high
- I do not know

4.7 How would you *qualify* the priority level given by your committee to the input of lake sturgeon *stakeholder groups*?

- Too low
- Low
- Somewhat low
- Somewhat high
- High
- Too high

4.8 What priority level is given by your *organization* to Great Lakes lake sturgeon *fishery issues*?

- Very low
- Moderately low
- Mildly low

- Mildly high
- Moderately high
- Very high
- I do not know

4.9 How would you *qualify* the priority level given by your organization to lake sturgeon *fishery issues*?

- Too low
- Low
- Somewhat low
- Somewhat high
- High
- Too high

4.10 What priority level is given by your organization to lake sturgeon *stakeholder groups*?

- Very low
- Moderately low
- Mildly low
- Mildly high
- Moderately high
- Very high
- I do not know

4.11 How would you *qualify* the priority level given by your organization to the input of lake sturgeon *stakeholder groups*?

- Too low
- Low
- Somewhat low
- Somewhat high
- High
- Too high

4.12 What percentage of your work involves Great Lakes lake sturgeon?

Depending on your work this may include enforcement, policy, management, research, sampling, outreach, or other components of your work that includes Great Lakes lake sturgeon.

- 0% (I do not work on lake sturgeon)
- less than 10%
- 10% to 20%
- 21% to 40%
- 41% to 50%
- 51% to 60%
- 61% to 80%
- more than 80%
- 100% (I only work on lake sturgeon)

4.13 Please write the full name, affiliated organization, and other relevant information in the spaces provided below for up to 5 people with whom you have discussions related to Great Lakes lake sturgeon. These people can be external to or part of the Great Lakes agency-appointed committees. If you do not discuss this topic with anyone please write "none" in the first box. *The people you list below will not be contacted. They will only be included within the information exchange network that I will be analyzing. The identity of the individuals you list will not be revealed. All data pertinent to them will be anonymized and generalized.*

- First Name & Middle Initial
- Last Name Organization
- Types of Lake Sturgeon Topics Discussed?

You are now starting the 5th and final section of the first part of this survey.

Thank-You!

Section 5: Personal Information

5.1 Among the following committees, subcommittees, and/or task groups, please indicate *all* committees, subcommittees, and/or task groups for which you have attended their meetings at least twice between 1995 and 2005, inclusive. If you have not attended any of these committees' meetings at least twice between 1995 and 2005, inclusive, please check the last check box beside "I have never been a participant in any of these committees". I have considered or do consider myself a participant of:

- Lake Ontario Committee (LOC)
- LOC's Standing Technical Committee
- LOC's Deepwater Ciscoe Task Group
- Lake Trout Technical Subcommittee
- Other LOC's subcommittees or taskgroups
- Lake Erie Committee (LEC)
- LEC's Standing Technical Committee
- LEC's Coldwater Task Group
- LEC's Forage Task Group
- LEC's Habitat Task Group
- LEC's Walleye Task Group
- LEC's Yellow Perch Task Group
- Other LEC's subcommittees or taskgroups
- Lake Huron Committee (LHC)
- Lake Huron Technical Committee
- LHC's Specialized Task Groups

- Other LHC's subcommittees or task groups
- Lake Michigan Committee (LMC)
- Lake Michigan Technical Committee
- LMC's Lake Sturgeon Task Group
- Other LMC's subcommittees or taskgroups
- Lake Superior Committee (LSC)
- Lake Superior Technical Committee
- Other LSC's subcommittees or taskgroups
- Law Enforcement Committee (LAW)
- LAW's Upper Lakes Committees
- LAW's Lower Lakes Committees
- Other LAW's subcommittees or taskgroups
- Council of Lake Committees
- Council of Great Lakes Fishery Agencies
- I have never been a participant in any of these committees

5.2 Insert the name of up to 5 meetings you selected in the previous question (5.1) in the spaces provided below. Among the answers listed below, select all the reasons why you have attended each of the meetings.

- Interested in agenda topics
- Wanted to observe their meeting process
- I was a guest speaker
- I was a member of that committee

- I was accompanying a colleague
- Wanted to meet a particular person present at the meeting
- Other? Please specify:

Great Lakes Fishery's Network of Information Exchanges Part One-B

Section 1: Your Great Lakes Committee

1.3 Among the following committees, subcommittees, and/or task groups, please indicate all committees, subcommittees, and/or task groups for which you have attended their meetings at least twice between 1995 and 2005, inclusive. If you have not attended any of these committees' meetings at least twice between 1995 and 2005, inclusive, please check the last check box beside "I have never been a participant in any of these committees". I have considered or do consider myself a participant of:

- Lake Ontario Committee (LOC)
- LOC's Standing Technical Committee
- LOC's Deepwater Ciscoe Task Group
- Lake Trout Technical Subcommittee
- Other LOC's subcommittees or taskgroups
- Lake Erie Committee (LEC)
- LEC's Standing Technical Committee
- LEC's Coldwater Task Group
- LEC's Forage Task Group
- LEC's Habitat Task Group

- LEC's Walleye Task Group
- LEC's Yellow Perch Task Group
- Other LEC's subcommittees or taskgroups
- Lake Huron Committee (LHC)
- Lake Huron Technical Committee
- LHC's Specialized Task Groups
- Other LHC's subcommittees or task groups
- Lake Michigan Committee (LMC)
- Lake Michigan Technical Committee
- LMC's Lake Sturgeon Task Group
- Other LMC's subcommittees or taskgroups
- Lake Superior Committee (LSC)
- Lake Superior Technical Committee
- Other LSC's subcommittees or taskgroups
- Law Enforcement Committee (LAW)
- LAW's Upper Lakes Committees
- LAW's Lower Lakes Committees
- Other LAW's subcommittees or taskgroups
- Council of Lake Committees
- Council of Great Lakes Fishery Agencies
- I have never been a participant in any of these Committees

1.4 Insert the name of up to 5 meetings you selected in the previous question (1.3) in the spaces provided below. Among the answers listed below, select all the reasons why you have attended each of the meetings.

- Interested in agenda topics
- Wanted to observe their meeting process
- I was a guest speaker
- I was a member of that committee
- I was accompanying a colleague
- Wanted to meet a particular person present at the meeting
- Other? Please specify:

1.5 Do you learn anything during the formal portions of your committee meetings? *Formal portions of the meetings refers to the presentations and committee led discussions. This does not include the informal interactions and discussions among participants.*

- No, I never learn anything
- Yes, I occasionally learn something
- Yes, I frequently learn something
- Yes, I always learn something

1.6 Do you learn anything during the informal portions of your committee meetings? *Informal portions of the meetings refers to coffee breaks, receptions, meals, and other informal settings during which you have interactions with the committee's meetings' participants.*

No, I never learn anything

- Yes, I occasionally learn something
- Yes, I frequently learn something
- Yes, I always learn something

1.7 How would you rate the usefulness of the information you learn from the informal (e.g., socials) portions versus the formal (e.g., presentations) portions of the meeting?

- Information from informal portions is much more useful than from the formal meeting
- Information from informal portions is more useful than from the formal meeting
- Information from informal portions is equally useful as from the formal meeting
- Information from informal portions is less useful than from the formal meeting
- Information from informal portions is much less useful than from the formal meeting

Thank-you for completing Section 1!

