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THE ROLE OF A SOCIAL NETWORK IN THE FUNCTIONING OF THE GRAND HAVEN CHARTER BOAT FISHERY, LAKE MICHIGAN

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Major Professor's Signature

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THE ROLE OF A SOCIAL NETWORK IN THE FUNCTIONING OF THE GRAND HAVEN CHARTER BOAT FISHERY, LAKE MICHIGAN

By

Katrina B. Mueller

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ABSTRACT

THE ROLE OF A SOCIAL NETWORK IN THE FUNCTIONING OF THE GRAND HAVEN CHARTER BOAT FISHERY, LAKE MICHIGAN

By

Katrina B. Mueller

Great Lakes charter captains targeting salmon and trout species operate under unpredictable and competitive environmental and socioeconomic conditions. Social interactions that generate social capital and assist in locating and catching salmonids may prove important in decreasing these fishery-related uncertainties and thereby increase the success of the charter industry and individual charter operations. An evaluation of the fishing-related informational exchanges between charter captains and their relationship to fishing success was thus performed in the port of Grand Haven, Lake Michigan, during 2003. This evaluation detected the presence of distinct information-sharing subgroups within the Grand Haven fleet. Although docking location played an important role in determining the frequency at which charter captains communicated with each other, a history of mutual support and trust, regardless of docking location, were factors that captains considered before they exchanged fishing-related information with others. Furthermore, captains usually communicated with those who had a similar or higher success at catching salmonids. This study has implications for both fisheries professionals and stakeholders by providing a mechanism to evaluate the flow of information within networks and how it can be utilized to enhance fishery resource management and stakeholder communication. Network analysis is thus highly valuable in understanding stakeholder groups and in the management of fisheries resources.

Dedicated to the Memories of

Captain George Bolhouse

&

Sis Schrems

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INTRODUCTION

Communication and other such interactions between individuals form the basis of social networks (Wasserman and Faust 1994). Networks are defined as bounded collections of actors (e.g., the individuals in an organized fishery stakeholder group) and the ties, or type of interactions, between them. Viewed through a network perspective, fishery stakeholders and their actions are interdependent, and as such, the ties between these individuals have important implications (Wasserman and Faust 1994) for fisheries. For example, ties have the potential to provide opportunities for or constrain individual behavior. Ties also facilitate the exchange of material or non-material resources, or goods, such as shared fishing gear and information which can be used to better one's circumstance.

An individual's ability to access resources through social relationships has been termed *social capital* (e.g., Frank et al., under review; Rudd 2000). Social networks, along with trust, reciprocity, and social norms (i.e. accepted modes of behavior) are crucial to the development of this type of capital (Pretty and Ward 2000; Frank and Yasumoto 1998). Trust between actors leads to cooperation and compliance with social norms or legal regulations. Those individuals who do not comply with these norms or exploit shared resources through non-compliance with regulations are cooperatively sanctioned by other individuals in the social network (e.g., Frank and Yasumoto 1998; Acheson 1988). Thus, avoidance of environmental tragedies of the commons has been attributed to the cooperation and compliance with regulations and norms that is mediated by social capital (Bennett and Clerveaux 2003) and stakeholder social networks.

The analysis of social networks has great utility in assessing and understanding the formation of fishery stakeholder groups, the flow of resources and communication within these groups, and the implications of stakeholder interactions on each other and fishery resources (e.g., Bennett and Clerveaux 2003). For example, social network analysis has been used to explain how innovations come to be diffused and adopted within networks (e.g., Frank et al. 2004; Rogers 1995), the formation of networks among fishery stakeholder organizations (e.g., Lynch 2001), the compartmentalization of taxa in aquatic food webs (e.g., Krause et al. 2003), and how human social networks mediate between global economic exchange, aquatic ecosystems, and fishery dynamics (e.g., Frank et al., under review). Nevertheless, application of social network analysis to fishery stakeholder types has been infrequent (e.g., Lynch 2001; Maiolo and Johnson 1992; McDonough et al. 1987).

Impact of Social Interactions on Fishery-Related Uncertainty and Resources

It is widely recognized that commercial fishing directly impacts fishery resources, for example the historical and systematic overexploitation of native Great Lakes fishes (Eshenroder and Burnham-Curtis 1999; Brown et al. 1999) and Atlantic cod stocks (Finlayson and McCay 1998; Kurlansky 1997). It has also been demonstrated that commercial operators are faced with complex social environments. For instance, commercial operators targeting the American lobster (*Homarus americanus*) in Maine and salmon species in Alaska are highly competitive and integrated into the local community and market supply chain (Acheson 1988; Gatewood 1984). The following case studies illustrate that, although their target species and geographical location vastly

differ, captains operating in these two fisheries exhibit similar social behavior that has proven critical to their success and consequent impact on fishery resources.

Maine Lobster Fishery

Maine commercial lobster operators target a species that exhibits limited mobility and generally congregates where rocky structure and kelp is readily available along the coast. The principal fishing gear used to catch lobsters is a baited trap, or pot, which is weighted, attached to a line and buoy, and lowered into lobster habitat where it can rest among rocks and other suitable lobster substrate (Sainsbury 1996). Although the American lobster can be found in depths ranging from 6 - 1,200 feet, they tend to concentrate in depths less than 180 feet. These lobsters seek deeper water during the winter and are often found within feet of the breaking surf during the spring and early summer. During their summer molt, Maine lobsters hide amongst rocks and are difficult to catch (Acheson 1988).

Success and profitability of the lobster fishery is influenced by lobster biology (e.g., movement, molting, and reproduction), weather conditions, other fisheries, markets, and other lobster fishing operations. Lobster fishers reduce uncertainty related to these factors through a variety of networks and community institutions—ties with other lobster operators, negotiation with dealers, and the sharing of resources (Acheson 1988). The social relations of Maine lobster fishers are primarily expressed through territorial-based "gangs," defined by local harbors (Acheson 1988). The roles of these gangs encompass not only protection of local fishing grounds from perceived intruders, but also professional and personal support among gang members. Gang members draw on social

relationships to aggressively protect territory in which they set traps by sabotaging the traps of perceived intruders. Sabotage consists of gang members either notching the intruder's trap(s) as a warning or cutting the buoy line to the trap. The social structure of the gangs is critical to sabotage as reinforcement of this behavior is considered mutually beneficial and all members of the gang are complicit in their silence of not revealing who sabotaged the intruder's traps. To defy the gang is to risk being ostracized, a serious social sanction as the success of a lobster operation is largely dependent upon access to proven fishing grounds and local and long-standing fishery-related knowledge held by gang members. Furthermore, because gangs rely on the social capital that results from long-held community involvement, friendships, and kin-based relationships, being ostracized affects one's social standing in the community as well as their standard of living. Gangs ultimately draw on this social capital to limit entry into the local lobster fishery which gives long-standing members of the fishery a competitive advantage. This advantage is further enhanced by sanctioning gang members who exceed or defy set management limits or regulations (similar, albeit less organized sanctions occur on fishermen operating within the Turks and Caicos Island spiny lobster [*Panulirus argus*] fishery that exhibit illegal fishing behavior such as poaching or using destructive fishing techniques—Bennett and Clerveaux 2003). Violators within the Maine lobster fishery are ostracized and thus made to face uncertainties related to fishing and markets on their own. As such, commercial lobster operations in Maine have yet to experience the massive declines in their target species indicative of overexploitation.

Alaska Salmon Fishery

The target species of commercial seining operations in Southeast Alaska are pink salmon (*Oncorhynchus gorbuscha*), chum salmon (*O. keta*), and sockeye salmon (*O. nerka*). These salmonids migrate long distances in the Pacific Ocean, traveling in relatively large schools until reaching the coastal waters of Southeast Alaska. Upon reaching the coast, they segment into smaller groupings which each home to their natal streams to spawn (Gatewood 1984). It is during this later phase of their life history that commercial seiners target these population segments, netting adults as they move along the coast in search of the mouths of their natal rivers. Given this migration pattern, it is critically important for seiners to successfully predict the daily location of migrating salmon during the relatively short spawning period and even shorter legal fishing season (as few as 18 days) (Gatewood 1984).

The Southeast Alaskan salmon fishery is strictly regulated (limited entry, licensing and gear regulations, short time allotment for legal fishing) and intensely competitive (Gatewood 1984). Most of the fishing vessels (350 - 400) in the Southeast Alaskan salmon seining fleet are company-owned, and these companies heighten competition between captains by offering financial incentives based on salmon-catching success (Gatewood 1984). Competition is still further enhanced by the fact that compensation by fish processing companies is based on individual vessel catches rather than those by the fleet.

Despite these incentives that inhibit cooperation between ship captains, Gatewood (1984) found that small groups of Alaskan commercial seine skippers exhibit cooperative behavior just prior to legal seine periods. During this time, skippers and their crews scout

for signs of concentrated schools of salmon (i.e. the occasional surfacing behavior exhibited by salmon) in nearshore Alaskan waters in order to better predict the location of these fish during the short fishing season. Captains rank scouted areas for potential of catching success based on the number of observed instances of surfacing behavior. Sometimes the captains form small cliques, or subsets of the entire fleet, with other seine captains within which information regarding the location of salmon is shared (Gatewood 1984). Not all captains participate in clique cooperation and no captains cooperatively share information in more than one clique. Cliques range in size from two to five captains and are primarily based on close kinship relations or life-long friendships (Gatewood 1984), of which trust is a critical component. Kinship or friendship constitutes a form of "social collateral" since failure in regards to honesty and secrecy would jeopardize prior social relationships. The validity of informational-contributions are thus based on trust and, due to the small size of cliques, the benefits of cooperation are equally distributed and each clique member is privy to all of the information provided by clique-members. Information regarding the scouted areas is not shared with non-clique members. Due to the synergistic nature of the cooperation (i.e. captains are able to obtain more information than they could acquire while acting independently), fish-catching success is enhanced. The role of information sharing in fisheries thus has important implications in the success of Alaskan commercial fisheries and their management.

Goal and Objectives

Salmonid charter fisheries in the Great Lakes face a number of issues and

uncertainties akin to those faced by the Alaskan salmon seiners and Maine lobster fishers. The species that are sought by Great Lakes salmonid charter fishing operators are highly mobile and dispersed within a large water body, making their detection difficult without cooperation. Many Great Lakes ports, such as that of Grand Haven, Lake Michigan, are utilized and frequented by large numbers of competing charter operators, private anglers, and tournament competitors. The goal of this study was thus to thoroughly evaluate the degree and magnitude of fishery-related information sharing occurring within the charter boat fishing fleet in one Lake Michigan port in order to assess the importance of social capital and networks on fishing success in the Great Lakes charter-based salmonid fishery. The objectives of this study were to 1) describe the communication network of the port of Grand Haven salmonid charter fishing fleet using social network analyses, and 2) determine the relationship between the exchange of fishing-related information between charter captains and their catch of trout and salmon species.

Study Area and Participants

The Lake Michigan charter fishing industry primarily came about in response to the introduction of coho (*O. kisutch*) and chinook (*O. tshawtscha*) salmon from the Pacific Northwest. Salmonids from this region, along with the Great Lakes-native lake trout, *Salvelinus namaycush*, were stocked in Lake Michigan beginning in the mid-1960s (Tanner and Tody 2002; Holey et al. 1995). These top predators were stocked to produce a valuable sport fishery and help control the nuisance and non-native alewife (*Alosa pseudoharengus*) population that littered the beaches when abundance exceeded carrying capacity (Madenjian et al. 2002; Tanner and Tody 2002).

Salmonids from the Pacific Northwest are highly migratory during their various life stages in both lentic and lotic environments. After migrating as smolts from natal streams, these salmonids track optimal temperatures and food sources and then later return as adults to the river from which they originated to spawn. The location of salmonids is less predictable in an open-water environment where constantly moving temperature "breaks" (e.g., where warm river water meets cooler lake water) offer the primary form of structure for pelagic adult fishes such as chinook and steelhead, or "lake-run" rainbow, trout (*O. mykiss*). The Lake Michigan salmonid charter fishing fleet is thus generally faced with uncertainty related to finding and catching its target species. It has generally been shown that cooperation between captains targeting pelagic, mobile, or somewhat unpredictable fishes is used to decrease such uncertainties and increase fishing success (e.g., Sampson 1991; Mangel and Clark 1983).

Grand Haven, Michigan is a port located where the Grand River meets southeastern Lake Michigan (Figure 1). This port is home to one of the largest salmon charter fishing fleets on the eastern side of Lake Michigan (www.micharterboats.com), with thirty-five fishing charters operating out of six marinas in 2003. Due to the effect of lake circulation patterns on water temperature (e.g. Wetzel 2001), the geographical location of Grand Haven affords relatively long fishing and thus long sampling seasons (late April through October) when compared to other Lake Michigan ports (John Roberston, personal communication).

The Lake Michigan sport fish primarily targeted by Grand Haven charter

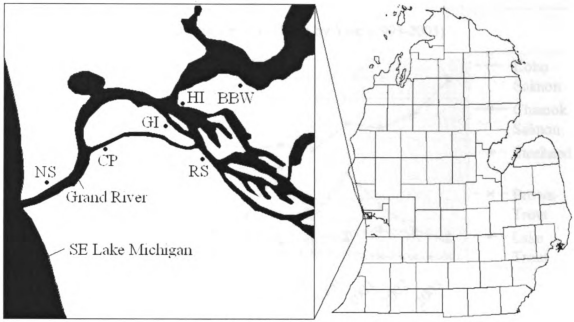


Figure 1. Southwest Michigan's Grand River and its connection to southeastern Lake Michigan. Shown in detail are the relative locations of the six marinas used by participating Grand Haven charter operations for docking. These marinas include Barrett Boat Works (BBW), Holiday Inn (HI), Rycengas (RS), Grand Isle (GI), Chinook Pier (CP), and North Shore (NS).

operations include lake trout, chinook salmon, coho salmon, steelhead trout, and brown trout (*Salmo trutta*). The Michigan charter boat industry provides an important means of public access to the Lake Michigan pelagic fishery and subsequently generates significant economic benefits to the surrounding region. For example, from 1993-2003, Michigan Charter Boat Association (MCBA) fishing charters operating out of Grand Haven provided over 60,000 resident and 12,000 non-resident fishing licenses. These charter operators also largely facilitated the harvest of salmonids, with just fewer than 110,000 coho salmon, chinook salmon, steelhead trout, brown trout and lake trout being taken by charter anglers between 1993 and 2003 (Figure 2) (MDNR [Michigan Department of Natural Resources] catch report database). Chinook salmon were the most frequently caught and lake trout harvest exhibited the most variability over time.

