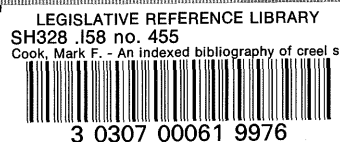


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Section of Fisheries  
**INVESTIGATIONAL REPORT**

**No. 455**

AN INDEXED BIBLIOGRAPHY OF CREEL SURVEYS,  
FISHING LICENSES SALES, AND RECREATIONAL  
SURFACE USE OF LAKES AND RIVERS IN MINNESOTA

February 1997

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**Division of Fish and Wildlife**





*Minnesota Department of Natural Resources  
Investigational Report 455, 1997*

**AN INDEXED BIBLIOGRAPHY OF  
CREEL SURVEYS,  
FISHING LICENSES SALES,  
AND RECREATIONAL SURFACE USE  
OF LAKES AND RIVERS IN MINNESOTA<sup>1</sup>**

by

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and

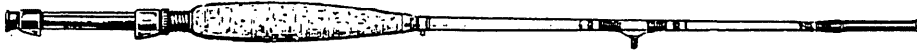
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<sup>1</sup>This project was funded in part by the Federal Aid in Sportfishing Restoration (Dingell-Johnson) Program. Partial Completion Report, Study 648, D-J Project F-26-R Minnesota.

## FORWARD



*“I hope that no one will go there with the expectation that he can catch any everlasting great quantity of fish every time he goes a-fishing, or succeed at all without studying the prime conditions of weather, time of day, and localities, or catch many without being a good fisherman . . . . Anybody can have good fun in boating and take home some fish, but it takes a workman, ordinarily, to bring home a good string if fairly caught, and I know of no place elsewhere to which the same remark is not applicable.”*

*Oliver Gibbs - 1869, In writing about his catch from  
Lake Pepin during the previous summer*



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## INTRODUCTION

This publication resulted from the activities undertaken during a historical analysis of creel survey estimates in Minnesota waters (Cook and Younk, In press). The bibliography is a compilation of documents collected mostly from governmental, private industry, and collegiate sources. Only technical and scientific manuscripts dealing with sport fishing or recreational surface use of Minnesota's lakes and streams were sought for inclusion in this bibliography (except articles from *The Minnesota Volunteer*). These reports contained estimates of sport fishing pressure, angler catch and harvest, recreational boating pressure, and/or angler attitudinal surveys. No attempt was made to include the thousands of popular articles about "how to fish" or stories about Minnesota fishing endeavors that are commonly found in outdoor magazines or newspapers. However, a few popular articles were included within this bibliography when we felt they provided useful anecdotal evidence about fishing in Minnesota from a scientific perspective.

Managing fisheries in Minnesota waters is the responsibility of the Minnesota Department of Natural Resources<sup>2</sup> (MNDNR). Therefore, the bulk of the reports listed in this document represent seven decades of work completed by the MNDNR. Citations were not limited to peer-reviewed or final reports. Unpublished manuscripts were also included in this bibliography because of their usefulness at the local level. This bibliography is current as of December 1996 and will provide a historical reference point for future management activities.

A historical review of creel surveys and fishing license sales in Minnesota precedes the bibliography section. Historical documents, coupled with institutional memory formed the foundation of this review. The bibliography section includes the subject categories, publication listing, and subject index. The body of the bibliography is arranged alphabetically by author, and chronologically for authors with more than one

publication. When the same author had multiple publications, with some using their middle name and some not, the order of the author's publications were still arranged chronologically, ignoring the middle initials. Several anonymous publications were assigned authorship by the field office that produced the report. Publications are cross-indexed by subject material and listed alphabetically by authors and publication year. Subject categories were chosen by reviewing and categorizing the material contained in the references. Papyrus™ (trademark of Research Software Design) was used in developing this bibliography<sup>3</sup>.