You are about to start Section 2. Section 2 focuses on your opinion and interests on Great Lakes fisheries. There are a total of 5 sections in the current survey for you to complete. Thank-You!

Section 2: Great Lakes Fishery

2.1 Are there some Great Lakes fisheries that are of greater interest to you than others? These can be fisheries within or external to your local Great Lake region.

- Yes
- No → Go to #2.3

2.2 Please write, from most (1) to least (5), up to 5 Great Lakes fisheries that are of interest to you.

- Great Lakes Fishery 1 (most):
- Great Lakes Fishery 2:
- Great Lakes Fishery 3:
- Great Lakes Fishery 4:
- Great Lakes Fishery 5 (least):

2.3 Are there some Great Lakes environmental issues that are of greater interest to you than others? These can be environmental issues within or external to your local Great Lake region.

- Yes
- No → Go to #2.5

2.4 Please write, from most (1) to least (5), up to 5 Great Lakes environmental issues that are of interest to you.

- Great Lakes Environmental Issue 1 (most):
- Great Lakes Environmental Issue 2:
- Great Lakes Environmental Issue 3:
- Great Lakes Environmental Issue 4:
- Great Lakes Environmental Issue 5 (least):

2.5 Please write the full name, affiliated organization, and other relevant information in the spaces provided below for up to 5 people to whom you turn to when you want to have an important discussion on Great Lakes fisheries related topics. These people can be external to or part of the Great Lakes agency appointed committees. If you do not discuss this topic with anyone please write "none" in the first box. *The people you list below will not be contacted. They will only be included within the information exchange network that I will be analyzing. The identity of the individuals you list will not be revealed. All data pertinent to them will be anonymized and generalized.*

- First Name & Middle Initial
- Last Name
- Organization
- Types of Fisheries Topics Discussed?

2.6 To be able to combine the initial information you have given me in the previous question regarding your information exchange network with the more detailed information you will be providing in Part 2 of the survey I need to have your full name and affiliation. This information will also allow me to merge your information with other respondents' networks to obtain a complete representation of the entire flow of information exchanges within and among the Great Lakes Agency Appointed Committees. I will assign a unique number to you, which will be used in the data analysis stage. Your name and other identifiable characteristics will not be shared with anyone or included in any publication. Thank you for participating in my research on the Great Lakes Fishery's Network of Information Exchanges. *This survey is confidential. Your answers will be kept confidential. We will not identify you by name or any other unique characteristic or set of characteristics in any written documents. You may contact Peter Vasilenko, Ph.D. Chairperson of UCRIHS (the human-subjects research review board) at Michigan State University (Telephone: (517) 355-2180 / Fax: 432-4503 / E-mail: ucrihs@msu.edu), in case you have concerns or questions about your rights in participating in this human-subjects research.*

Your first and last name:_____

Your affiliation (agency, university, tribe, organization, etc.):_____

Thank-you for completing section 2!

The current section, section 3, asks about your opinion on topics related to management and enforcement of Great Lakes fisheries. Thank-You!

Section 3: Management and Enforcement of Great Lakes Fisheries

3.1 How valuable is it to have Great Lakes Fisheries Biologists and Managers interact through the following platforms? For each of the statement below please select your answer from the following answer choices: No value, Low value, Low to moderate value, Moderate value, Moderate to high value, High value.

- Biologists and Managers interacting through the Lake Committees
- Biologists and Managers interacting through the Law Committee
- Biologists and Managers interacting through the Council of Lake Committees
- Biologists and Managers interacting through the Council of Great Lakes Agencies
- Biologists and Managers interacting within their common organization
- Biologists and Managers interacting where they work, whether this be within or outside their jurisdiction, in the field or in the lab, or other forum where they both conduct their work

3.2 How valuable is it to have Great Lakes Fisheries Law Enforcement Officers and Great Lakes Fisheries Biologists/Managers interact through the following platforms? For each of the statement below please select your answer from the following answer choices: No value, Low value, Low to moderate value, Moderate value, Moderate to high value, High value.

- Officers and Biologists/Managers interacting through the *Lake* Committees
- Officers and Biologists/Managers interacting through the *Law* Committee
- Officers and Biologists/Managers interacting through the *Council of Lake* Committees

- Officers and Biologists/Managers interacting through the *Council of Great Lakes Agencies*
- Officers and Biologists/Managers interacting within their common *organization*
- Officers and Biologists/Managers interacting *where they work*, whether this be within or outside their jurisdiction, in the field or in the lab, or other forum where they both conduct their work

3.3 To assure the sustainability of shared Great Lakes fisheries, what relative amount of management decisions do you think should be made by each jurisdiction independently (uni-jurisdictional) and what relative amount of management decisions should be made jointly by all involved jurisdictions (multi-jurisdictional) concerning shared fisheries? Scenarios range from: (1) all management activities pertaining to shared fisheries are implemented based only on a jurisdiction's decisions. Decisions do not take into account input from other jurisdictions (only uni-jurisdictional); (2) individual jurisdictions make no independent management decisions for the shared fishery (only multi-jurisdictional); and (3) a combination of these two approaches. *Sustainability refers to using a fishery resource, and the ecosystem that supports the fishery resource, in such a way to assure that the fishery maintains a healthy population size. Shared fisheries refers to fisheries that cross jurisdictional boundaries, thus having more than one jurisdiction with management and enforcement authority of these fisheries.*

- Only unijurisdictional
- Mostly unijurisdictional
- Half unijurisdictional and half multijurisdictional

- Mostly multijurisdictional
- Only multijurisdictional
- I do not know

3.4 How effective do you believe is the Joint Strategic Plan in achieving an inter-jurisdictional coordinated fishery management in the Great Lakes? *The Joint Strategic Plan for Management of Great Lakes Fisheries was adopted in 1981 as a commitment to interjurisdictional coordinated fishery management based upon an ecosystem approach. The entire text is available online at http://www.glfc.org/fishmgmt/jsp97.htm*

- Completely ineffective
- Moderately ineffective
- Mildly ineffective
- Mildly effective
- Moderately effective
- Completely effective
- I do not know

3.5 How effective are Fish Community Objectives as a tool for guiding the Committee's effort in achieving its desired fish community structure? *Fish Community Objectives: the Lake Committees will define objectives for the structure of each of the Great Lakes fish communities and develop a means of measuring progress toward their achievement.*

- Completely ineffective
- Moderately ineffective

- Mildly ineffective
- Mildly effective
- Moderately effective
- Completely effective
- I do not know

3.6 How valuable is the combined role of the Boards, Committees, and Partners under the Great Lakes Fishery Commission umbrella in assuring the sustainability of the Great Lakes' shared fisheries? *Boards include: Board of Technical Experts; Sea Lamprey Integration Committee; and Great Lakes Fish Habitat Conservation Committee. Agency-Appointed Committees include: Council of Great Lakes Fishery Agencies; Council of Lake Committees; Law Enforcement Committee; Fish Health Committee; Lake Superior Committee; Lake Michigan Committee; Lake Huron Committee; Lake Erie Committee and Lake Ontario Committee. Partners include: Fisheries and Oceans Canada; Michigan State University; U.S. Army Corps and Engineers; U.S. Geology Survey; University of Guelph and U.S. Fish and Wildlife Service Sustainability refers to using a fishery resource, and the ecosystem that supports the fishery resource, in such a way to assure that the fishery maintains a healthy population size. S hared fisheries refers to fisheries that cross jurisdictional boundaries, thus having more than one jurisdiction with management and enforcement authority of these fisheries.*

- No value
- Low value
- Low to moderate value

- Moderate value
- Moderate to high value
- High value
- I do not know

You are finished with Section 3!