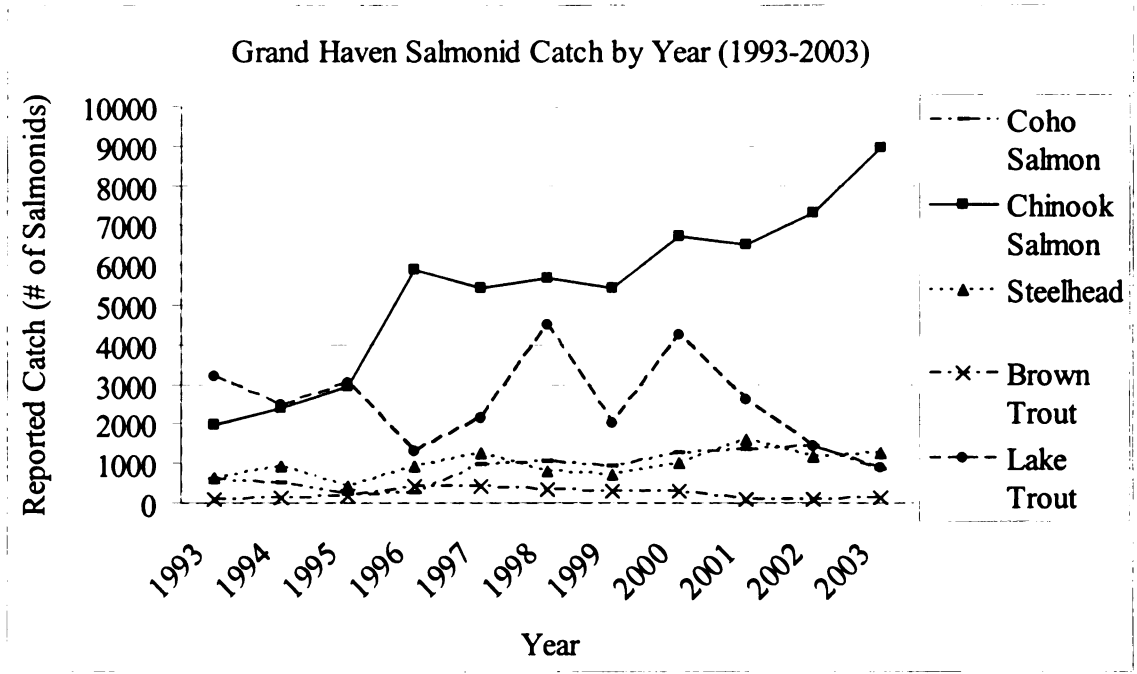


Figure 2. Total annual salmonid catch of the five species (coho salmon, chinook salmon, steelhead trout, brown trout, and lake trout) targeted by all Grand Haven charter fishing operations from 1993-2003.

Non-governmental organizations (NGOs), such as the MCBA, are comprised of stakeholders with a common interest(s). For example, the MCBA is a state-level NGO dedicated to establishing and maintaining a professional charter industry that promotes safe and quality charter excursions for resident and non-resident anglers (www.micharterboats.com). Members of the MCBA and its local chapters meet annually to discuss fishery-related issues, and operators from the same port have the opportunity to interact and/or cooperate during the late spring, summer and fall. The qualities of the MCBA and its local chapters (such as that in Grand Haven) make this stakeholder group an ideal candidate for the evaluation of an information-sharing and social network as it is related to fish-catching success. Thus, individuals targeted for participation in the study were licensed captains that were members of the MCBA and the primary operators (as

some licensed captains acted as first mates) of charter operations in the port of Grand Haven, Michigan.

METHODS

Contacting and Soliciting Participants

The names and contact information of all 2003 Grand Haven charter captains who were also members of the MCBA were obtained from the MCBA webpage (www.micharterboats.com). After the study was approved by Michigan State University's Institutional Review Board, The University Committee on Research Involving Human Subjects in the spring of 2003, these captains were mailed a one-page letter of intent (Appendix A). This letter described the study's goal and objectives and explained the captain's potential role as a participant. Each captain was then contacted personally via telephone in May of 2003 with the intention of formally requesting his or her participation in the study and describing the study goal, objectives, survey length (approximately one-half hour to complete), and on-board observation methodologies. All participating captains willingly signed the UCRIHS-approved consent form (Appendix B) prior to their participation in the study. Following analysis of survey responses and observational data, participants were mailed a summary of the study results (Appendix C).

Survey Instrument

The survey was personally provided to Grand Haven captains during the 2003 fishing season (May-September). Captains were asked to return the survey in person or via mail. To describe the communication network of the Grand Haven charter fishing fleet and then relate the fishing-related transfer of information to fish-catching success of

its captains, it was necessary to develop a survey instrument that would describe 1) fleet and captain attributes, 2) relative fish-catching success of Grand Haven charter captains, and 3) exchange of fishing-related information between captains. In order to develop this survey, a review of related literature (e.g. Hilborn and Ledbetter 1985) and discussions with representatives of the charter industry were initiated to evaluate the social and biological dynamics related to the Great Lakes salmonid charter fishery. From these information sources, a list of survey variables was constructed (Table 1) which was used in the development of the survey instrument (Appendix D).

Survey Variables	**Survey Question #**
Vessel size	4
Age of captain	8
Years of experience	9, 10
Occupational	11, 12,13
Fishing Motivation	14
Kin/industry ties	15,16
Education	17
Competitiveness	18,19
Level of involvement	22, 23
Knowledge seeking	20, 21, 27, 33
Innovativeness	24, 25, 26, 28, 30
Feelings towards management	40, 41, 43
% return customers	44
Communication	
Modes	29, 29b
Perceived value	31, 32
Quality	35, 37, 38, 39, 42
Frequency	32, 33, 45
Fish catching success	34

Table 1. The survey variables as they are imbedded within the survey instrument used to assess fleet and captain attributes, communication, and catch.

Survey Design

The survey was designed to first elucidate responses dealing with fleet (i.e. vessel length and docking location) and captain attributes and then to ascertain how these

captains communicated with other Grand Haven captains and assess their the relative success at catching salmonids. Redundancy of certain variables throughout the survey occurred in order to best capture the effect of complex variables (Fowler 1998).

The survey instrument asked captains to provide their age and the highest level of education they had completed. Captains were also asked to describe any additional occupations they currently held and income received in addition to charter fishing to determine if full time/part time status had any effect on the amount of fishing-related information shared between captains. They were also asked to describe their motivation (e.g., social) for charter fishing and their level of competitiveness (defined as participation in tournaments).

Acheson (1988) found that lobster fishers that possessed kin ties with other fishers had more access to fishing-related help. Thus, Grand Haven captains were asked to describe their kin ties within the charter fleet. A point system was created to rank the weight of influence that kin ties had on access to fishing-related information. Each captain received a kin tie value of 2.0 for each mate to whom they were related and a kin tie value of 3.0 for each captain with whom they had familial relations. Relations with other captains were given a higher value since it was assumed that captains were more invested and permanent within the industry than mates and could thus provide a higher quality and quantity of fishing-related information that could potentially influence the catch. For example, a captain who had a spouse as a mate and a brother as a captain would receive a kin tie value of 5.0, whereas a captain with kin ties with two other captains would receive a value of 6.0.

The survey also assessed captain's interest in being actively involved in shaping

the fishery. Research (e.g., Gigliotti and Peyton 1993) has correlated membership in special interest organizations with an individual's desire to be politically influential. As such, captains were asked to describe their membership and involvement in NGOs. Additionally, captains were asked whether they kept a personal fishing log (in which information in excess to that required by the MDNR was recorded). This was a measure of each captain's desire to actively acquire information which would improve their success. Additionally, attendance of trade fishing shows (where fishing products are displayed and sold) was attributed to information-seeking affinity.

Innovation is described as an important aspect of the "skipper effect." The skipper effect is a captain's ability to influence his or her own fishing success and can be used to illustrate a one's propensity to take risks and try new techniques (Durrenberger and Palsson 1986). In this study, measures of innovativeness included use of Nextel phones, utilizing the internet, and having business-related websites.

Captains were also asked to describe their opinions regarding management, i.e. perceived quality of communication with fisheries managers and effectiveness of different branches of governing bodies (i.e. local, state or federal).

Since I intended to evaluate the relationship between individual attributes, communication networks, and catch, captains were also asked to provide their average catch per trip for each month (May-August) for 2002 and 2003 and describe the mode (e.g., cell phone or radio), frequency, perceived value, and quality of communication with other identified Grand Haven captains. As another measure of success as a charter fishing operation, participating captains were asked to estimate the percentage of their customers that returned from year to year (% return customers). It was thought that fish-

finding ability and the quality of experience provided by the charter captains and mate would influence the amount of customers that returned and chartered the operations multiple times.

Comparing Survey-reported Catch to MDNR Catch Records

Following administration of the survey instrument, I personally contacted MDNR biologists and staff at the Charlevoix Fisheries Research Station in Michigan in regards to accessing the 2003 salmonid charter fishing catch report database. The data provided by the MDNR was anonymous and included information regarding fleet catch per trip/day/month. Using this data, I calculated the fleet's average daily catch per month. These values were then compared to the average monthly catch per day as reported by participating captains in the survey. This comparison allowed the classification of captains as catching above or below the fleet average (above-average was defined as being at greater than one-tenth above the fleet average).

Identifying Survey-reported Subgroups

Based on how frequently surveyed captains reported exchanging fishing-related information with other members of the Grand Haven fleet, Frank's "KliqueFinder" algorithm (Frank 1995) was used to analyze and identify information-sharing subgroups within the fleet. KliqueFinder iteratively reassigns actors to subgroups by maximizing a single (or set of) parameter(s) that measure the extent to which interactions (in this study, the frequency of fishing-related informational exchanges) occur within a subgroup. Thus, the process accounts for the unique qualities of the network as defined by the

researcher (Frank 1995).

In this study, KliqueFinder identified cohesive information-sharing subgroups within the Grand Haven charter fishing fleet when ties between captains were relatively more frequent when compared to those within the entire social network. KliqueFinder addressed the validity of the placement of captains within subgroups by maximizing the odds that there was a tie based on fishing-related communication between two captains (as opposed to an absence) that was associated with membership in a common subgroup (e.g. Frank and Yasumoto 1998). Captains who did not exchange fishing-related information or who did so with only one other captain were not assigned to a subgroup. After assigning captains to information-sharing subgroups within the Grand Haven fleet, KliqueFinder produced a graphical representation of fleet in the form of a crystallized sociogram. "Crystallized" refers to the fact that the subgroups are defined by high concentrations of ties and then integrated among the sparse ties.

Sociograms provide a visual representation of the relative frequency or strength of ties within and between individuals holding membership in cohesive subgroups (e.g., Frank and Yasumoto 1998). Frequency or strength of interactions (e.g., exchanging fishing-related information) between actors (e.g., charter captains) is portrayed by the distance between both individuals and subgroups. For example, captains or subgroups of captains that exchange more information would appear in closer proximity while those who communicate less frequently would be farther apart (Figure 3). The more frequently actors interact, the more they have the potential to influence one another (Wasserman and Faust 1994).

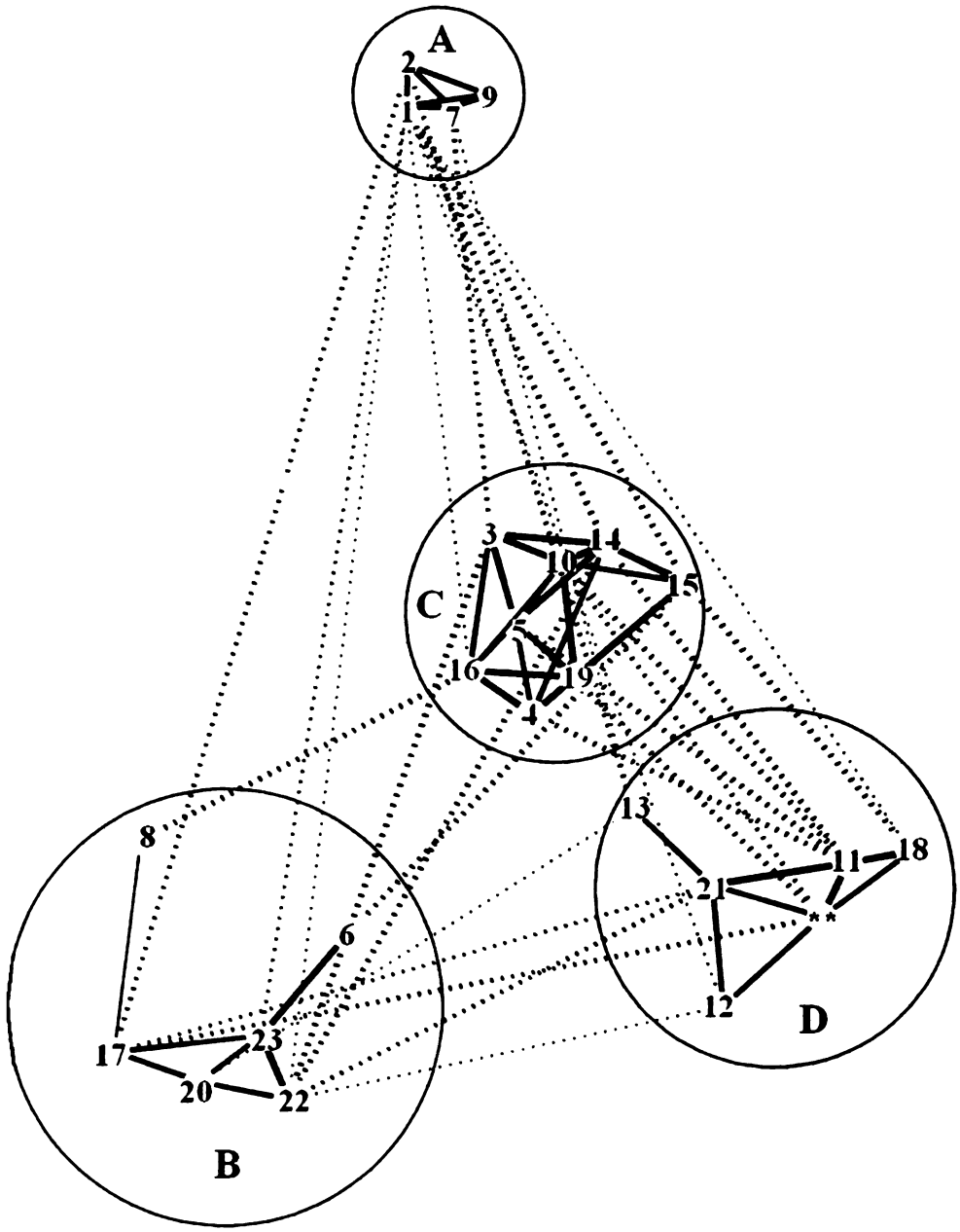


Figure 3. Sociogram adapted from Frank 1998. This sociogram represents the process by which teachers influenced one another through discussions. Those teachers that communicated on a near daily basis are indicated by having thick, solid lines within the boundary of a subgroup. Thinner lines between members of subgroups indicate that discussions occurred less frequently.

Characterizing Survey-reported Subgroups

The fleet and captain attributes, communication, and catch data from the survey were analyzed using descriptive statistics (e.g., the mean, mode and range of captain's ages and experience). The results of these descriptive statistics were then used to characterize each survey-reported information-sharing subgroup identified within the fleet by its member's attributes.