## A HISTORY OF CREEL SURVEYS IN MINNESOTA

Recreational fishing is among the most popular outdoor activities in Minnesota. In 1991, Minnesota residents spent \$846 million on fishing related expenses and nonresident anglers spent an additional \$119 million on trip related expenses (U.S. Department of the Interior and U.S. Department of Commerce, 1993b). Currently, more than two million anglers annually fish Minnesota waters. The MNDNR has conducted creel surveys as the primary means to estimate the recreational fish harvest on over 1,000 water bodies since 1937 (Cook and Younk, In press). In the next few paragraphs, we will describe the history of creel surveys in Minnesota.

During the past seven decades, the sampling and statistical techniques used to estimate the recreational catch have been established and modified multiple times. Nearly all available creel survey techniques have been used in Minnesota's waters at least once. The earliest creel surveys frequently collected only fishing pressure and harvest information. Prior to the widespread use of computers in analyzing creel surveys, not all the data collected during a survey was analyzed due to budget and/or time constraints. However, as computers became common, the quantity of creel surveys and the information contained in written reports increased.

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<sup>2</sup> The Minnesota Department of Natural Resources was formerly known as the Minnesota Department of Conservation. This agency is consistently referred to within the text of this document as the Minnesota Department of Natural Resources.

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<sup>3</sup> Electronic copies of the bibliography can be provided by contacting the authors at the Minnesota Department of Natural Resources, Area Fisheries Office, 2114 Bemidji Avenue, Bemidji, MN 56601.



In Minnesota, most creel surveys have partially sampled the total population of anglers, and estimates were expanded from that sample to represent the total population. These surveys were incorrectly called "creel censuses" in early reports. Recently, the term "creel survey" has become the accepted terminology for angler harvest surveys. The value of a sport fishery in Minnesota has traditionally been measured as harvest of fish (numbers or weight). Historically, the terms harvest and catch were used synonymously. Only in recent years have these two terms been used to describe very different aspects of a fishery. As Malvestuto (1983) described, harvest should refer to fish removed from the water, while catch refers to fish both harvested and fish returned to the water. Since the mid-1980s, when true catch and release fishing gained popularity, the released component of the catch has received more attention in MNDNR creel surveys. This is particularly true for species such as largemouth bass *Micropterus dolomieu*, muskellunge *Esox masquinongy* and trout *Salmo spp.* A more subtle change has taken place with the definition of "quality" when referring to a fishery. The historical meaning of a "quality" fishery was a high harvest rate of an acceptable-sized fish. Of late, the term "quality" implies a fishery comprised of a higher proportion of larger fish, and less emphasis is being placed on a high catch rate.

The first quantified records of the recreational catch for Minnesota waters were recorded by anglers who chronicled their travels. Lanman's journal (1856) describes the "gentle art of angling" in the Mississippi River, a catch rate of 18 smallmouth bass per hour, and "the majority of them weighed over two pounds apiece." He also describes "My best fishing for muskalounge (sic) occurred at a bend in the Mississippi, about one hundred and fifty miles above the Falls of St. Anthony. I took them with a spear and by torchlight . . ." Carlander (1954) summarized the history of the Mississippi River fishery, and used several angler accounts of angling in the river, including some of Lanman's writings. Some of the earliest records of Mille Lacs Lake were kept by Harry Ayer from the Mille Lacs Indian Trading Post (Anonymous.1927). In west central Minnesota, the Monmouth Miltona Club maintained catch records from 1894 to 1897 (Moyle 1954a, 1954b). Using fishing contest records from a 58-

year period, Olson and Cunningham (1989) were able to demonstrate several long term changes in the fisheries of northwestern Minnesota.

The first creel surveys in Minnesota were administered by the U.S. Forest Service from 1935-1940 (USDA Forest Service 1935, 1938; Stoudt 1939). These surveys were conducted in response to increasing fishing pressure in the National Forests (Chippewa and Superior) resulting from easier access on paved roads and increased automobile use. Labor for these creel surveys was provided by the Civilian Conservation Corps (C.C.C.). Smith and Moyle (1944) discussed the increased use of North Shore streams by anglers and presented data demonstrating the increase in automobile traffic traveling along the North Shore from 1925 to 1941. Lake Winnibigoshish creel estimates were reported with more detail than other waters, in part due to a tagging study that was being completed in cooperation with the University of Minnesota and the MNDNR (Stoudt and Eddy 1939a, 1939b).