You have only 2 more short sections (section 4 & 5) to complete before you are done with Part 1 of the survey. Section 4 focuses on your opinion about Great Lakes lake sturgeon topics. Thank-you!

Section 4: Great Lakes Lake Sturgeon

4.1 How would you describe the current Great Lakes lake sturgeon population found within your committee's jurisdiction?

- Extirpated (no longer found within your jurisdiction)
- Endangered (very few in numbers)
- Threatened (few in numbers)
- Moderate, healthy population, that can support a limited recreational and/or commercial harvest
- Large, healthy population, that can support a substantial recreational and/or commercial harvest
- I do not Know

4.2 In your opinion, what amount of effort would be needed to rehabilitate threatened/endangered Great Lakes lake sturgeon populations? *Effort refers to the amount of financial and human resources invested.*

- No effort needed (population healthy)
- Very low amount of effort
- Moderately low amount of effort
- Low amount of effort
- High amount of effort
- Moderately high amount of effort
- Very high amount of effort
- An incredibly high amount of effort
- I do not know

4.3 To assure the sustainability of shared *Great Lakes lake sturgeon*, what relative amount of management decisions do you think should be made by each jurisdiction independently (uni-jurisdictional) and what relative amount of management decisions should be made jointly by all involved jurisdictions (multi- jurisdictional) concerning shared fisheries? Scenarios range from: (1) all management activities pertaining to shared fisheries are implemented based only on a jurisdiction's decisions. Decisions do not take into account input from other jurisdictions (only uni-jurisdictional); (2) individual jurisdictions make no independent management decisions for the shared fishery (only multi-jurisdictional); and (3) a combination of these two approaches. *Sustainability refers to using a fishery resource, and the ecosystem that supports the fishery resource, in such*

a way to assure that the fishery maintains a healthy population size. Shared fisheries refers to fisheries that cross jurisdictional boundaries, thus having more than one jurisdiction with management and enforcement authority of these fisheries.

- Only unijurisdictional
- Mostly unijurisdictional
- Half unijurisdictional and half multijurisdictional
- Mostly multijurisdictional
- Only multijurisdictional
- I do not know

4.4 What priority level do you think the 7 Great Lakes committees should give to Great Lakes lake sturgeon fishery issues? *Great Lakes committees include: Lake Ontario Committee, Lake Erie Committee, Lake Huron Committee, Lake Michigan Committee, Lake Superior Committee, Law Enforcement Committee, Council of Lake Committee.*

- Very low
- Moderately low
- Mildly low
- Mildly high
- Moderately high
- Very high
- I do not know

4.5 What level of value do you think that the Great Lakes committees should assign to the input of lake sturgeon stakeholder groups? *Great Lakes committees include: Lake Ontario Committee, Lake Erie Committee, Lake Huron Committee, Lake Michigan Committee, Lake Superior Committee, Law Enforcement Committee, Council of Lake Committee.*

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value
- I do not know

4.6 Please write the full name, affiliated organization, and other relevant information in the spaces provided below for up to 5 people with whom you have discussions related to Great Lakes lake sturgeon. These people can be external to or part of the Great Lakes agency-appointed committees. If you do not discuss this topic with anyone please write "none" in the first box. *The people you list below will not be contacted. They will only be included within the information exchange network that I will be analyzing. The identity of the individuals you list will not be revealed. All data pertinent to them will be anonymized and generalized.*

- First Name & Middle Initial
- Last Name

- Organization
- Types of Lake Sturgeon Topics Discussed?

You are now starting the 5th and final section of the first part of this survey.

The first question in this section is question # 5.3

Thank-You!

Section 5: Personal Information

5.3 Please select which of the following best describes your current employer.

- Federal agency
- State agency
- Provincial agency
- Tribal/First Nations agency
- Commercial fishery organization
- Recreational fishery organization
- Stakeholder organization
- Academic institution
- Public outreach organization

5.4 Please write your current job title:

Job Title:_____

5.5 Among the list below select all the terms that describe the type of work you currently do.

- Public education/outreach
- Stakeholder representative
- Policy
- Lobbying
- Fisheries management
- Habitat management
- Enforcement of fisheries regulations
- Enforcement of habitat regulations
- Facilitator
- Research
- International level
- National level
- Regional level
- Local level
- Other? Please specify

5.6 Select the range of years that best corresponds to the total number of years you have been associated with the Great Lakes Fishery Commission or any of its related boards, committees, and sub-committees. *Associated includes attending meetings as an invited guest presenter, as a participant, as an official member, or any other type of activity that*

resulted in you interacting with other people associated with the Great Lakes Fishery Committee's boards, committees, or subcomittees.

- 0 to 1 year
- 2 to 5 years
- 6 to 10 years
- more than 10 years

5.7 Among the list of organizations listed below, please indicate all the organizations of which you are a member.

- American Fisheries Society, Parent organization
- American Fisheries Society, Division or Chapter
- American Sportfishing Association
- Canadian Climate Impacts and Adaptation Research Network
- Canadian Conference for Fisheries Research
- Canadian National Sport Fishing Foundation
- International Association for Great Lakes Research
- Ontario Commercial Fisheries' Association
- Wisconsin Commercial Fishermen's Association
- Other? Please specify:

5.8 Where do you live?

- Canada
- United States

- Other? Please specify:

5.9 Please select your gender:

- Female
- Male

5.10 Please select your age group:

- under 25 years of age
- 25 to 34 years of age
- 35 to 44 years of age
- 45 to 59 years of age
- over 60 years of age

5.11 What is your race?

Race reflects self-identification by people according to the race or races with which they most closely identify. Race categories include White, Black, African American, American Indian, Alaska Native, Asian, Pacific Islander, combination of two or more races, and so forth.

- Race:_____

5.12 From the categories below please select the highest level of education level that you have completed.

- General Equivalency Diploma,

- High School equivalency diploma (GED)
- High School Diploma
- College Degree (2-years)
- Bachelor Degree
- Master Degree
- PhD Degree
- Other? Please specify:

Thank you for completing part 1 of this survey.

Part 2 of the survey contains only one section which serves to gather important information on the information exchange among the Great Lakes Agency Appointed Committees. This second part of the survey is a crucial component of this research project as it will provide the information needed to reveal and analyze the structure of information exchange among members and participants of the committees.

Thank-you for your participation. You are almost finished with the survey.

APPENDIX E

Survey Questions and Answer Choices for Part Two

Great Lakes Fishery's Network of Information Exchanges

Thank-you for participating in the second and final part of my survey. This second part of the survey contains the Your Network of Information Exchanges section, which is a crucial component of this research project.