On-board Observations

Catch and fishing-related communication of Grand Haven charter captains was observed and recorded while on-board Grand Haven charter boats. This was done in conjunction with administration of the survey instrument during the 2003 fishing season (May-September). I maximized direct interactions with the charter fishing crews (i.e. through the on-board observations) in order to establish enough rapport to ideally persuade all Grand Haven charter captains to participate in the study, as a census or near-census is preferred for this type of social network analysis (e.g., Frank 1996; Aldeman 2003). For this purpose, I acquired a MCBA mate's card, which allowed me to act as a surplus crewmember. As such, I was able to carry out on-board observations related to fishing-related communication and fish-catching success.

Observed Communication

The communication behavior of Grand Haven captains was observed and recorded in a fishing log (Appendix E) while on-board charter boats and during chartered fishing trips. Data collected regarding on-board fishing-related informational exchanges

included mode of communication (radio, cell phone, Nextel phone, and walkie-talkie), communicators (identity as later coded as a randomized number), and exchanged fishing-related information (dialogue). Fishing-related information exchanged between captains included description of lures being used, gear set-up (e.g., spinner on a lead core), depth of set-ups, vessel speed, species caught, and etcetera.

Exchanges consisted of direct fishing-related transfer of information regarding lures, gear set-up, depth, location, temperature, water temperature, and boat speed. Each transfer was uni-(one-way transfer of information), bi-(exchange between two captains) or multidirectional (exchange between three or more captains). For example, one captain might ask another captain or private angler a set of fishing-related questions to which the other captain would respond (unidirectional). This would be considered a single "unit" of information provided to the information-seeker since it was bounded by a beginning and end (the end being when the information-seeking captain had received all of the information he requested). Each captain received one point for each unit of information transferred to others. During any given charter trip, such exchanges occurred multiple times between pairs of captains, resulting in multiple points for each fishing-related information provider. Cumulative points of exchange between captains were used to determine subgroup membership based on frequency of observed fishing-related informational exchanges.

Observed Catch

Number of salmonids caught was also observed for each captain during each chartered fishing trip. The catch from each trip was then compared to the daily fleet

average calculated using the MDNR catch report database. This daily fleet average of catch per trip was computed in a similar manner as the survey-reported daily catch per month averages by dividing the total number of captains fishing on an observation day by the total number of salmonids caught that day (from the MDNR catch report database). This calculation gave the average catch per trip per day for the entire Grand Haven charter fishing fleet. This fleet average was then compared to the observed catch of individual captains on each observation day to determine if the captain caught below or above the average for that day. An observed catch value was determined for each captain by calculating the difference between the average fleet catch and that captain's catch on a given observation day. That captain's best observed catch (in relation to that of the fleet) was used when statistically relating catch to other variables (below). These values thus ranged from negative to positive values (i.e. negative values for catches below the fleet average) and were non-categorical. For example, if a captain was observed on three occasions and caught a number of salmonids below the average number of salmonids caught by the charter fishing fleet each time, his *best* catch in relation to the fleet was used, even if it was a negative value.

Identifying Observed Subgroups

The use of KliqueFinder to identify information-sharing subgroups and depict them in a crystallized sociogram was repeated, this time using the observational data (i.e. the number of fishing-related information units transferred) related to observed fishing-related communication between Grand Haven captains and private fishermen during 2003. This second analysis was done in order to validate the survey responses related to

who communicated with whom and the frequency at which communication occurred.

Relating Catch, Communication, and Attributes

A chi-squared test, in addition to a correlation test, was used in showing how strongly pairs of survey and observed variables were related (Rao 1998; Kitchens 1998). In order to find the direction of the correlation between the survey-reported and observed variables, the SAS correlation procedure was used to compute the correlation coefficient (r) and probability (p) values (Younger 1998). A confidence interval of $\alpha = 0.05$ was used. The data used for this test was all non-categorical data collected either through observations or survey responses, such as experience (number of years), catch (number of salmonids), and the reported exchange of fishing-related information (frequency).

RESULTS

Survey Responses

Twenty-nine of thirty-three (87.9%) primary Grand Haven charter captains completed the survey. Survey results are divided into four categories. These include fleet and captain attributes, fishing-related communication, and reported catch. From this information, the communication network was identified, described and finally related to success at catching salmonids.

Fleet Attributes

Although all study participants operate from the port of Grand Haven, these captains docked at least six marinas within the port, and were thus not all geographically adjacent. Figure 4 shows the percentage of participating charter operations at each docking location within the port of Grand Haven in 2003. The marina at which the majority of participating captains docked was Chinook Pier (48%), followed by Grand Isle Marina (14%). The average length of 2003 charter vessels was 32.5 feet and ranged from 22 to 37 feet.

Captain Attributes

All participating captains were male (100%) and primarily Caucasian (94%). The average age of captains was 53.5 years, and ranged from 33 to 80 years. Participating captains had gained the majority of their charter fishing experience operating as captains

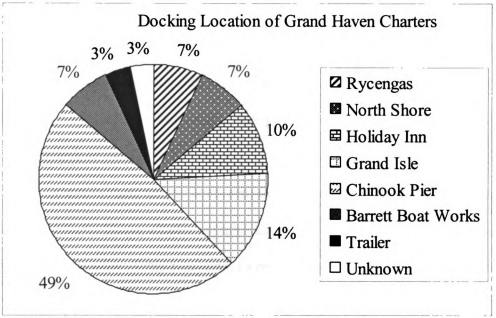


Figure 4. Percentage of participating Grand Haven charter captains docking at each Grand Haven marina or private location in 2003: North Shore Marina, Chinook Pier, Grand Isle Marina, Rycengas Marina, Holiday Inn Marina, Barrett Boat Works, private trailers, and unknown.

in Grand Haven for an average length of 16.4 years (range = 35 years, median and mode = 20 years). The cumulative charter fishing experience (i.e. including locations other than Grand Haven) was only slightly higher (17.9 years, on average). This illustrates the fact that captains had generally been in the same fishery and social system for the majority of their charter fishing careers.

Reported income, in excess of profit derived from chartered fishing trips, came from a wide variety of sources including the automotive industry (e.g., General Motors), sales, law enforcement, social security, pension, retirement, investments, various companies, engineering, taxidermy and mortgage broking. No captain relied solely on income generated by the charter fishery for their livelihood.

Approximately 57% of participating captains characterized their primary

motivation to fish as the personal satisfaction they acquired during charter fishing-related activities, while the motivation of 29% of participants was based primarily on their enjoyment related to being outdoors. The remainder of participants reported being motivated by the social satisfaction they gained during the charter fishing season or by a combination of the above factors.

Kin tie values ranged from zero to seven, with an average of 2.5. Thus, on average, Grand Haven charter captains had familial relations with at least one other Grand Haven mate. Only two captains reported having connections with people holding professional fishery-related positions (e.g., in academia or management).

Approximately 25% of 2003 Grand Haven captains had obtained high school degrees as their highest level of schooling, one-quarter completed four or more years of college education, and the remainder had completed one to three years of college courses.

Grand Haven captains participated in an average of 1.4 tournaments in 2003. Thirteen captains did not participate in any tournaments during 2003, while the highest number of tournaments that any one captain competed in was six. Many captains competed in the same tournaments, especially the Grand Haven and Tri-city tournament, the latter including the Lake Michigan ports of (South Haven, Grand Haven, and Holland).

Grand Haven charter captains belonged to an average of two NGOs, one of which was the MCBA (requirement of being a participant). Participating captains also commonly held membership with one or more of the following NGOs: the Grand Haven chapter of the MCBA (GHCBA), the Michigan United Conservation Clubs (MUCC), the National Association of Charter Boat Operators (NACO), the National Rifle Association

(NRA), the Michigan Steelhead and Salmon Fishermen's Association (MSSFA, known commonly as "Steelheaders"), and the Michigan Anglers Association. Eleven participants reported holding leadership positions (i.e. secretaries, presidents, treasurers, board members, chairs, and advisors) in the MCBA, GHCBA, local pier associations (i.e. Chinook Pier), the NRA, Steelheaders, LMTF, NACO, MDNR Lake Michigan Advisory Council and the Great Lakes Fishery Commission (GLFC).

As related to knowledge-seeking activities, eleven participants kept detailed logs related to fishing equipment success and lake/weather conditions (in excess of that required by the MDNR). Twenty-one participants reported attending trade-fishing shows, primarily to examine new products and talk with other charter boat operators about the value of these new products. Captains also reported attending trade-fishing shows to see what other charter operators and anglers were buying. The diversity of fishing-related information sources sought by Grand Haven charter fishing captains included membership meetings and magazines, other fishermen, agency personnel, web-pages, agency meetings, etc., and these sources are detailed in Table 2.

Just over two-thirds of participants exhibited innovativeness by owning a Nextel phone. On average, captains have owned a Nextel for three years, with ownership ranging from 2 to 8.5 years. Forty-five percent of 2003 Grand Haven charter captains had a website advertising their charter fishing business. Approximately 80% of participants reportedly utilize the Internet (email, searching for fishing-related information) and 46% expressed willingness to enter their MDNR-required catch reports online.

Based on survey responses, only ten (34%) participating charter captains felt

Source of Information	Number of Captains Utilizing Source	Priority of Use on avg. (1 as highest priority)	Detail
Membership Meetings	15	2.5	MCBA GHCBA MSSFA
Membership Magazines	19	1.8	MCBA GHCBA MUCC Great Lakes Angler Great Lakes Fisherman MSSFA Michigan Out of Doors Saltwater Sportsman Rod Maker Magazine
Word-of-mouth (Grand Haven)	23	1.9	Charter captains Private anglers
Word-of-mouth (elsewhere)	13	2.3	Charter captains Private anglers
Agency Personnel	9	4.0	MDNR Sea Grant
Web-pages	6	4.1	MDNR weather.com Lake MI webcam MSU Coastwatch Not-specified
Agency Meetings	7	5.5	Sea Grant
Other Sources	3	1	Trial and error MSU Sea Grant Newspaper articles Michigan Out of Doors Practical Sportsman

Table 2. Sources utilized by participating Grand Haven charter captains to obtain fishing-related information.

confident that fishery management agencies such as the MDNR effectively communicated with natural resource stakeholders. Expectedly, the majority of Grand Haven captains also felt that they preferred local to distant (e.g. federal) management of their target resource.

On average, 62.9% of Grand Haven charter captain's customers were returns, i.e. they returned multiple times in a given season or year to year. However, given that some captains were in their first year of operation, percent return customers within the charter fishing fleet ranged from zero to one-hundred.

Survey-Reported Communication

On a scale of 1-10, with 10 being the highest ranking, participating captains felt that the importance of exchanging fishing-related information with other fishermen on their success ranked, on average, a 6.7, with a median and mode of 7 and 8, respectively. On average, participating captains identified 4.6 captains with whom they reported exchanging fishing-related information. Four captains reported not exchanging information with anyone, whilst one captain identified 15 captains that he communicated with (median and mode = 4, range = 15). Captain responses were compared to see if the captains identified by participants as being someone they communicate with listed them in turn. On average, captains held only 2.3 ties in common with those they identified communicating with (verses the 4.6 identified), illustrating that not all captains identified by other participating captains identified those captains as someone they communicated with (median = 2, mode = 1, range = 0 to 7).

Survey-reported Catch

In response to the survey question soliciting the average monthly catch per trip, approximately half (48%) of participants were willing or able to provide the requested information. Reported monthly catch per trip was compared with the monthly fleet

average per trip as documented in the MDNR catch report database (*Figure 5*). Nine captains (ID numbers 149, 360, 591, 692, 754, 225, 820, 847, and 975) reported catching, on average, more salmonids per trip in 2003 than the Grand Haven fleet average catch. The catches of these captains are illustrated in Table 3.

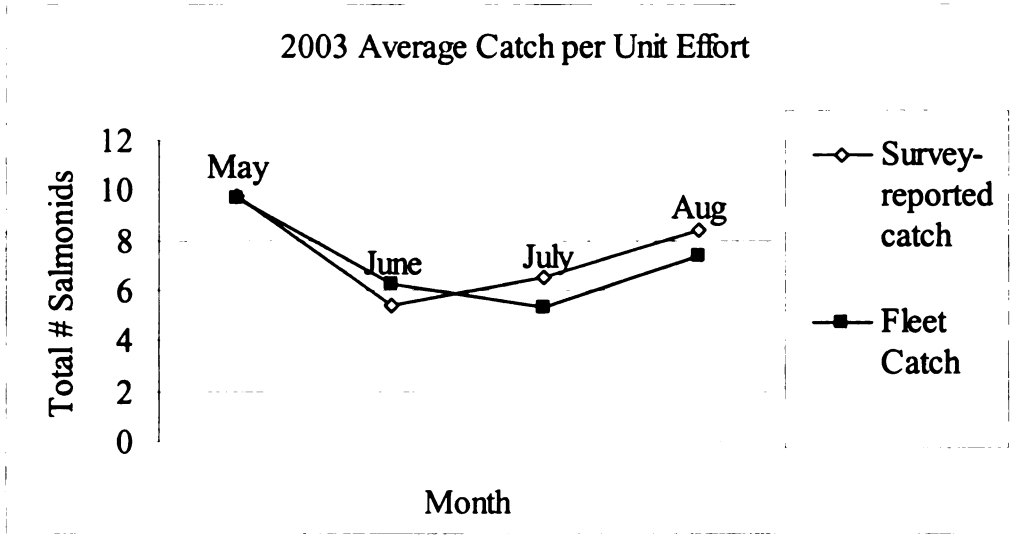


Figure 5. The average daily catch per month (# salmonids) by captains operating out of the port of Grand Haven in 2003. This graph compares the fleet average monthly catch per trip as calculated using the Michigan Department of Natural Resources catch report database and the average monthly catch per trip as reported by participating Grand Haven captains.

		May	June	July	August	2003 Total
Captain ID	*Fleet Average*	*9.7*	*6.3*	*5.3*	*7.4*	*7.2*
149		13.0	6.5	10.0	11.0	10.1
360		14.0	10.0	5.0	7.0	9.0
591		8.0	7.0	8.0	11.0	8.5
692		15.0	4.0	5.0	10.0	8.5
754		10.0	8.0	10.0	12.0	10.0
225		13.3	4.1	5.3	8.9	7.9
820		11.2	6.0	6.8	N/A	8.0
847		9.6	9.6	4.5	N/A	7.9
975		16.0	9.0	5.0	N/A	10.0

Table 3. The reported average monthly catch (# of salmonids) per trip in 2003 of each participating Grand Haven charter captain exceeding the fleet average monthly catch per trip as described in the Michigan Department of Natural Resource's catch report database.

Subgroups Identified Using Survey Data

Using the KliqueFinder algorithm, two non-overlapping cohesive subgroups were identified from the data regarding the frequency at which captains reported exchanging fishing-related information with others in the fleet (Figure 6). With the exception of the random number representing Grand Haven private fishermen in general, each number in the sociogram indicates a Grand Haven charter captain; lines indicate the frequency of fishing-related communication between captains. Seventeen charter captains communicated frequently enough with each other to form a non-overlapping cohesive subgroup (A), while eleven charter captains and the private boat category (one identification number) formed subgroup B. Six Grand Haven charter captains were not assigned to a subgroup based on lack of reported exchanges of fishing-related information with other Grand Haven captains.