In this section I will be asking you to identify who you know and to describe your professional relationship with each individual. This information is extremely important as it allows me to construct the network diagram of the flow of fishery related information among all individuals involved in the Great Lakes' Agency Appointed Committees (figure 1). Once constructed this diagram will increase our understanding of the current flow of information among participants and thereby contribute to enhancing our management of Great Lakes fishery resource. If a person that you know appears under more than one committee, please indicate that you know them under each committee but only answer the more in-depth questions for them once.

Thank-you for taking the time required to provide me with the critical information needed to build a complete network diagram of the fishery related information exchanges in the Great Lakes!

Nancy Leonard

Michigan State University

Department of Fisheries and Wildlife

13 Natural Resources Building

East Lansing, Michigan 48824

Leonar80@msu.edu

(734) 662-3209 ext.29

Your Network of Information Exchanges

To be able to construct your information exchange network and merge it with other respondents' networks I need to have your full name and affiliation. I will assign a unique number to you, which will be used in the data analysis stage. Your name and other identifiable characteristics will not be shared with anyone or included in any publication. Thank you for participating in my research on the Great Lakes Fishery's Network of Information Exchanges. *This survey is confidential. Your answers will be kept confidential. We will not identify you by name or any other unique characteristic or set of characteristics in any written documents. However, as this survey includes name rosters compiled using attendance sheets from Great Lakes Committee meetings, your name along with other names may be listed in the survey. You may contact Peter Vasilenko, Ph.D. Chairperson of UCRIHS (the human-subjects research review board) at Michigan State University (Telephone:355-2180 / Fax: 432-4503 / E-mail: ucrihs@msu.edu), in case you have concerns or questions about your rights in participating in this human-subjects research.*

- Your First and Last Name:_____
- Your affiliation (agency, university, tribe, organization, etc.): _____

Your Network of Information Exchanges - GLFC Commissioners, Secretariat, and Advisors

1. Below is a partial list of Great Lakes Fishery Commission Commissioners, Great Lakes Fishery Commission Secretariat, and Advisors. If there are two or more people in the network with the same name their affiliation is noted in { } to facilitate differentiating between them. Please select all the individuals that you know including casual acquaintances and close colleagues. Next copy the names you have selected in the space provided on the fold-out page located on the left. If you selected more than 10 person write the names of those with whom you prefer to discuss important topics relevant to your work (up to 10 names). If your name is among those listed below do not select your name. If you do not know any of the people listed below please check the "I do not know any of these people" box.

- Arcuri, Don
- Atkinson, Arthur B.(Bert)
- Barnhart, Gerry
- Beamish, Bill
- Bodin, Jeff 2
- Burkett, Dale
- Christie, Gavin
- Jackson, Don
- Jackson, John
- Jensen, Paul
- Johnson, Vermont
- Kenyon, Roger
- Knight, Roger
- Krueger, Chuck
- Kustich, Rick
- Quinney, Terry
- Reuss, Dick
- Russell, Merlynn
- Ryan, Michael(Mike)
- Sander, Edmund
- Scott, Steven(Steve)
- Sisler, Sean

- Conlin, Mike
- Cowan, E.R.(Ted)
- Culligan, William(Bill)
- Davis, John

{Affiliation: DFO}

- Davis, Larry
- Dexter, Jim
- Dochoda, Marg
- Engel, Matt
- Eshenroder, Randy
- Finster, Jill
- Gaden, Marc
- Garton , Robert
- Goddard, Chris
- Grinold , Dennis
- Hansen, Bernard
- Hansen, Michael
- Haslerud, Charles
- Hecky, Robert
- Hetz, Robert
- Hickey, Dennis
- Laitinen, Ronald
- LaPan, Steve
- Lawrence, Ted
- Leonard, Nancy
- Lewis(Bronkowski), Pat
- Lonsdale, David
- Lutz, Heather
- Makauskas, Ed
- Manson, Craig
- Mathers, Jerry
- Matta, Michael(Mike)
- Matthews, Robert
- May, Gerald
- McLeod, Scott
- Merckel, Kenneth(Ken)
- Newcomb, Tammy
- Newman, Kurt
- Niggemyer, Allison
- Obert, Eric
- Sivertson , Stuart
- Smith, Kelley
- Staples, Barbara(Barb)
- Stein, Roy
- Taylor, William(Bill)

{Affiliation: MSU}

- Trudeau, Tom
- Wallace, Peter
- Watson-Wright, Wendy
- Weisinger, Russell(Russ)
- Wendler, Paul
- Wilcox, Ralph
- Williams , Forrest
- Wingate , Paul J.(Jack)
- Wofford (Martineau), Sean
- Zhuang, Hao

- House, Alfred(Al)
- Hoven, Harvey
- Pierce, Ray
- Pistis, Charles(Chuck)
- Pollesch, Todd
- Zuverink, Gordon
- I do not know any of these people

2. Beside each name please indicate how often you have interacted with each person during the last 12 months.

- 1 to 3 times (x) a year
- 4 to 6x a year
- 1 to 3x a week
- Daily
- No interactions during last 12 months

3. Beside each name, please indicate how long you have known each person.

- less than 6 months
- 6 to 11 months
- 1 to 5 years
- 6 to 10 years
- more than 10 years

4. Beside each of the names, please indicate how much you value the information you gain from discussions with each individual regarding Great Lakes fishery topics. If you do not discuss Great Lakes fishery related topics with a person please select "We do not discuss fisheries topics" as your answer.

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value
- We do not discuss fisheries topics

5. Beside each of the names that you identified in the previous question as people with whom you have Great Lakes fishery related discussions, please indicate what proportion of your discussions include Great Lakes lake sturgeon related topics.

- None of our discussions
- Few
- Less than half
- About half
- More than half
- Almost all
- All of our Discussions

6. Are there other past or current Great Lakes Fishery Commission Commissioners, Great Lakes Fishery Commission Secretariat, and Advisors not listed in the previous roster with whom you have important discussions on Great Lakes fisheries related topics?

- Yes

- No

7. Please type the full name, affiliated organization, and other relevant information in the spaces provided below for up to 10 people who are past or current Great Lakes Fishery Commission Commissioners, Great Lakes Fishery Commission Secretariat, and Advisors and with whom you have important discussions on Great Lakes fisheries related topics.

- First Name & Middle Initial
- Last Name
- Organization
- Types of Fisheries Topics Discussed (general, lake sturgeon, other)?

Your Network of Information Exchanges - Council of GLFC Agencies and Council of Lake Committees

8. Below is a partial list of members and attendees of the Council of Great Lakes Fishery Commission Agencies and Council of Lake Committees. If there are two or more people in the network with the same name their affiliation is noted in { } to facilitate differentiating between them. Please select all the individuals that you know including casual acquaintances and close colleagues. Next copy the names you have selected in the space provided on the fold-out page located on the left. If you selected more than 10 person write the names of those with whom you prefer to discuss important topics relevant to your work (up to 10 names). If your name is among those listed below do not select your name. If you do not know any of the people listed below please check the "I do not know any of these people" box.