Characterization of Survey-based Subgroups

The attributes of subgroup and non-subgroup members are summarized in Table 4. In general, each subgroup was comprised of captains from four or more marinas. However there was a dominant presence (>40%) of captains from one marina in each subgroup. For instance, charter captains operate out of six marinas in subgroup B. Over 42% of these captains are docked in one marina (Figure 7). Furthermore, captains from the same marina tended to communicate more frequently with each other than with captains from other marinas within this subgroup.

When compared to subgroup B, individuals in subgroup A have, on average, less years experience as charter captains in Grand Haven or elsewhere. Subgroup B is also

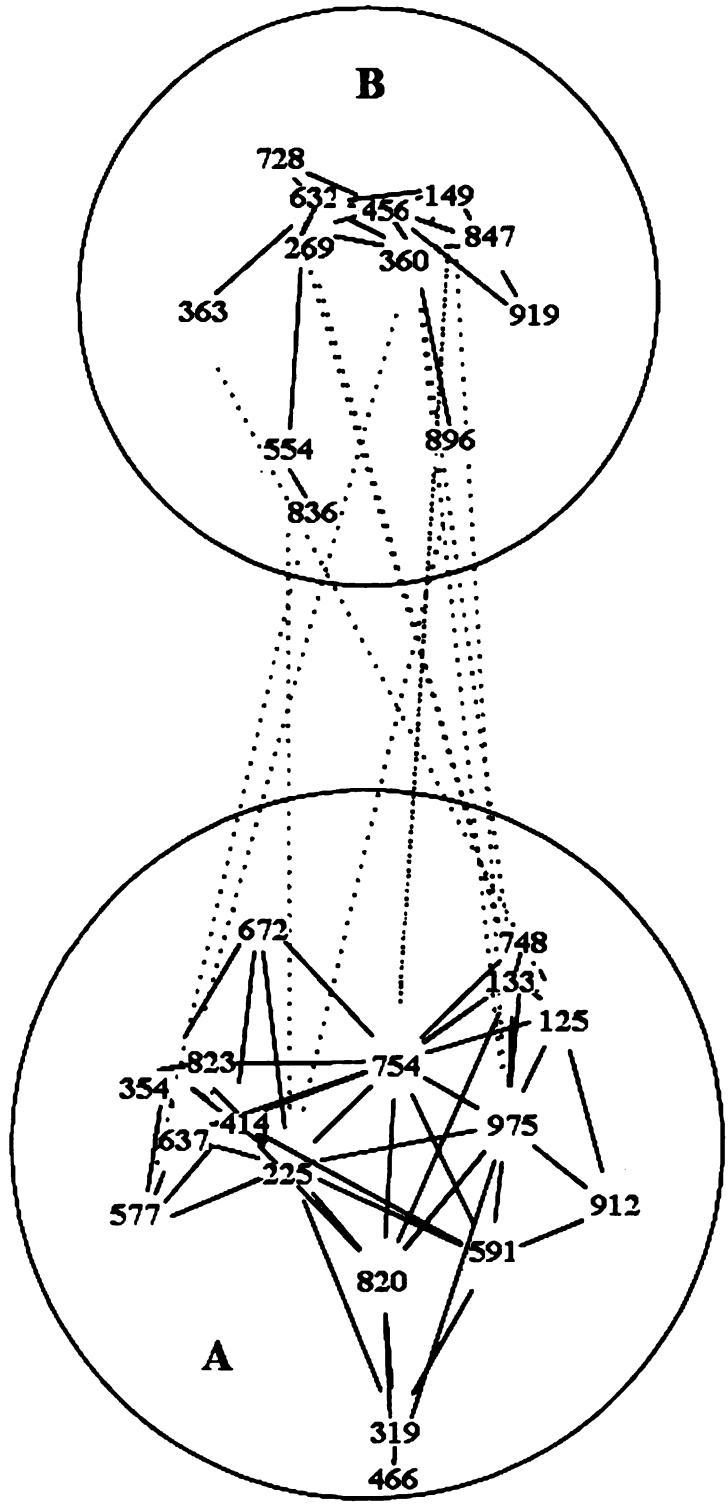


Figure 6. A sociogram depicting the non-overlapping information-sharing subgroups of the 2003 Grand Haven charter fishing fleet as derived from survey responses regarding the frequency at which participating Grand Haven captains communicated with identified captains.

Fleet and Captain Attributes	Subgroup A	Subgroup B	Subgroup non-members
n (# of participating captains)	15	10	4
Docking location (highest % of captains in same marina)	64	44.4 (n-1)	50
Vessel size (avg. length in ft.)	33.1	32.6	29
Age (avg. years)	46.4 (n-1)	62.8	56.5 (n-2)
Experience as Grand Haven captain (avg. years)	14.9	21.2	10.0
Kin ties (avg. value: mates=2, captains=3)	2.3	3.0	1.5
Education (avg: 1=HS, 2=some college, 3=college graduate)	2.2	1.9 (n-2)	2.0
Competition (% that compete in tournaments) (avg. # tournaments for % that compete)	 80 2.9	 22 1 (n-1)	 25 1
Industry involvement (% captains with leadership positions)	27	60	25
Information seeking (% of captains that keep a fishing log)	47	33	25
Innovativeness (% captains that own a Nextel phone)	80	63 (n-2)	25
Communication (frequency) (% captains that communicate more than 10 times/day with other captain)	73	50	0
% return customers	62.9 (n-1)	52	74.5
Communication (perceived importance on fish catching success) (1-10, 10 as most important)	7.2	7.4 (n-1)	3.0
Observed catch (% captains with above avg. catch)	27 (n-2)	33 (n-1)	0 (n-1)
Communication (avg. # captain reported sharing information with)	5.6 (n-1)	5.1 (n-2)	0
(avg. # that reported sharing information w/ captain)	5.0	3.8 (n-1)	0.5
(avg. # of shared ties based on exchange of fishing-related info)	2.5	3.1	0

Table 4. A summary of survey responses by participating Grand Haven charter captains who were members and non-members of information-sharing subgroups in 2003.

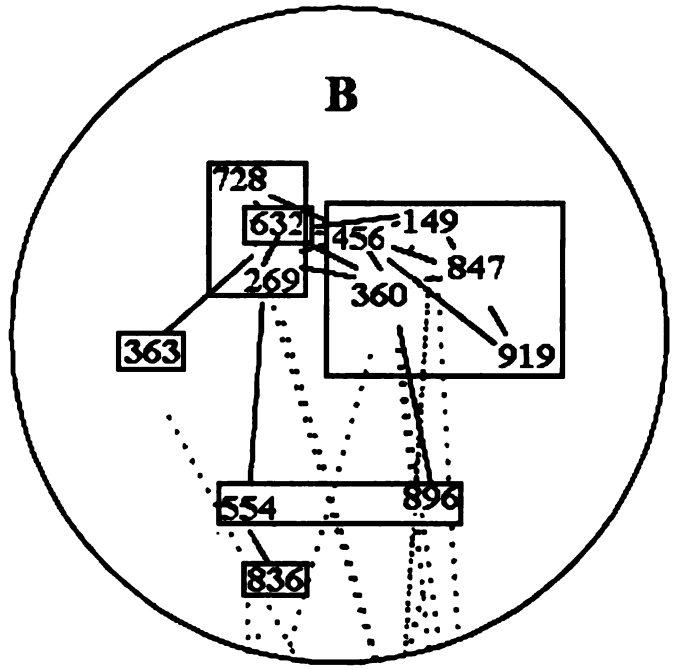


Figure 7. A sociogram depicting the docking locations of Grand Haven captains identified through survey responses regarding the frequency at which participating Grand Haven captains communicated with identified captains as being members of subgroup B. Each of the six marinas represented by captains in subgroup B is boxed.

generally comprised of older captains. Although 57% of participating captains identified the factor that most motivated them to fish as the personal satisfaction they obtained from being a charter captain, more charter captains in subgroup A were more motivated by the social interactions provided by fishing than those in subgroup B, who were generally more motivated by spending time on the water (i.e. outdoor enjoyment).

No patterns between kin ties and the structure of the social network of the Grand Haven fishing fleet were evident. Although many participating captains were in some way related to their mates (e.g., grandchildren, children, parents, spouses), only two pairs of captains that were members of the same information-sharing subgroup were related. Thus, family ties in the Grand Haven charter fishing fleet did not exhibit as significant an effect on subgroup membership or fish-catching success as seen in other fisheries.

Members of subgroup A, on average, had more years of formal schooling than captains in subgroup B. The most frequently held level of education of captains in subgroup A was 1-3 years of college, followed by four or more years of college (one third). Half of the captains in subgroup B had received a high school diploma as the highest level of schooling completed, over a third completed four or more years of college, and approximately 12% completed 1-3 years of college.

Participation in tournaments, as a measure of competitiveness, was highly varied between the two subgroups, with members of subgroup A exhibiting the most competitive behavior. Only 22% of captains in subgroup B reported competing in tournaments in 2003, while 80% of the charter captains in subgroup A participated in at least one tournament a year, with those captains competing in an average of 2.9 tournaments.

Members of subgroup B were generally more involved in leadership roles within fishery-related organizations. Sixty percent of the individuals in subgroup B have held positions of leadership in various organizations or agencies, whereas only one quarter of respondents in subgroup A held such positions.

Nearly half of the captains in subgroup A collected data in excess of that required by the MDNR in a fishing log while only a third of captains in subgroup B collected such information. Additionally, captains in subgroup A were found to be more innovative than those in subgroup B. For example, captains in subgroup A had, on average, owned a Nextel phone for over 3.5 years, while captains in subgroup B owned a Nextel for just over 2.5 years. No difference was noted in the availability of a business website between subgroups. However, all captains that were not members of a subgroup did not have a

website, and all but one non-member owned a Nextel phone.

On average, captains in subgroup A had more customer returns than those captains in subgroup B (62.9% vs. 52%). The percent of customers returning to those captains not in a subgroup exceeded that of both subgroup B and A members at 74.5%.

Captains that reported having above-average catches of salmonids tended to hold relatively "central" positions within the Grand Haven social network, i.e. they identified and were identified more often as someone with whom fishing-related information was exchanged than those captains with below-average catch (Figure 8).

Communication within and between Survey-based Subgroups

Charter captains in subgroup A tended to communicate more frequently with each other than captains in subgroup B; only 50% of those in group B reported exchanging information (any mode) with other captains more than ten times a day, while 75% of those in subgroup A report this level of exchange per day. No captains who were not part of a subgroup reported exchanging fishing-related information more than ten times a day.

In general, those who reported exchanging fishing-related information more than ten times a day also felt that communication significantly improved their fish-catching success. On a scale of 1 to 10, with 10 being the highest ranking of perceived importance, Grand Haven charter captains from both subgroups ranked the importance of fishing-related communication on the success of their charter business as being slightly over seven (subgroup A=7.2, subgroup B=7.4). Captains who were not included in an information-sharing subgroup ranked the importance of fishing-related communication on the success of their charter operation an average of only 2.3.

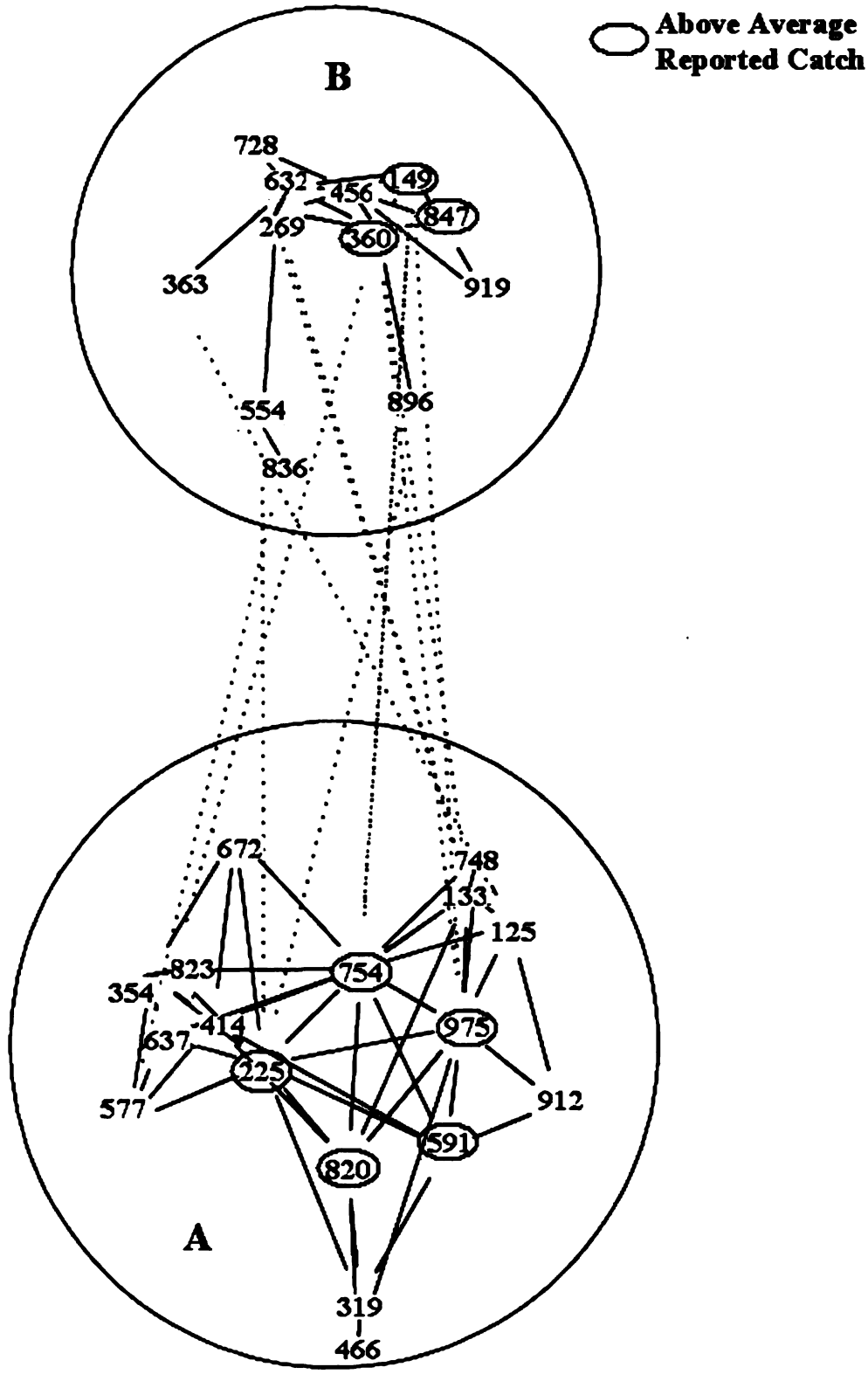


Figure 8. A sociogram depicting (through circles) the identification numbers of participating Grand Haven captains that reported having an average monthly catch per trip in 2003 determined to be above the fleet average monthly catch per trip.

Subgroup A has the greatest proportion (60%) of captains that reported or were reported as giving sometimes less than reliable information. These included 692, 754, 748, 975, 912, 125, 133, 820, and 591. In subgroup B, only two captains (847, 149) and private anglers in general (363) reportedly gave slightly unreliable information (30%). Interestingly, all respondents strongly agreed that they considered any exchanges of fishing-related information with those not in their subgroup reliable.

On-board Observations

Observed Catch and Communication

Communication between captains and catches of salmonids were observed and recorded during forty-one charter-fishing trips from May 18, 2003 through September 6, 2003. Throughout the entire fishing season, and while I was on *their* boat during a chartered fishing trip, captains being observed received a total of 138 units of fishing-related information. In turn, these captains gave 132 units of information to other vessels while I was on their boat. I also observed the catching of 280 salmonids during this time.

Subgroups Identified Using Observational Data

KliqueFinder depicted the existence of four subgroups from the on-board observational data as opposed to the two, as identified when using communication data from the survey (Figure 9). During on-board observations, three charter captains who were described with the survey data as *not* participating in the exchange of fishing-related information with others *were* indeed observed to communicate with more than one person

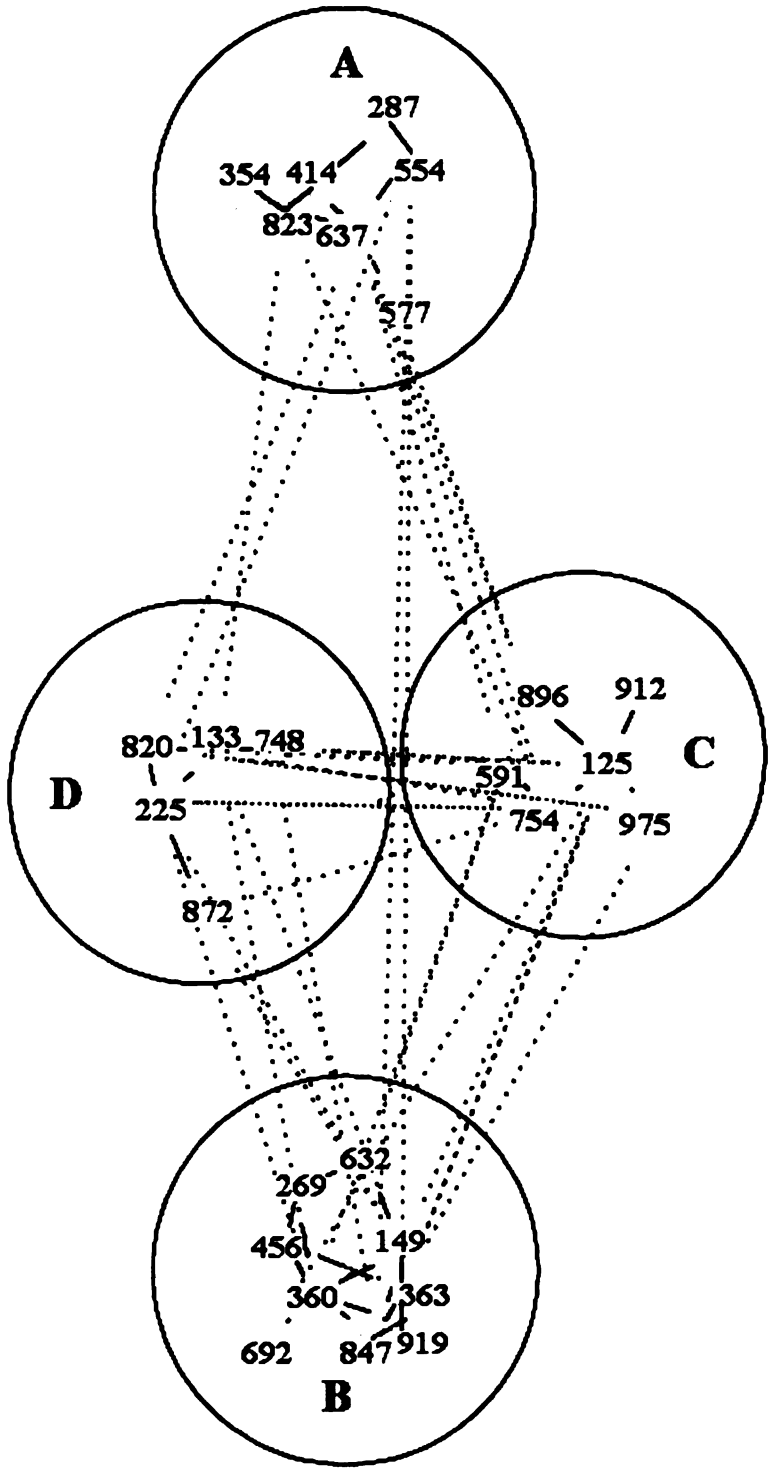


Figure 9. A sociogram depicting the non-overlapping information-sharing subgroups of the Grand Haven charter fishing fleet as derived from on-board observations of fishing-related informational exchanges.

and were therefore included in the sociogram based on observed fishing-related communication. Additionally, it was noted that four charter captains included in one of the two subgroups based on survey-reported frequency of fishing-related communication were *not* actually observed to communicate with one or more captain or private vessel and were hence excluded in the depiction of the network based on observed ties.

Although there were four subgroups based on observed ties rather than the two as reported by survey responses, there were similarities between the two KliqueFinder sociogram outputs. For instance, all but two of the captains that comprised the subgroup B based on survey-reported ties were also in the same subgroup that was based on on-board observations (subgroups B, observed). Survey-reported subgroup A captains that were observed to be in different subgroups (A, C, and D, observed) still maintained communication with the same captains that they had reported communicating with in the survey—the observed frequency was just less and likely a product of observation hours.

Due to the close proximity of subgroups C and D in the sociogram derived from observations, it was evident that these two subgroups exchanged relatively more fishing-related information with each other than the other two subgroups (A and B). This indeed reflects the fact that these captains from observed subgroups C and D reported communicating frequently enough with each other that they were initially included in the same subgroup (A) based on survey responses related to fishing-related informational exchanges. Subgroups A and B exchanged relatively less information with each other than with subgroups C or D, which was also reflected in the survey data.

Six Grand Haven captains (360, 847, 754, 225, 896 and 975) were observed to be more successful in locating and catching salmonids than other captains during the

summer of 2003 (Figure 10). These captains caught above the fleet average on days when they were observed. Figure 11 contrasts the observed catch against the average fleet catch.

Relationships between Catch, Communication and Attributes

A chi-squared test determined that geographic (docking) location of charter operations was significantly related to captain membership in subgroups. However, geographic location was not the only determinant that participants use when choosing with whom to exchange fishing-related information. Communication occurred between those captains that had a history of mutual support, who acknowledged support when it was given, who acted in the best interest of others, and who were likely to reciprocate.

The SAS correlation determined that the following variables were significant at $\alpha = 0.05$. Observed catch was significantly and positively correlated with the number of NGOs in which a captain was a member ($p = 0.0337$; $r = 0.44422$) and number of reciprocal ties held by captains ($p = 0.0144$; $r = 0.52540$). Vessel length was significantly and positively correlated with experience in Grand Haven ($p = 0.0002$; $r = 0.63711$) and elsewhere ($p = 0.0007$; $r = 0.59303$), in addition to the number of kin ties held ($p = 0.0188$; $r = 0.43357$). Age was significantly and positively correlated with experience in Grand Haven ($p = 0.0058$; $r = 0.52596$) and elsewhere ($p = 0.0026$; $r = 0.56637$), but negatively correlated with education ($p = 0.0438$; $r = -0.41495$) and competitiveness ($p = 0.0348$; $r = -0.42377$). Experience in Grand Haven was significantly and positively correlated (as was experience elsewhere) with kin ties ($p = 0.0102$; $r = 0.46951$) and the amount of times a captain was listed by other captains as

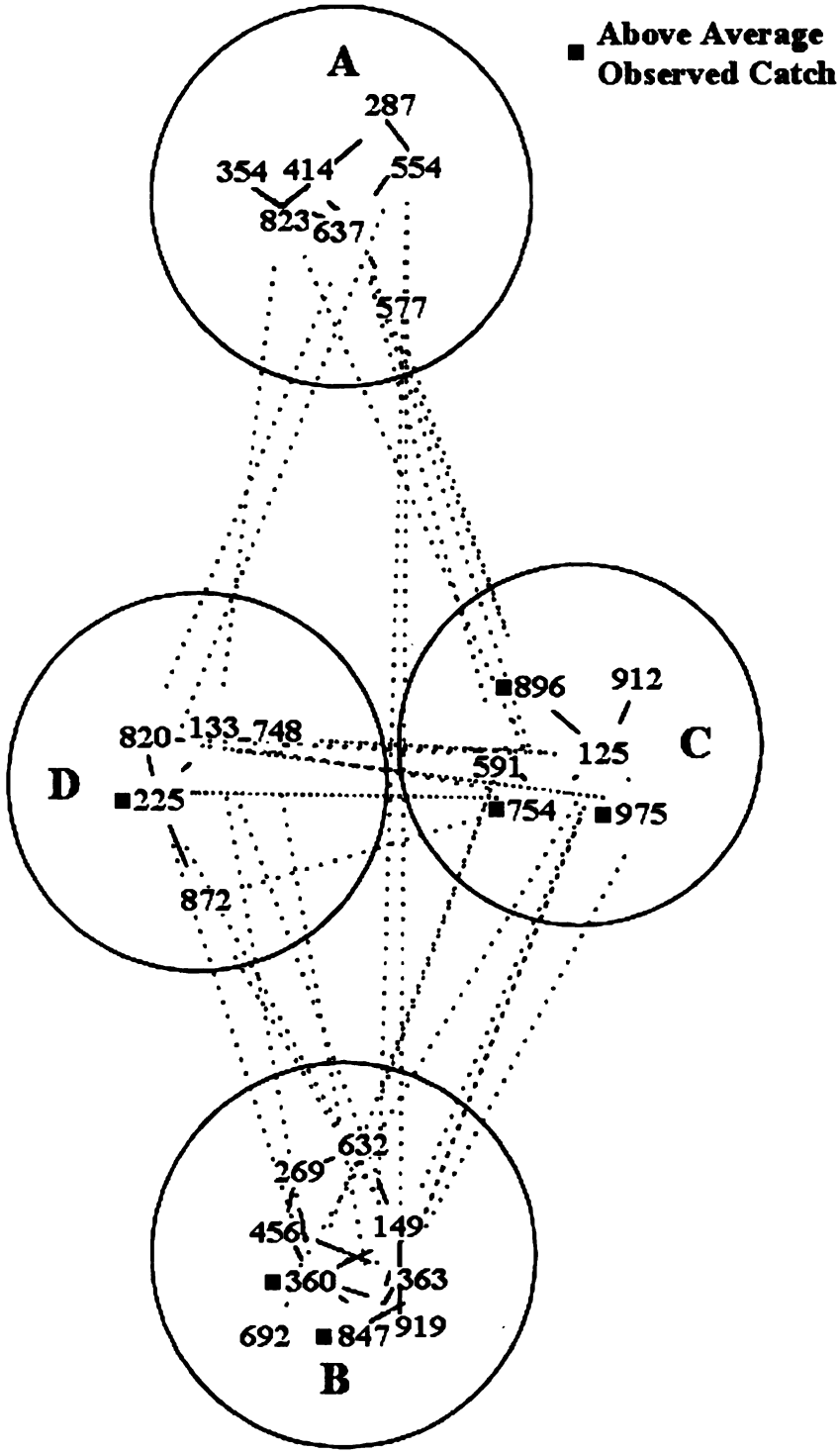


Figure 10: A sociogram depicting (through adjacent black squares) the identification numbers of participating Grand Haven captains that were observed in 2003 to catch above the fleet average during an observation day as determined through use of the Michigan Department of Natural Resources catch report database.

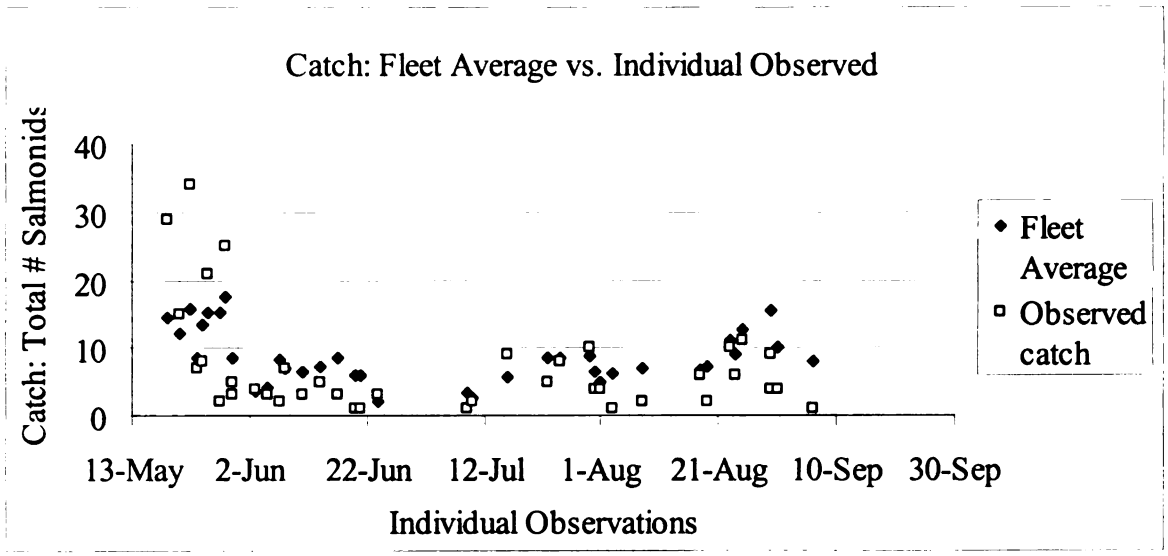


Figure 11. The observed number of salmonids caught per trip by Grand Haven participating charter captains in 2003 contrasted against that's day's fleet average as determined through use of the Michigan Department of Natural Resources catch report database.

someone they communicated with ($p = 0.0214$; $r = 0.43275$). Competitiveness was significantly and positively correlated with the amount of times a captain was listed by other captains as someone they communicated with ($p = 0.0450$; $r = 0.38882$). Membership in NGOs was significantly and positively correlated with the amount of times a captain was listed by other captains as someone they communicated with ($p = 0.0073$; $r = 0.50412$) and also with reciprocal ties ($p = 0.0200$; $r = 0.46239$). Innovativeness (years of Nextel ownership), the number of ties identified by captains, and % return customers were not significantly correlated to any variables.

Comparison of Observed and Reported Catch and Communication

On-board observations verified that five of ten captains that reported catching above the fleet average did indeed catch, on average, more salmonids than others within the Grand Haven fleet (Figure 12). Captains with both above-average observed and

reported catch generally reported having more ties than other participating captains with below-average catch (Figure 13). Additionally, captains with both observed and reported above-average catch were in the top ten as being listed most frequently by other captains as someone they communicated with about fishing-related information (Figure 14). The same was true for reciprocated ties, i.e. seven above-average captain (observed or reported) were in the top ten as having listed a captain that also listed them (Figure 15). Five captains with above-average observed and reported catch were within the top ten as listing the most ties with other Grand Haven captain.