- Archambault, Bill
- Breidert, Brian
- Cairns, Vic
- Carl, Leon
- Colin, Mike
- Cooley, John
- Culligan, William (Bill)
- Cullis, Ken
- Dexter, Jim
- Fynn-Aikin, Kofi
- Galloway, Jim
- Gannon, John
- George, Sandra
- Gesl, Dave
- Gillman, D. Victor
- Gorenflo, Tom
- Grannemann, Norman
- Groat, Chip
- Haseltine, Sue
- Hoopes, Rick
- Horns, William (Bill)
- Horvatin, Paul
- Isbell, Gary
- Jackson, Gerry
- James, William
- Kenyon, Roger
- Kmiecik, Neil
- Knight, Roger
- Krantzberg, Gail
- Lange, Robert (Bob)
- LaPan, Steve
- Locke, Brian
- MacGregor, Rob
- Mack, Cameron (Cam)
- Mattes, Bill
- McLeish, David (Dave)
- Morencie, Mike
- Morrison, Bruce
- Newcomb, Tammy
- Newman, Kurt
- Orsatti, Sandra
- Payer, Ronald (Ron)
- Reid, David (Dave)
- Scott, Steven (Steve)
- Shipman, Stuart (Stu)
- Smith, Kelley
- Staggs, Michael (Mike)
- Trudeau, Tom
- Wingate, Paul J. (Jack)
- Zorn, James
- I do not know any of these people

9. Beside each name please indicate how often you have interacted with each person during the last 12 months.

- 1 to 3 times (x) a year
- 4 to 6x a year
- 1 to 3x a week
- Daily
- No interactions during last 12 months

10. Beside each name, please indicate how long you have known each person.

- less than 6 months
- 6 to 11 months
- 1 to 5 years
- 6 to 10 years
- more than 10 years

11. Beside each of the names, please indicate how much you value the information you gain from discussions with each individual regarding Great Lakes fishery topics. If you do not discuss Great Lakes fishery related topics with a person please select "We do not discuss fisheries topics" as your answer.

- No value
- Low value

- Low to moderate value
- Moderate value
- Moderate to high value
- High value
- We do not discuss fisheries topics

12. Beside each of the names that you identified in the previous question as people with whom you have Great Lakes fishery related discussions, please indicate what proportion of your discussions include Great Lakes lake sturgeon related topics.

- None of our discussions
- Few
- Less than half
- About half
- More than half
- Almost all
- All of our Discussions

13. Are there people who attend meetings of the Great Lakes Fishery Commission Agencies and Council of Lake Committees not listed in the previous roster with whom you have important discussions on Great Lakes fisheries related topics?

- Yes
- No

14. Please type the full name, affiliated organization, and other relevant information in the spaces provided below for up to 10 people who attend the Great Lakes Fishery Commission Agencies and Council of Lake Committees meetings and with whom you have important discussions on Great Lakes fisheries related topics.

- First Name & Middle Initial
- Last Name Organization
- Types of Fisheries Topics Discussed (general, lake sturgeon, other)?

Your Network of Information Exchanges - Law Enforcement Committee

15. Below is a partial list of members and attendees of the Law Enforcement Committee. If there are two or more people in the network with the same name their affiliation is noted in { } to facilitate differentiating between them. Please select all the individuals that you know including casual acquaintances and close colleagues. Next copy the names you have selected in the space provided on the fold-out page located on the left. If you selected more than 10 person write the names of those with whom you prefer to discuss important topics relevant to your work (up to 10 names). If your name is among those listed below do not select your name. If you do not know any of the people listed below please check the "I do not know any of these people" box.

- Bennett, David
- Bishop, Darren
- Boraski, James (Jim)
- Collins, Robert
- Johnson, John
- Jondle, Jeff
- Jones, Ross
- Kitt, Michael (Mike)
- Knight, Roger
- Pestinger, Matthew
- Quaintance, Patrick
- Quinney, Terry
- Ramsey, Kevin
- Rooney, Gordon

(Bob)

- Cottrell, Randy
- Culligan, William (Bill)
- de Bros, Jr., Arthur Leonard
- Delis, Michael (Mike)
- Desloover, Larry
- Edwards, Thomas (Tom)
- Erickson, Woody
- Fisher, Matt
- Fuller, James (Jim)
- Gerould, Steven
- Gibson, Robert (Rob)
- Halley, Mark
- Hansen, Thomas (Tom)
- Harrod, Tom
- Hausman, David
- Hopkins, Daniel (Dan)
- Humber, Derrick
- Ingham, Bill
- Insley, Sean
- Johncox, Charles
- Lafferty, Bill
- LeClair, Daniel
- Lumadue, Robert (Bob)
- Manley, Gary
- Maulson, Fred
- McCharles, Scott
- Mysak, John
- Neal, Patrick (Mike)
- Nestor, Robert (Bob)
- Orok, Matthew (Gord)
- Santel, Tim
- Scott, Michael (Mike)
- Serdar, Neil
- Sheill, Daniel
- Shults, Steve
- Smith, Jim
- Stein, Roy
- Tetzlaf, Michael (Mike)
- Tilson, Tim
- Tolbert, Brook
- Tomlinson, Bruce
- VanDerOetelaar, Edwin
- Weakley, Jim
- Willis, Kevin
- Wilson, Gary
- Wulfkuhle, Gus
- White, Gerald
- I do not know any of these People

16. Beside each name please indicate how often you have interacted with each person during the last 12 months.

- 1 to 3 times (x) a year
- 4 to 6x a year
- 1 to 3x a week
- Daily
- No interactions during last 12 months

17. Beside each name, please indicate how long you have known each person.

- less than 6 months
- 6 to 11 months
- 1 to 5 years
- 6 to 10 years
- more than 10 years

18. Beside each of the names, please indicate how much you value the information you gain from discussions with each individual regarding Great Lakes fishery topics.
If you do not discuss Great Lakes fishery related topics with a person please select "We do not discuss fisheries topics" as your answer.

- No value
- Low value
- Low to moderate value

- Moderate value
- Moderate to high value
- High value
- We do not discuss fisheries topics

19. Beside each of the names that you identified in the previous question as people with whom you have Great Lakes fishery related discussions, please indicate what proportion of your discussions include Great Lakes lake sturgeon related topics. Draw a line through, or leave blank, the check boxes beside the names with whom you do not discuss fishery topics.

- None of our discussions
- Few
- Less than half
- About half
- More than half
- Almost all
- All of our discussions

Are there other past or current Law Enforcement Committee meeting participants who are not listed in the previous roster with whom you have important discussions on Great Lakes fisheries related topics?

- Yes
- No → Go to #22

21. Please type the full name, affiliated organization, and other relevant information in the spaces provided below for up to 10 people who attend the Law Enforcement Committee meetings and with whom you have important discussions on Great Lakes fisheries related topics.

- First Name & Middle Initial
- Last Name
- Organization
- Types of Fisheries Topics Discussed (general, lake sturgeon, other)?

Your Network of Information Exchanges - Lake Ontario Committee

22. Below is a partial list of members and attendees of the Lake Ontario Committee. If there are two or more people in the network with the same name their affiliation is noted in { } to facilitate differentiating between them. Please select all the individuals that you know including casual acquaintances and close colleagues. Next copy the names you have selected in the space provided on the fold-out page located on the left. If you selected more than 10 person write the names of those with whom you prefer to discuss important topics relevant to your work (up to 10 names). If your name is among those listed below do not select your name. If you do not know any of the people listed below please check the "I do not know any of these people" box.

- Adair, Robert (Bob)
- Anderson, Janet
- Andrew, Wayne
- Belasco, Barbara
- Johannsson, Ora
- Johnson, James (Jim){Affiliation: USGS}
- Pearsall, Webster
- Mathers, Alastair
- McCullough, Russell

- Bishop, Dan
- Bowen, Kelly
- Bowlby, Jim
- Brown, Dave
- Burgess, Mary
- Casselman, Stephen
- Clark, Mandi
- Connerton, Michael
- Cooper, John
- Corradin, Lisa
- Correa, Cristian
- Craine, Ian
- Culligan, William (Bill)
- Dakin, David
- Daniels, Marion
- Day, Quentin
- Dermott, Ron
- Desjardine, Ron
- Dietrich, Jay
- Dittman, Dawn
- Doka, Susan
- Johnson, Nick
- Johnson, Tim
- Keir, Michael (Mike)
- Klindt, Rodger
- Koops, Marten
- Kovecses, Jen
- Lake, Colin
- Lange, Robert (Bob)
- Lange, Cameron
- Lantry, Brian
- Lapan, Steve
- Lavis, Dennis (Denny
- Lellis, Bill
- Lepak, Jesse
- MacGregor, Rob
- Mackey, Scudder
- MacNeill, David
- Markham, James (Jim)
- Meisenheimer, Peter
- McKeown, Paul
- Portiss, Rick
- Prindle, Scott
- Quinney, Terry
- Reid, Kevin
- Riley, Stephen (Steve)
- Ritchie, Bev
- Roseman, Edward (Ed)
- Sanderson, Matt
- Schaner, Ted
- Smythe, Garry
- Stewart, Tom
- Strang, Theodore
- Sullivan, Patrick (Pat)
- Sullivan, Paul
- Thomas, Dan
- Timmins, Bud
- Trometer, Betsy
- Vaughan, Raymond

- Domske, Helen
- Edwards, Bill
- Edwards, Patricia
- Einhouse, Don
- Elliott, Will
- Ferguson, Mark
- Fitzpatrick, Mark
- Fitzsimons, John
- Flack, Frank
- Fodale, Michael (Mike)
- Fynn-Aikins, Kofi
- Gouveia, Suzanne
- Hoeve, John
- Hoyle, Jim
- Jarvie, Scott
- Millard, Scott
- Morencie, Michael(Mike)
- Morrison, Bruce
- Morse, Terry
- Munawar, Mohi
- Nalbone, Jennifer
- Neave, Fraser
- Newman, Kurt
- Nichols, Jerrie
- Noakes, David
- O'Gorman, Robert (Bob)
- Owens, Randy
- Patch, Stephen (Steve)
- Patel, Aviva
- Patterson Jr., Neil
- Marks, Thomas
- Walsh, Dawn
- Walsh, Maureen
- Ward, Rocky
- Whittle, Mike
- Wilkinson, Michael
- Williston, Bill
- Wright, Elizabeth (Beth)
- Young, Robert (Rob)
- Zelazny, Donald (Don)
- Zollweg, Emily
- I do not know any of these people

23. Beside each name please indicate how often you have interacted with each person during the last 12 months.

- 1 to 3 times (x) a year

- 4 to 6x a year
- 1 to 3x a week
- Daily
- No interactions during last 12 months

24. Beside each name, please indicate how long you have known each person.

- less than 6 months
- 6 to 11 months
- 1 to 5 years
- 6 to 10 years
- more than 10 years

25. Beside each of the names, please indicate how much you value the information you gain from discussions with each individual regarding Great Lakes fishery topics.
If you do not discuss Great Lakes fishery related topics with a person please select "We do not discuss fisheries topics" as your answer.

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value
- We do not discuss fisheries topics

26. Beside each of the names that you identified in the previous question as people with whom you have Great Lakes fishery related discussions, please indicate what proportion of your discussions include Great Lakes lake sturgeon related topics. Draw a line through, or leave blank, the check boxes beside the names with whom you do not discuss fishery topics.

- None of our discussions
- Few
- Less than half
- About half
- More than half
- Almost all
- All of our Discussions

27. Are there people who attend meetings of the Lake Ontario Committee not listed in the previous roster with whom you have important discussions on Great Lakes fisheries related topics?

- Yes
- No → Go to #29

28. Please type the full name, affiliated organization, and other relevant information in the spaces provided below for up to 10 people who attend the Lake Ontario Committee meetings and with whom you have important discussions on Great Lakes fisheries related topics.

- First Name & Middle Initial
- Last Name
- Organization
- Types of Fisheries Topics Discussed (general, lake sturgeon, other)?

Your Network of Information Exchanges - Lake Erie Committee

29. Below is a partial list of members and attendees of the Lake Erie Committee. If there are two or more people in the network with the same name their affiliation is noted in { } to facilitate differentiating between them. Please select all the individuals that you know including casual acquaintances and close colleagues. Next copy the names you have selected in the space provided on the fold-out page located on the left. If you selected more than 10 person write the names of those with whom you prefer to discuss important topics relevant to your work (up to 10 names). If your name is among those listed below do not select your name. If you do not know any of the people listed below please check the "I do not know any of these people" box.

- Adair, Robert (Bob)
- Adragna, Claudio
- Barbetti, Felix
- Boase, James (Jim)
- Bur, Mike
- Clayton, Don
- Clapsadl, Mark
- Cook, Andy
- George, Sandra
- Haas, Robert
- Herr, Joe
- Hoopes, Rick
- Isbell, Gary
- Johnson, Tim
- Kayle, Kevin
- Kenyon, Roger
- Newman, Kurt
- Niven, Stu
- Obert, Eric
- Ramsey, Kevin
- Reider, Robert (Bob)
- Reisen, Kelly
- Reynolds, Frank

- Corkum, Lynda
- Culligan, William (Bill)
- Domske, Helen
- Edwards, Bill
- Einhouse, Don
- Kissell, Ed
- Knight, Roger
- Kocovsky, Patrick
- Lavis, Dennis (Denny)
- Levan, Edward (Ed)
- Locke, Brian
- Ludsin, Stuart (Stu)
- MacLennan, Don
- Marinelli, Alfred
- Markham, James (Jim)
- Morencie, Michael (Mike)
- Morse, Terry
- Murray, Chuck
- Ryan, Phil
- Siddall, Wayne
- Stapanian, Martin
- Sullivan, Paul
- Thomas, Dan
- Thomas, Michael (Mike)
- Tyson, Jeff
- Vandergoot, Chris
- Whittle, Mike
- Witzel, Larry
- I do not know any Of these people

30. Beside each name please indicate how often you have interacted with each person during the last 12 months.

- 1 to 3 times (x) a year
- 4 to 6x a year

- 1 to 3x a week
- Daily
- No interactions during last 12 months

31. Beside each name, please indicate how long you have known each person.

- less than 6 months
- 6 to 11 months
- 1 to 5 years
- 6 to 10 years
- more than 10 years

32. Beside each of the names, please indicate how much you value the information you gain from discussions with each individual regarding Great Lakes fishery topics. If you do not discuss Great Lakes fishery related topics with a person please select "We do not discuss fisheries topics" as your answer.