Summary of Results

This study identified a distinct network through which fishing-related information flowed between members of the Grand Haven charter fishing fleet during 2003. Subgroups of concentrated ties based on fishing-related informational exchanges within the fleet had unique captain attributes, such as level of experience, competitiveness, involvement as leaders, and perceptions regarding fishery management. Captains with above-average fish-catching success generally had more access to information (i.e. more ties) and held a relatively central position within the communication network. Captains were generally able to depict their position within this communication network and recall ties with other captains, especially if the other captains exhibited similar or higher fish-finding and -catching ability.

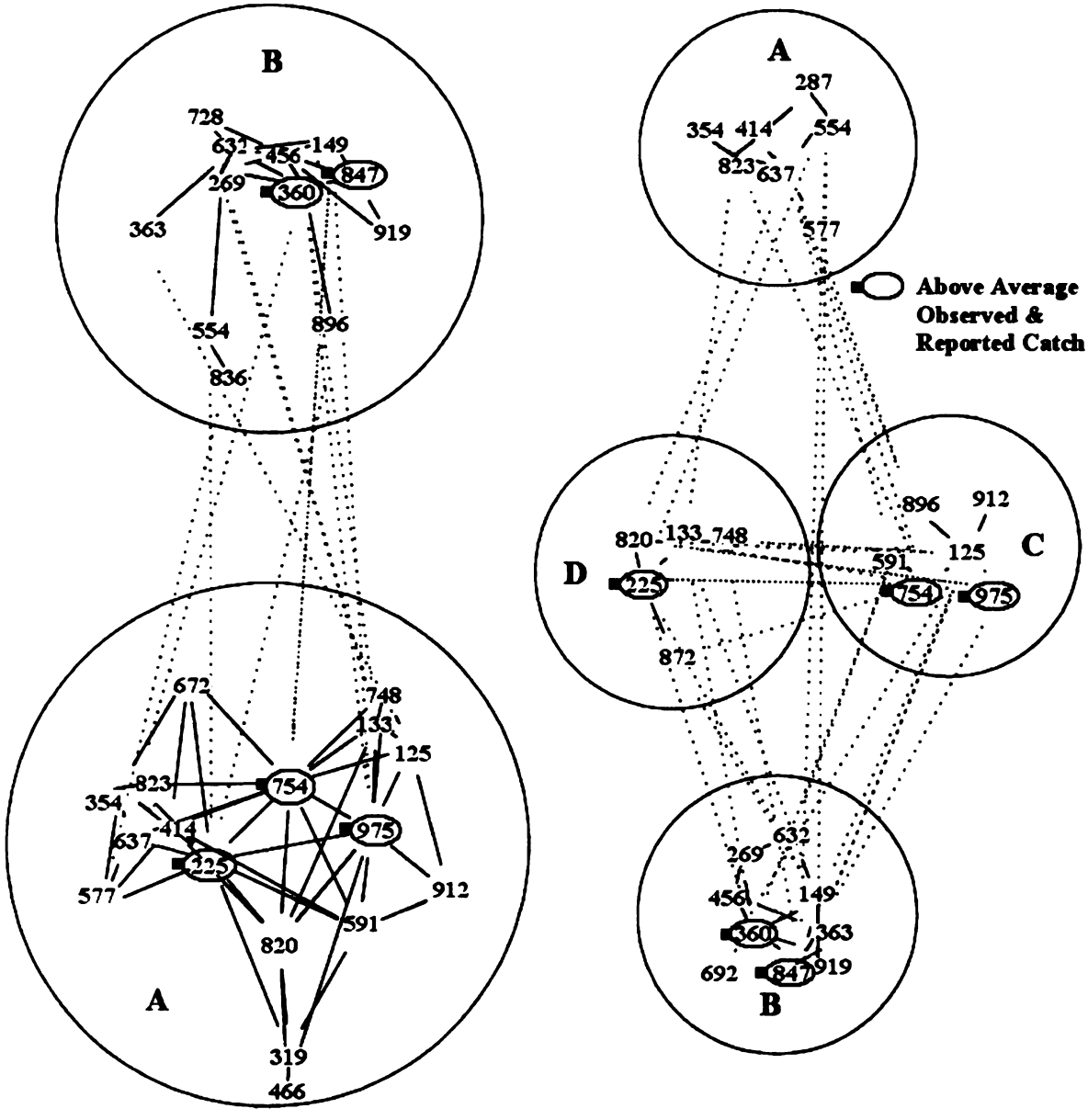


Figure 12. The sociograms derived from observed and reported communication data depicting captains with both above-average observed and reported catches of salmonids during 2003.

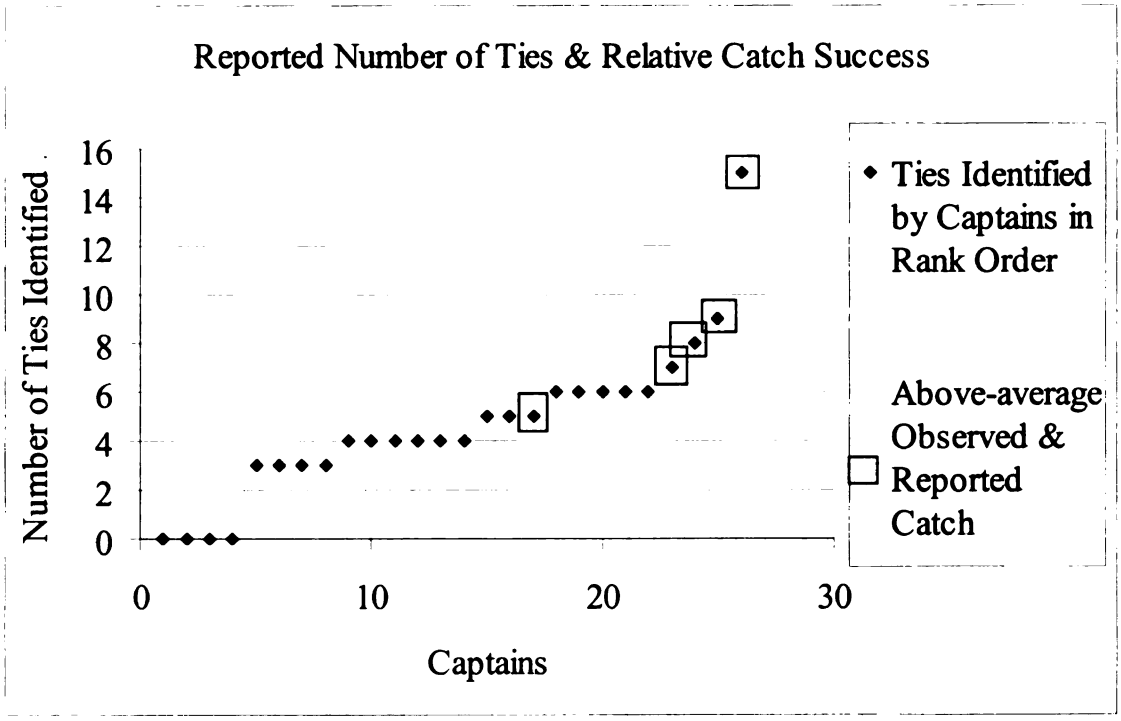


Figure 13. Graph depicting the tendency for participating Grand Haven captains having observed and reported catches above the fleet average in 2003 to target relatively more individuals to give and receive fishing-related information.

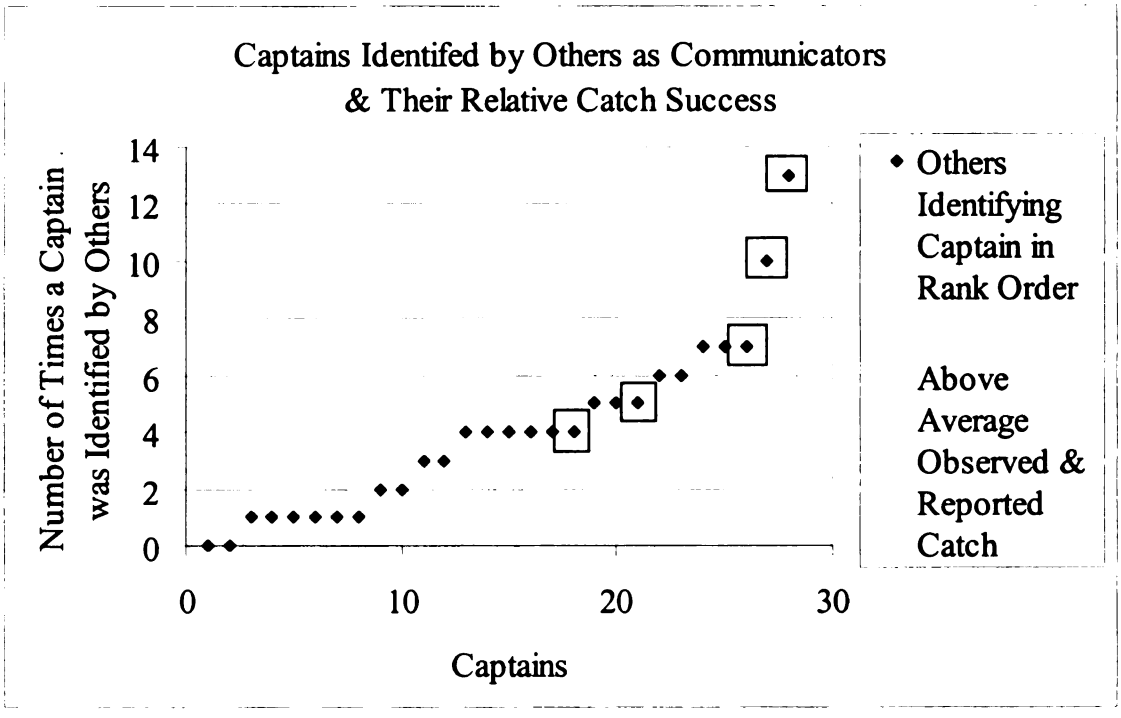


Figure 14. Graph depicting the tendency for participating Grand Haven captains having catches above the fleet average in 2003 to be the target of fishing-related informational exchanges.

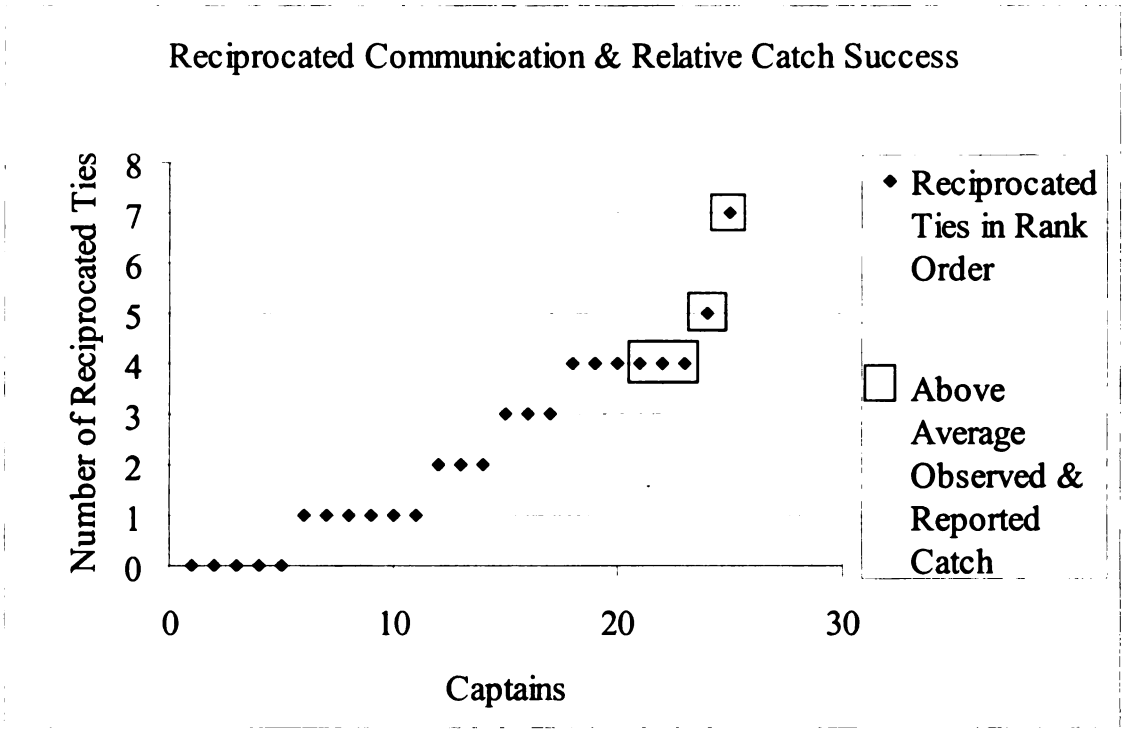


Figure 15. A graph depicting the tendency of participating Grand Haven charter captains having catches above the fleet average in 2003 to also have high numbers of other participating captains reciprocate in listing them as someone they exchange fishing-related information with.

DISCUSSION

Summary of Discussion Topics

Grand Haven charter captains belong to information-sharing subgroups which appear to be related to fish-catching success. The formation of subgroups within fisheries is not unique to Grand Haven as Acheson (1988) and Gatewood (1984, 1987) reported similar phenomena for Maine lobster fishermen and Alaskan salmon seiners. In all cases, these subgroups formed in response to fishery-related uncertainty. The formation of subgroups inherently results in unequal sharing of information and other resources throughout fishing fleets that benefits some while not others. The benefits and social capital that Grand Haven charter captains acquire through the sharing of fishing-related information appear to outweigh the consequences related to helping competitors. Grand Haven charter captains selectively choose whom to exchange fishing related information with and the quality of the information transmitted. Social network analysis was useful in determining the communication network of the Grand Haven charter fishing fleet and provides a methodology for assisting fishery managers in understanding stakeholder groups for more efficient management in the future.

Subgroup Verses Whole Fleet Sharing of Fishing-related Information

A basic premise for subgroup formation within a fishery is to minimize competition for a resource while maximizing benefits for those within the subgroup. For instance, if captains were to exchange fishing-related information with everyone, their fish-catching success would likely be decreased since too large of a cooperative group

would result in diminished catch of salmonids for all (e.g., Hoetzel's 1993 study regarding optimal group sizes of killer whales [*Orcinus orca*] foraging for migratory salmonids). In Grand Haven, the formation of information-sharing subgroups appeared to be attributed to the tendency of captains to share fishing-related information with those whom they 1) have a social history (e.g., graduating from the same Coast Guard captain licensing class), 2) perceive to provide quality information that increased their likelihood of catching fish 3), share docking facilities, and 4) have desirable personal character traits (e.g., expressing gratitude for or reciprocating past help). Captains minimize their interactions with those that do not meet these criteria.

Benefits of Sharing Fishing-related Information with Competing Operators

Grand Haven charter captains who exchange success-enhancing information with other charter captains received several important benefits that likely outweighed the disadvantages related to helping competitors find and catch salmonids. For example, Grand Haven captains having difficulty finding salmonids would often call another Grand Haven captain, volunteer fishing-related information, and then either ask a direct question (e.g., "Where are you fishing?") or wait for a reciprocated sharing of information in response to the volunteered information. Captains who participated in the exchange of fishing-related information often increased their immediate (e.g., current conditions) and long-term (e.g., techniques) breadth of knowledge, thus also increasing their likelihood of finding and catching highly mobile and somewhat unpredictable salmonids. Thus, Grand Haven captains who were classified as having salmonid catches above the fleet average were generally found to exchange more fishing-related

information with other captains than those captains with below average catches. Captains were aware of and ranked highly the importance of fishing-related communication on their fish-catching success. The existence of information-sharing subgroups within other types of fishing fleets, such as those formed by Alaskan salmon seiners, lend benefits such as increased fish-catching success or, at worst, diffusion of the responsibility placed on the captain by the crew in the event of an unsuccessful fishing attempt (e.g., Gatewood 1984). In communicating with others, skippers of Alaskan seining vessels were perceived by their crew as actively trying to maximize catch and thus protecting their welfare. As such, the crew did not blame the captain in the event of poor catches, as they perceived that the skipper had done all possible to maximize their fish-catching success.

Sharing fishing-related information and helping in other ways (e.g., giving another captain a lure with proven fish-catching ability) also enabled Grand Haven captains to acquire a key social currency, social capital. The benefits of acquiring and maintaining social capital included the ability of Grand Haven captains to access fishing-related information through those captains who had previously received their help or, for example, who had generally acted in the best interest of other captains. Social capital also assisted in providing new opportunities to the cooperating captains, such as customer referrals. Through their survey responses, charter captains exhibited a predisposition to target other captains with fishing-related information with whom social capital had been acquired in the past, e.g., they shared a history of mutual support and reciprocation. A similar phenomenon, deferred gratification, has been described in other fisheries (e.g. small-scale fishermen in Puerto Rico) as an adaptive characteristic in situations where uncertainty is high (Poggie 1978).

Within the Grand Haven charter fishing fleet, social capital appeared to be acquired through both success at catching fish and previous positive social relations. For example, the directionality of voluntarily offered fishing-related information was often aimed at captains with equal or greater fish-catching success. Thus captains with lesser catches could use positive social interactions with others to bolster their social capital that could then be used to access fleet resources, such as fishing knowledge. Captains with high catches were likely already at an advantage since their catching success gave them more access to fleet resources and the respect of others.

Selective Exchange of Fishing-related Information

Selective exchange of fishing-related information in Grand Haven was not largely driven by kinship ties. This is contrary to what has been noted in other fishing networks, such as that of the Maine lobster (e.g., Acheson 1988) and southeast Alaskan salmon seining fisheries (Gatewood 1984), in which ancestry and kinship allow for access to many resources, including fishing grounds, capital (social and monetary), and fishing-related information. However, past employment as a mate in Grand Haven appeared to insure some social benefits within the fleet. For example, a captain who mated as a crew member for two successful and socially-integrated Grand Haven captains in the past was a member, albeit at the periphery, of a subgroup despite his relatively isolated docking location and inexperience. Additionally, a docking neighbor of this captain was also part of the larger subgroup again at the periphery as, he too, was at the same isolated marina, relatively inexperienced, and had not previously acted as a mate for others in that subgroup. Ties through secondary employment were also somewhat indicative of

subgroup composition, since people who worked together outside of fishing developed stronger friendship ties or had more interactions outside of charter fishing. Loyalty to licensed cohorts appeared to also have an effect on subgroup membership. For example, although one captain was somewhat on the fringe of being included in a Grand Haven information-sharing subgroup for past socially unacceptable behavior, he enjoys the benefits of subgroup membership due to his long-lasting friendship with another highly integrated (i.e. who has many information-sharing ties with others) captain.

In Grand Haven, the most obvious reason why captains communicated with selected captains was geographical convenience. Being docked in the same marina was shown to be statistically related to the likelihood of captains exchanging fishing-related information. This is likely a function of the ease at which such interactions could occur when not fishing. However, this was not the only determinant regarding who exchanged fishing-related information with whom. For example, four captains in subgroup A were docked adjacently in the same marina and frequently shared fishing-related information. However, in response to the survey question regarding communication choices (#32, "I choose to communicate with other charter fishermen while charter fishing when it is…), none of these adjacently-docked captains agreed that they based their communication decisions purely on convenience (i.e. docking adjacently) and only one agreed that he "chose to communicate with others when it was easy" (i.e. with neighbors). Grand Haven captains thus chose whom to approach for and share fishing-related information, regardless of docking location and convenience. Reasons for this selectivity included the catch and individual attributes of captains. In the Grand Haven fishery, captains sought to communicate with those captains having equal or higher catch and who reciprocated

over time. To do otherwise would be counterproductive. The directionality in the communication between captains is also evident in other fishing fleets. Maine lobster fishermen have been described as tending not to divulge secrets unless the resource (information, social capital etc.) obtained during the exchange is worth at least as much as what they are giving (Acheson 1988). In addition, highly successful lobster fishermen have relatively more abundant and diverse access to resources, as many fishermen want to talk to them. Additionally, highly successful lobster fishermen were found to often initiate and maintain ties with other successful fishermen distant from their local network, thereby gaining access to new innovations and thus higher catching abilities (e.g., Granovetter 1973; Rogers 1995). This was also observed in Grand Haven as some captains maintained ties, albeit less frequent, with others not in their subgroup.

In Grand Haven, exclusion of those charter captains that did not contribute to the increased success or social capital of other captains was gradually being accomplished through a variety of means. For example, the adoption and utilization of Nextel and cellular telephones in the transferring of fishing-related information has become a more popular means of communication than ship-to-ship radios, the latter of which allows everyone to tune in and eavesdrop. Unlike the radio, Nextel and cell phones offer a much more direct and selective means for charter captains to target individuals with or for fishing-related information based on their historical success or individual attributes.

Selective communication thus not only leads to the formation of information-sharing subgroups within specific fishery groups, but also acts to further separate differing fishing groups (i.e. charter fishing fleet vs. private anglers). For example, Grand Haven charter captains described that reporting helpful fishing-related

information, such as the location of a high density of salmonids, to someone over the radio often resulted in many private vessels or inexperienced charter captains congregating around the reported area, creating maneuvering problems, tangling fishing gear, and ultimately resulting in decreased fish-catching success for experienced charter captains and their customers. As many private fishermen clock less angler hours than more business-oriented charter captains, these fishermen often try to compensate for their lack of experience and knowledge regarding the fishery by trying to emulate the tactics of more experienced captain without considering the possible negative impacts and hindrance that their fishing behavior causes to the experienced fleet captains.

Similarly, interactions between recreational/part time and full-time commercial Maine lobster fishermen mirror those between Grand Haven private fishermen and charter fishing operations (Acheson 1988). Part-time lobster fishermen tend to learn obtrusively from highly successful, full-time fishermen due to a lack of understanding of the lobster fishery and existing social norms that would guide them in learning unobtrusively.

Both part-time lobster fishermen and private fishing boats in Grand Haven are generally unable to reciprocate or build social capital due to infrequent fishing and thus inexperienced. They are oftentimes perceived as impinging on rights established through following social norms and are considered at best a nuisance. This is accentuated by the fact that private fishermen do not depend on fishing as a source of income, and thus have less to lose if they are the recipient of sanctions as a result of inconsiderate behavior.

The Curiousness of Sharing Not-so-helpful Fishing-related Information

Those that share membership in subgroups are already afforded access to resources and protection from potentially detrimental outside forces, such as competing users or uncertainty (e.g., Frank and Yasumoto 1998; Frank et al., under review). Interestingly, the fishing-related information reportedly shared between a number of Grand Haven charter captains in the same subgroups (based on survey) data was reported as somewhat untimely or unreliable. This is contrary to Gatewood's (1987) description of salmon seining cliques in Alaska, where individuals in a clique within the larger network generally exchanged trustworthy and reliable information. Even more interesting is that information flow *between* Grand Haven subgroups was reported as reliable and timely. Exchanges of unreliable information within subgroups, yet not between, is worthy of note and begs addressing.

The reason for these differences in information quality was likely related to delegation of social capital and enforceable trust within and between subgroups as seen in Frank and Yasumoto's (1998) study of the French financial elite. Frank and Yasumoto (1998) showed that hostile actions, such as a corporate takeover among the French financial elite, seldom occurred within subgroups. However, it was observed that members of the French financial elite sought to engender new obligations and access new information and resources by helping those outside their subgroups (Frank and Yasumoto 1998). They further hypothesized that actors would be less likely to enforce each other's trust and more likely to engage in reciprocation and supportive actions if they were *not* members of the same subgroup. It was reasoned that members of the French financial elite supported others outside their subgroups because they already had social capital

within their subgroups via enforceable trust – the dense social ties within subgroups increased the likelihood that anyone who betrayed the trust of a subgroup member would be sanctioned, socially and otherwise, by the group as a whole.

As with the French Financial elite, it is likely that Grand Haven captains had developed enough social capital with those in their subgroup and could thus afford, at times, to withhold or minimize the quality of the information exchanged. Since subgroup non-members are generally not afforded all of the benefits of members, it a captain's best interest to exhibit socially acceptable behavior and provide a higher quality of fishing-related information to those not in their subgroup. So perhaps, as Frank and Yasumoto (1998) describe, actors that share membership in the same subgroup are confident they will receive subgroup benefits (e.g., customer referrals within the charter industry) and are therefore motivated to push the limit of providing sub-par information while still maintaining social capital.

Additionally, it must be understood that charter fishing is a highly visible, potentially lucrative, and ego-driven endeavor which provides an underlying context for social behavior while fishing. For instance, captains, crewmembers, customers, and private anglers are publicly made aware of other captain's catches via display at public filleting stations. Charter fishing is thus a high profile sport, not only affecting the angling customers but also captain and crew. As such, it would not be inconsistent human behavior for charter captains to sometimes stray from being completely accurate or thorough in what information they choose to distribute during a fishing excursion. Described as not timely or exaggerated by Grand Haven captains, exchange of low quality information has been attributed to information management in competitive

endeavors such as fishing (e.g., Anderson 1973).

Also interesting is that a number of Grand Haven captains stated that they could tell the difference between exaggerated or untimely information and reliable information. Primarily this was a function of the experience and judgment of the captain receiving the information with the fishing conditions of the day and previous experience with the information-giver. Even with the awareness that the information passed between subgroup members could be marginal, they still exchanged fishing-related information as some information could be helpful in increasing their fish-catching success.

Communication behavior was least reliable between competitive Grand Haven captains with exaggerations being amplified in subgroups in which captains fished tournaments. This coincides with Anderson's (1973) study which described exaggerations as being reputation-based and competitive. It should be noted that informational exchanges between "exaggerators" were often playful in nature and could be considered a good representation of maritime fishing traditions (e.g., Anderson 1973). The exchange of "chatter" and "real" information is a function of the fishing circumstance. When Grand Haven captains and other types of fishermen are having moderate or high success at finding and catching fish, they are more likely to banter; when finding and catching fish is difficult, the quality of information improves and atmosphere of exchange becomes more serious. Furthermore, communication between Grand Haven captains was more reliable when captains were faced with safety and well-being issues (i.e. mechanical problems while fishing).

The Persistence and Strength of Stakeholder Communication Networks

As it has been shown in this study and in others (e.g., Gatewood 1984), anglers targeting species with unpredictable behavior tend to form subgroups of information-sharers. Gatewood (1984) found that the formation of information-sharing cliques prior to salmon seine periods are somewhat ephemeral. This is likely due to the year-to-year changes in the fishery and how important skippers feel information-sharing is to their success and respectability by their crews. Likewise, Grand Haven charter captains tended to elicit fishing-related information more frequently and at levels of higher detail during periods of time when they were having difficulty locating and catching salmonids. Thus, fisheries that are in a state of unpredictability or poor shape will have networks that facilitate communication and interactions of a higher quality and quantity than those that are stable.

Use of Social Network Analysis for Fisheries Management

Social network methodologies provide fisheries managers with useful tools that enhance their understanding of stakeholder groups and the influence of their interactions on shaping behaviors towards natural resources. Use of these tools allows for fisheries professionals to evaluate the distribution of resources (e.g., knowledge, social capital, innovations) within networks and thereby enable them to more effectively communicate with stakeholder groups (e.g., Maiolo and Johnson 1992; Acheson 2001). For example, Acheson (2001, 1975) reported that managers could better predict reactions of lobster fishermen to management schemes once they understood the importance informal norms which were generated through the strong interactions between stakeholders operating within the Maine lobster fishery. Failure to do so can result in negative consequences for

fishery resources (Hilborn 1985). In the Maine lobster fishery, managers were able to use social network knowledge formalize already-existing social institutions into the management structure, thereby creating a more acceptable and effective management regime for this lobster fishery (Acheson 1975). In a case study, Acheson (1975) argued that potential opposition to fisheries regulations would be minimized if such regulations were congruent with existing social network norms and institutions. He reported that limited entry as a management intervention was the most effective protocol for declining lobster catch as it was consistent with what the local fishing community determined socially acceptable. This limited entry management approach essentially formalized the way in which lobster fishermen operate (Acheson 1975, 1980). Thus, insight into social network processes of stakeholder groups will likely result in development and establishment of better decisions which garner stakeholder support and the needed sustained behavioral modifications which assist sustainability of the target fishery.

Social network methodologies also provide a means to evaluate the flow of resources within a stakeholder network. Furthermore, these methods enable managers to better anticipate how resources diffuse through networks and subsequently the best ways in which track the adoption of new innovations and success of management programs. (e.g., Rogers 1995; Decker and Krueger 1999; Frank et al. 2004).

Understanding social network dynamics is becoming increasingly important as fisheries become more globalized in nature. In most fisheries, external influences from non-locally derived stakeholders as well as those who are local but do not directly engage in fishing are dominating the management landscape. As local fisheries experience globalization, the utilization of social networks will become increasingly important to

stakeholders and management agencies. For example, providing opportunities for socially central stakeholders to serve on community advisory committees might, in part, ameliorate problems that arise when management becomes increasingly distant (Maiolo and Johnson 1992). In Grand Haven, a number of charter captains serve on advisory committees for Great Lakes agencies, i.e. the MDNR and GLFC. Furthermore, given the time, person power, and financial limitations of many natural resource agencies, approaching central and influential network members that have many ties within the network has the potential to decrease the resources required to implement new innovations or policies that are acceptable to the stakeholder community as these central actors are better able to communicate effectively and diffuse information through the network efficiently due to their earned social capital (e.g., Frank et al. 2002). It is important to note that the central actors have the trust or respect of the majority of other stakeholders within the group and thus can be viewed as influential voices for all stakeholders within the community.

The reactions of fishermen to fishery-related uncertainty are better understood and predicted with increased insight into the social fabric of fishing communities and their fishery resources (Acheson 2001; Mangel and Clark 1983; Sampson 1991). This study described the importance of interactions among Lake Michigan salmonid carter captains on their target fishery resource. The selective exchange of fishing-related information and use of social capital within the Grand Haven fleet enabled charter captains to increase their likelihood of locating and catching salmonids. In this way, captains have the ability to influence their current and future access to fleet and fishery resources.