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value
- We do not discuss fisheries topics

33. Beside each of the names that you identified in the previous question as people with whom you have Great Lakes fishery related discussions, please indicate what proportion of your discussions include Great Lakes lake sturgeon related topics. Draw a line through, or leave blank, the check boxes beside the names with whom you do not discuss fishery topics.

- None of our discussions
- Few
- Less than half
- About half
- More than half
- Almost all
- All of our Discussions

34. Are there people who attend meetings of the Lake Erie Committee not listed in the previous roster with whom you have important discussions on Great Lakes fisheries related topics?

- Yes
- No → Go to #36

35. Please type the full name, affiliated organization, and other relevant information in the spaces provided below for up to 10 people who attend the Lake Erie Committee meetings and with whom you have important discussions on Great Lakes fisheries related topics.

- First Name & Middle Initial

- Last Name
- Organization
- Types of Fisheries Topics Discussed (general, lake sturgeon, other)?

Your Information Exchanges - Lake Michigan Committee

36. Below is a partial list of members and attendees of the Lake Michigan Committee. If there are two or more people in the network with the same name their affiliation is noted in { } to facilitate differentiating between them. Please select all the individuals that you know including casual acquaintances and close colleagues. Next copy the names you have selected in the space provided on the fold-out page located on the left. If you selected more than 10 person write the names of those with whom you prefer to discuss important topics relevant to your work (up to 10 names). If your name is among those listed below do not select your name. If you do not know any of the people listed below please check the "I do not know any of these people" box.

- Adair, Robert (Bob)
- Adams, Jean
- Allen, Paul
- Argyle, Ray
- Beck, Judy
- Bence, James (Jim)
- Brandt, Stephen (Steve)
- Brege, Dorance
- He, Ji Xe
- Herman, Mike
- Hewett, Steve
- Hogler, Steve
- Holey, Mark
- Horns, William (Bill)
- Jensen, Paul
- Jenson, Olaf
- Olsen, Erik
- Peeters, Paul
- Pilara, Joe
- Pistis, Charles (Chuck)
- Reider, Robert (Bob)
- Richards, Jessica
- Ripple, Paul

- Breidert, Brian
- Bronte, Charles (Chuck)
- Carl, Leon
- Casselman, John
- Chong, Stephen (Steve)
- Clapp, Dave
- Claramunt, Randy
- Cook, Andy
- Cuddy, Doug
- Davis, Bruce
- Desorcie, Timothy
- Dettmers, John
- Dexter, Jim
- Donofrio, Mike
- Ebener, Mark
- Eggebraaten, Ted
- Eggold, Bradley (Brad)
- Gorenflo, Tom
- Grondin, Jason
- Johnson, James (Jim)
- {Affiliation: Michigan DNR}
- Jonas, Jory
- Kapuscinski, Kevin
- King, David
- Kinnunen, Ronald (Ron)
- Klar, Gerald (Gary)
- Knutzen, David
- Koon, Ellie
- Koops, Marten
- Kubisiak, John
- Elliott, Robert (Rob/Bob)
- Fielder, David (Dave)
- Lavis, Dennis (Denny)
- Madenjian, Chuck
- Martell, Archie
- Robillard, Steve
- Rozich, Tom
- Rutherford, Ed
- Savino, Jaci
- Schneeberger, Phil (P.J.)
- Schreiner, Don
- Scott, Steve
- Shipman, Stuart (Stu)
- Smith, Kelley
- Smith, Kregg
- Staggs, Michael (Mike)
- Stockwell, Jason
- Thomas, Dan
- Todd, Tom
- Toneys, Mike
- Trudeau, Tom
- Twohey, Mike
- Warner, Dave
- Wesley, Jay

- Fodor, Geogina
- Friez, Curtis
- Gulvas, Joan
- Hasz, Justine
- Mason, Doran
- McClain, Jerry
- Mullett, Katherine
- (Kasia)
- Newcomb, Tammy
- Ollila, Dale
- McSawby, Suzanne
- Michael, Edward (Ed)
- Morse, Terry
- Moy, Philip (Phil)
- Westerhof, Rick
- Whelan, Gary
- Wingate, Paul J. (Jack)
- Wright, Greg
- Young, Robert (Rob)
- Yule, Daniel (Dan)
- Zorn, Troy
- I do not know any

Of these people

37. Beside each name please indicate how often you have interacted with each person during the last 12 months.

- 1 to 3 times (x) a year
- 4 to 6x a year
- 1 to 3x a week
- Daily
- No interactions during last 12 months

38. Beside each name, please indicate how long you have known each person.

- less than 6 months
- 6 to 11 months
- 1 to 5 years
- 6 to 10 years more
- than 10 years

39. Beside each of the names, please indicate how much you value the information you gain from discussions with each individual regarding Great Lakes fishery topics. If you do not discuss Great Lakes fishery related topics with a person please select "We do not discuss fisheries topics" as your answer.

- No value
- Low value
- Low to moderate value
- Moderate value
- Moderate to high value
- High value
- We do not discuss fisheries topics

40. Beside each of the names that you identified in the previous question as people with whom you have Great Lakes fishery related discussions, please indicate what proportion of your discussions include Great Lakes lake sturgeon related topics. Draw a line

through, or leave blank, the check boxes beside the names with whom you do not discuss fishery topics.

- None of our discussions
- Few
- Less than half
- About half
- More than half
- Almost all
- All of our Discussions

41. Are there people who attend meetings of the Lake Michigan Committee not listed in the previous roster with whom you have important discussions on Great Lakes fisheries related topics?

- Yes
- No → Go to #42

41. Please type the full name, affiliated organization, and other relevant information in the spaces provided below for up to 10 people who attend the Lake Michigan Committee meetings and with whom you have important discussions on Great Lakes fisheries related topics.

- First Name & Middle Initial
- Last Name
- Organization

- Types of Fisheries Topics Discussed (general, lake sturgeon, other)?

Your Information Exchanges - Lake Huron Committee

42. Below is a partial list of members and attendees of the Lake Huron Committee. If there are two or more people in the network with the same name their affiliation is noted in { } to facilitate differentiating between them. Please select all the individuals that you know including casual acquaintances and close colleagues. Next copy the names you have selected in the space provided on the fold-out page located on the left. If you selected more than 10 person write the names of those with whom you prefer to discuss important topics relevant to your work (up to 10 names). If your name is among those listed below do not select your name. If you do not know any of the people listed below please check the "I do not know any of these people" box.

- Adair, Robert (Bob)
- Agawa, Gregory
- Argyle, Ray
- Baker, James (Jim)
- Bence, James (Jim)
- Bergstedt, Roger
- Boase, James (Jim)
- Borgeson, David (Dave)
- Bredin, Jim
- Brege, Dorance
- Gibson, Robert (Rob)
- Gordon, Graham
- Gorenflo, Tom
- Gorman, Owen
- Holey, Mark
- Holleszko, Jeffrey
- Horns, William (Bill)
- Huntly, David
- Johnson, Chris
- Morse, Terry
- Neal, Patrick (Mike)
- Newcomb, Tammy
- Ollila, Dale
- Riley, Stephen (Steve)
- Ripple, Paul
- Savino, Jaci
- Schaeffer, Jeff
- Schreiner, Don
- Schroeder, Brandon

- Carl, Leon
- Cuddy, Doug
- de Bros, Jr., Arthur
- Desloover, Larry
- Dobiesz, Norine
- Ebener, Mark
- Edsall, Carol
- Enterline, Heather
- Fielder, David (Dave)
- Fitzsimons, John
- Fodale, Michael (Mike)
- French, John
- Gonder, David
- He, Ji Xe
- Hill, Tracy
- Hogler, Steve
- Johnson, Jim {Affiliation:MichiganDNR}
- Kinnunen, Ronald (Ron)
- Klar, Gerald (Gary)
- Koon, Ellie
- LiBkauskas, Arunas
- Lumadue, Robert (Bob)
- Madenjian, Chuck
- McClain, Jerry
- McLeish, David (Dave)
- Mcleod, Scott
- Michael, Edward (Ed)
- Mohr, Lloyd
- Morbey, Yolanda
- Olsen, Erik
- Peeters, Paul
- Plautz, Jeremy
- Reid, David (Dave)
- Scott, Steven (Steve)
- Seyler, John
- Sullivan, Paul
- Thomas, Dan
- Todd, Tom
- Tomlinson, Bruce
- Toneys, Mike
- Twohey, Michael (Mike)
- Warner, Dave
- Westerhof, Rick
- Wingate, Paul J. (Jack)
- Wright, Greg
- Young, Robert (Rob)
- I do not know any Of these people

43. Beside each name please indicate how often you have interacted with each person during the last 12 months.

- 1 to 3 times (x) a year
- 4 to 6x a year
- 1 to 3x a week
- Daily
- No interactions during last 12 months

44. Beside each name, please indicate how long you have known each person.

- less than 6 months
- 6 to 11 months
- 1 to 5 years
- 6 to 10 years
- more than 10 years

45. Beside each of the names, please indicate how much you value the information you gain from discussions with each individual regarding Great Lakes fishery topics.
If you do not discuss Great Lakes fishery related topics with a person please select "We do not discuss fisheries topics" as your answer.

- No value
- Low value
- Low to moderate value
- Moderate value

- Moderate to high value
- High value
- We do not discuss fisheries topics

46. Beside each of the names that you identified in the previous question as people with whom you have Great Lakes fishery related discussions, please indicate what proportion of your discussions include Great Lakes lake sturgeon related topics. Draw a line through, or leave blank, the check boxes beside the names with whom you do not discuss fishery topics.

- None of our discussions
- Few
- Less than half
- About half
- More than half
- Almost all
- All of our Discussions

47. Are there people who attend meetings of the Lake Huron Committee not listed in the previous roster with whom you have important discussions on Great Lakes fisheries related topics?

- Yes
- No → Go to #49

48. Please type the full name, affiliated organization, and other relevant information in the spaces provided below for up to 10 people who attend the Lake Huron Committee meetings and with whom you have important discussions on Great Lakes fisheries related topics.

- First Name & Middle Initial
- Last Name
- Organization
- Types of Fisheries Topics Discussed (general, lake sturgeon, other)?

Your Information Exchanges - Lake Superior Committee

49. Below is a partial list of members and attendees of the Lake Superior Committee. If there are two or more people in the network with the same name their affiliation is noted in { } to facilitate differentiating between them. Please select all the individuals that you know including casual acquaintances and close colleagues. Next copy the names you have selected in the space provided on the fold-out page located on the left. If you selected more than 10 person write the names of those with whom you prefer to discuss important topics relevant to your work (up to 10 names). If your name is among those listed below do not select your name. If you do not know any of the people listed below please check the "I do not know any of these people" box.

- Adair, Robert (Bob)
- Baker, James (Jim)
- Bence, James (Jim)
- Bowman, Rich
- Horns, William (Bill)
- Hrabik, Tom
- Jackson, Gerry
- Pratt, Dennis
- Pratt, Tom
- Quinlan, Henry
- Richards, Jessica

- Brege, Dorance
- Bronte, Charles (Chuck)
- Chong, Stephen (Steve)
- Cuddy, Doug
- Cullis, Ken
- Donofrio, Mike
- Dryer, Mark
- Ebener, Mark
- Elliot, Robert (Rob/Bob)
- Fielder, David (Dave)
- Gesl, Dave
- Gibson, Robert
- Gorenflo, Tom
- Gorman, Owen
- Greenwood, Susan
- Hewett, Steve
- Hogler, Steve
- Holey, Mark
- Kinnunen, Ronald (Ron)
- Klar, Gerald (Gary)
- Kmiecik, Neil
- Madenjian, Chuck
- Martell, Archie
- Mason, Doran
- Mattes, Bill
- McClain, Jerry
- McSawby, Suzanne
- Mensch, Gene
- Michael, Edward (Ed)
- Mohr, Lloyd
- Morse, Terry
- Moy, Philip (Phil)
- Mullett, Katherine
- (Kasia)
- Newcomb, Tammy
- Ollila, Dale
- Olsen, Erik
- Peeters, Paul
- Ripple, Paul
- Savino, Jaci
- Schneeberger, Phil
- Schram, Stephen
- Schreiner, Don
- Scott, Steven (Steve)
- Seider, Michael
- Staggs, Michael (Mike)
- Steeves, Mike
- Stockwell, Jason
- Sutton, Trent
- Thomas, Dan
- Todd, Tom
- Toneys, Mike
- Wingate, Paul J. (Jack)
- Young, Robert (Rob)
- I do not know any

Of these people

50. Beside each name please indicate how often you have interacted with each person during the last 12 months.

- 1 to 3 times (x) a year
- 4 to 6x a year
- 1 to 3x a week
- Daily
- No interactions during last 12 months

51. Beside each name, please indicate how long you have known each person.

- less than 6 months
- 6 to 11 months
- 1 to 5 years
- 6 to 10 years
- more than 10 years

53. Beside each of the names, please indicate how much you value the information you gain from discussions with each individual regarding Great Lakes fishery topics.
If you do not discuss Great Lakes fishery related topics with a person please select "We do not discuss fisheries topics" as your answer.

- No value
- Low value
- Low to moderate value
- Moderate value

- Moderate to high value
- High value
- We do not discuss fisheries topics

53. Beside each of the names that you identified in the previous question as people with whom you have Great Lakes fishery related discussions, please indicate what proportion of your discussions include Great Lakes lake sturgeon related topics. Draw a line through, or leave blank, the check boxes beside the names with whom you do not discuss fishery topics.

- None of our discussions
- Few
- Less than half
- About half
- More than half
- Almost all
- All of our Discussions

54. Are there people who attend meetings of the Lake Superior Committee not listed in the previous roster with whom you have important discussions on Great Lakes fisheries related topics?

- Yes
- No → Go page 50

55. Please type the full name, affiliated organization, and other relevant information in the spaces provided below for up to 10 people who attend the Lake Superior Committee meetings and with whom you have important discussions on Great Lakes fisheries related topics.

- First Name & Middle Initial
- Last Name
- Organization
- Types of Fisheries Topics Discussed (general, lake sturgeon, other)?

Thank you for completely Part 2 of my survey!

You are now finished with my survey. Please us the pre-stamped addressed envelope included at the back of your survey booklet to return your completed survey to:

Nancy Leonard

2100 Commonwealth Blvd., suite 100

Ann Arbor, MI 48105

USA

Thank you for participating in my research survey!

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REFERENCES

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