APPENDIX A

APPENDIX A

Replicated Letter of Intent to Potential Study Participants

Date

Address

Dear [Name of Grand Haven MCBA charter captain]:

I am a graduate student in the Department of Fisheries and Wildlife at Michigan State University. My research focus is on the manner in which and the degree that communication influences catch success in the charter industry. Ultimately I believe this will help fisheries managers gain a better understanding of social dynamics within the charter industry, which will enable managers to work more constructively with charter fishing captains. I have received a MCBA mate's license, and would like very much the opportunity to serve as a second mate on your charter for 2 days this summer at your convenience. This mate's license will enable me to board your boat as a non-customer.

I plan to collect observational data, such as catch, and general information on communication and use of cell phones, 2 way radios, etc., and will help out with any chores (not limited to fish cleaning, customer service, and line-rigging). I am also asking charter captains and mates operating from Grand Haven to answer questions regarding communication patterns with other captains as part of my graduate research. Signing a consent form and answering the survey questions indicates your consent as a participant in this study in so far as your responses will be analyzed. I will keep all data collected as confidential. Preserving confidentiality, I will share the generalized results with participants by 2004. Participation in this study is voluntary.

I plan on contacting you in person to make two appointments: 1) to serve as a second mate and make observations as mentioned above, and 2) to serve as a second mate, make observations, and provide the survey (this should take approximately 25-30 minutes at the end of the charter trip after the customers have left).

Thank you for your time. I look forward to talking to you in the near future. If you have further questions, please feel free to contact me: 703-927-2087 or muell112@msu.edu

Sincerely,

Katrina B. Mueller
Graduate Research Assistant

APPENDIX B

APPENDIX B

UCRIHS-approved study participation consent form

The Effects of Communication and Social Capital on the Catch Success of Charter Boat Operators in Grand Haven, Michigan

I am asking charter captains and mates in your port, Grand Haven, to answer the following questions as part of my graduate research in the Fisheries and Wildlife Department at Michigan State University. My research focus is on understanding aspects of social dynamics of fishery stakeholders, namely the manner in which and the degree that communication influence catch success in the charter industry. Ultimately I believe this will help fisheries managers, including myself, work more constructively with charter boat captains by better understanding communication and social dynamics.

I plan to collect the following data as part of this research project:

1. Field notes based on observations on charter boats and at the dock.
2. The estimated 30-minute interview that is on the following pages.

Participation is voluntary. You may choose not to participate at all, or you may refuse to answer certain questions or discontinue the interview at any time. I will keep all data collected as confidential. Preserving confidentiality, results will be available in 2004.

Although no trade secrets will be revealed and I will protect your confidentiality by using confidential identification numbers for individual charter boat captains in all publications, you or others may be able to discern some of the identities based on reported attributes of participants. There is also the possibility of unforeseeable risks. You may withdraw your consent and discontinue participation in the study at any time during the interview.

If you have any questions or comments, please contact my advisor (Bill Taylor, 517-353-0647, taylorw@msu.edu) or myself (517-353-6697, mueller112@msu.edu). If you have questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact—anonymously, if you wish, Ashir Kumar, M.D., Chair of the University Committee on Research Involving Human Subjects (UCHRIS) by phone: 517-355-2180, fax: 517-432-4503, email: ucrihs@msu.edu, or mail: 202 Olds Hall, East Lansing, MI 48824. I appreciate your taking time to participate.

Katrina Mueller, Master's candidate

I voluntarily agree to participate in this study _____date_____

APPENDIX C

APPENDIX C

Post-study Summary for Participating Captains

THE ROLE OF A SOCIAL NETWORK IN THE FUNCTIONING OF THE GRAND HAVEN CHARTER BOAT FISHERY, LAKE MICHIGAN

By Katrina B. Mueller

Project Summary

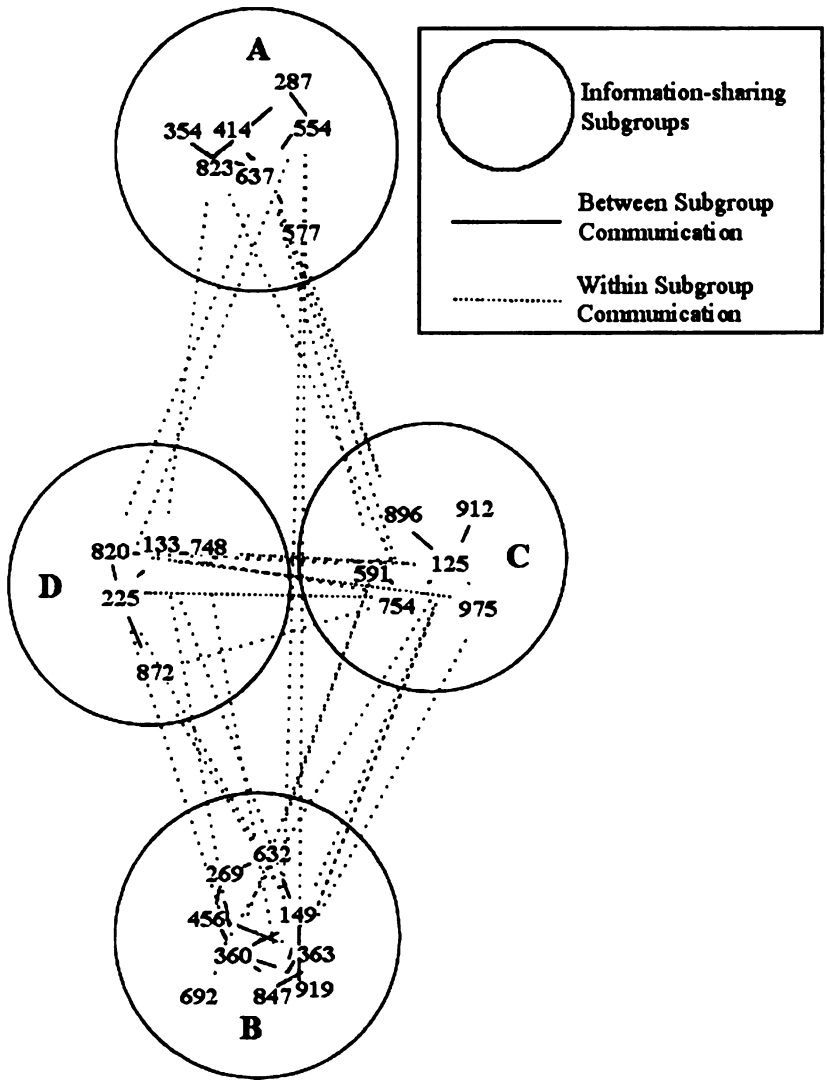
Evaluation of fishing-related communication between charter captains and fishing success was performed in cooperation with the charter boat industry in the Grand Haven, Michigan Harbor during the 2003 fishing season. I used direct observation while on board charter captain's boats during charter trips and a survey instrument to ascertain the dimensions and dynamics of information-sharing subgroups within the charter fleet. Additionally these identified subgroups were examined as to their relationship to relative fishing success as determined by catch.

Key Findings

- The Grand Haven charter fishing fleet is comprised of four information sharing subgroups that differ in regards to fishing success, individual attributes, and frequency of fishing-related communication
- Although marina location plays an important role in determining the frequency of and ease at which charter captains communicate with other captains, communication reportedly occurs between captains with some history of mutual support and trust, regardless of docking location.
- The number of captains with whom a captain communicates is positively related to fishing success
- Charter captains with above-average catch (reported and/or observed) generally have access to informational exchanges with more captains
- In general, access to fishing-related information increases the likelihood of finding and catching salmonids for captains within each subgroup.

The Grand Haven Information Sharing Network

The diagram (flipside) represents the observed flow of information between Grand Haven charter captains. Random numbers represent each captain. The distance between captains represents the frequency at which they exchange information; the shorter the line, the more frequent the communication. Similarly, the closer the subgroup, the more frequent the communication between its members. In Grand Haven, I found that more fishing-related communication occurs between subgroups D and C than between the other subgroups and little communication occurs between subgroups A and B. Members of subgroup A are, on average, the least experienced and have the lowest reported and observed catch. Charter captains from subgroups A and B are also most geographically isolated from each other.



APPENDIX D

APPENDIX D

Replication of the 2003 survey instrument

1. Name:
2. Boat Name:
3. Position:
4. Boat Type/Length:
5. Species:
6. Handicap Accessible (Yes/no):
7. Phone/email:
8. Date of birth:
9. Years as a charter captain/mate:
10. Years as a charter fisherman in Grand Haven, MI:

11. If applicable, please list your occupation(s) *before* becoming a charter captain in Grand Haven (Company/agency name, total years worked, and job title/position).

12. Do you have a source of secondary income during the fishing season? If yes, list company name/type and % of total yearly income

13. During the off-season, what is your source of primary income (if applicable)? Company name/type and % of total yearly income:

14. Rank the following as they are most important to you, 1 being most important: Being a charter fisherman gives me

[ ] personal satisfaction
[ ] social satisfaction
[ ] time to enjoy being outdoors
[ ] money
[ ] Others? Please list

15. Do you have any family members that work as charter captains or mates (yes/no)? If yes, please list your relationship to them and where they operate

16. Do you have any friends or family members that work in a field related to fisheries (aquaculture, fisheries management, non-profit organizations, goods/sales, tourism etc) (yes/no)? If yes, please list relationship to them and their field.

17. What is the highest level of schooling completed (circle)? 11 years or less, high school equivalency test, 1-3 years of college, or 4 or more years of college.

18. If you participate in fishing tournaments, please list by name, location, and approximate date.

19. I participate in tournaments (yes/no). If yes, rank in order of importance, 1 being the most important

[ ] To learn about other people's fishing techniques
[ ] To see how new gear is being used
[ ] for competition
[ ] To socialize
[ ] To talk to fishermen from other ports
[ ] Other, please explain

20. Do you go to trade/fishing shows? Yes/no. If yes, rank in order of importance, 1 being the most important

[ ] Look at new products
[ ] Talk to charter fishermen about new products
[ ] See what other charter fishermen are buying
[ ] To see what other fishermen are buying
[ ] Other, please explain

21. Where do you find fishery-related information about regulations, fishery issues, etc.? Rank all that apply with 1 being the method you use most.

[ ] Membership magazines (please list here)>
[ ] Membership meetings (please list organizations)>
[ ] Word of mouth from other charters in Grand Haven
[ ] Word of mouth from outside this port
[ ] From agency personnel:
[ ] From governmental web pages:
[ ] From attending management agency meetings (please list)>
[ ] Other (please explain)>

22. Are you a member of any non-profit natural resource-related organizations? Yes/no. If yes, please list:

23. Do you serve on any committees or boards natural resource-related agencies or organizations (i.e. MCBA, NGOs, etc.) Yes/no. If yes, please list:

24.- 27. Check the box that applies

	Strongly agree	Agree	Disagree	Strongly disagree
I use the latest fishing gear				
Other charter captains or mates ask me what gear I am using				
I am one of the first people to try something new				
I seek out current information dealing with the state of the fishery				

28. I use the internet at least [X once a day] [once a week] [once a month] [never]

29. While fishing, I use a cell phone/Nextel (circle) for fishing related conversation at least [once a day] [2-5 times a day] [5-10 times a day] [more than 10 times] [never]

29b. Radio use per day (see choices in 29)?

30. How long have you owned a Nextel (if applicable)?

31. Rank the following, 1 being the most important in regards to locating fish while on a charter .

[ ] cell phone/Nextel
[ ] 2-way radio
[ ] fish finder
[ ] observation of other charter boats
[ ] other, please explain: (i.e. experience etc.)

32. On a scale of 1-10 (10 being most important), how important do you think informational exchanges are to the catch success of you charter?_____. To other charters?_____.

33. Do you keep personal logs of your catch and effort in addition to that required by state? If yes, what data do you collect and how long have you been collecting it?

34. If possible, please fill in the following table.

	May	June	July	August	September
Total average catch per day in Grand Haven (2002)					
Total average catch per day in Grand Haven (2003)					

32. I choose to communicate with other charter fishermen while charter fishing (SD=strongly disagree, D=disagree, A=Agree, SA=strongly agree)

S	D	DA	SA	
1	2	3	4	With whom I have a history of mutual support
1	2	3	4	Who acknowledge my support
1	2	3	4	Who act in the best interest of other fishermen
1	2	3	4	When it is convenient for me to do so
1	2	3	4	Who are likely to reciprocate
1	2	3	4	When others expect me to do so
1	2	3	4	When doing so will directly benefit me
1	2	3	4	When it is easy for me to do so
1	2	3	4	When doing so will indirectly benefit me

36. To describe how you feel you fit into the charter fishing culture, mark 1 (strongly agree); 2(agree); 3(disagree); or 4 (strongly disagree)

[ ] I am relatively solitary and don't interact much with other charter fishermen at my dock, marina, or in Grand Haven itself

[ ] I am of average position in the fleet meaning that a lot of other charter fishermen have a similar frequency of interactions and informational exchanges

[ ] I am central to the network, meaning I have more interactions and informational exchanges relative to other charter captains

[ ] I interact and communicate with people outside the port than within the port

37. How do you choose whom you give your cell phone number to (fishing-related)?

38. How does fishing related information given out while fishing differ than communication after-hours?

39. Describe the timing of fishing related communication, i.e. is it given out in a timely manner or hours after the fact?

40. Do you think management agencies such as the DNR effectively communicate with natural resource stakeholders? Please explain:

41. Describe how you feel about local verses distant management of natural resources, i.e. state/local management agencies verses federal agencies

42. Rank the importance of information as it is given to you
a. number of fish caught_____
b. lure used_____
c. Rig_____
d. Side of boat that rig/gear is on_____
e. Depth of lure/rig_____
f. Longitude_____
g. Latitude_____
h. Depth that other boat is in_____
i. Water temperature_____
j. Speed of boat_____
k. Etc., please list

43. Would you be willing to enter your catch report into a computer yourself if a more thorough report was sent to you in a more timely fashion by the DNR?

44. Approximately what percentage of your customers return year to year or multiple times in one year?

45. With whom do you communicate about fishing-related information in Grand Haven (fill out table below)?

Name (please list captains and/or mates)	Amount 1=multiple Xs/day 2=1X/day 3=1X/week 4=1X/month	Info Exchange 1=I give info 2=they give info 3=we exchange info	Info is reliable 1=SA 2=A 3=D 4=SD

APPENDIX E

APPENDIX E

Replication of On-board Observation Log

Date:
Boat name:
Captain:
1st mate:
Number of customers:
Time of departure:
Weather at time of departure:
Additional comments:

Time	Species	Depth	Water temperature	Location (longitude/latitude)

Communication/interactions

Observation #:
Time:
Type (communication with or observation of another boat):
Mode:
Actors:
Dialogue:

Observation #:
Time:
Type (communication with or observation of another boat):
Mode:
Actors:
Dialogue:

Observation #:
Time:
Type (communication with or observation of another boat):
Mode:
Actors:
Dialogue:

Observation #:
Time:
Type (communication with or observation of another boat):
Mode:
Actors:
Dialogue:

Observation #:
Time:
Type (communication with or observation of another boat):
Mode:
Actors:
Dialogue:

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