Also during the late 1930s, Dr. Samuel Eddy of the University of Minnesota was examining the angling catch on lakes throughout Minnesota in conjunction with the MNDNR (Eddy 1938, 1940, 1941). Eddy's work examined hundreds of lakes and thousands of anglers in order to describe the quality and quantity of fishing in Minnesota. Two current fish management problems, allocation and quality of fisheries, were a problem back as early as the 1930s (Eddy 1940, 1941). The winter harvest of fish (both by angling and spearfishing) and declining sizes of fish (northern pike *Esox lucius* and crappies *Pomoxis spp.*) were causing concern amongst anglers at that time.

Responsibility for conducting the statewide creel survey shifted to the Bureau of Fisheries Research in 1940 (Hiner 1943a). The statewide creel survey was discontinued during the summer of 1943 because of World War II and was resumed during the winter of 1945-46 (Hiner 1947). Between 1938 and 1946 creel information was collected on 442 Minnesota lakes by using Game Wardens to gather information intensively for three days per month (three summer and two winter months). Using these creel estimates, Hiner (1943a) was the first Minnesota researcher to examine the effects of walleye (*Stizostedion vitreum*) stocking on the angler's catch. Unfortu-

nately, much of the lake specific data from this time period has been lost.

During the 1950s, the MNDNR selected a group of 12 lakes with which to describe the "goodness of fishing" in Minnesota (Moyle 1952c; Moyle and Franklin 1957). The lakes selected from 1952-1954 were scattered throughout the state and were considered a representative cross section of Minnesota's fishing waters. The objective was to determine the amount and quality of angling provided by typical Minnesota lakes, consisting of several fish population types (Scidmore 1961). Creel data was collected by systematic sampling, instantaneous counts, and completed trip interviews (Moyle and Franklin 1952). The methods used and information collected in these surveys were presented by Moyle and Franklin (1957), and have become the backbone of creel information collected in present day MNDNR creel surveys. Starting in 1955, the number of lakes was increased to 14 (from 12), and were divided into two groups of lakes based on fish populations, either northern pike-panfish or walleye lakes (Johnson and Kuehn 1956). Except for several lake substitutions, the methods and analysis remained the same for the duration of the statewide creel survey period through the summer of 1961 (Kuehn and Johnson 1956; Johnson 1957, 1958, 1959, 1960). In addition to these 14 representative lakes, itinerant lakes where management techniques were being evaluated were also creel surveyed during this same time. The accuracy of the systematic sampling methods used in these creel surveys was examined by using data from a complete census of Many Point Lake (Johnson and Wroblewski 1962).

These surveys were conducted by the Surveys and Inventories Unit (presently called the Ecological Services Section) in conjunction with the Bureau of Research and Planning. Seven "Creel Census Biologists" collected the creel survey information in conjunction with the "District Biologists" of the Fisheries Research Unit. It was the availability of Dingell-Johnson monies (which could not be spent on propagation) that made this needed, but costly effort possible.

Daley and Skrypek (1964) were among the first MNDNR researchers to conduct creel surveys using incomplete trip interviews in combination with instantaneous counts collected by a roving creel clerk. In addition, they were among the first

to report targeting angler harvest rates (harvest rates from only those anglers seeking a particular species). Their 1964 report is one of the most cited reports in the methods sections for MNDNR creel surveys.

Also during the early 1960s, Dennis Schupp began developing a creel survey methodology for use on Minnesota's largest lakes. Most creel surveys prior to the 1960s had been conducted on smaller Minnesota lakes (less than 5,000 acres). Lake Winnibigoshish was the exception with two creel surveys completed prior to 1960 (Stoudt and Eddy 1939a, 1939b; Johnson and Johnson 1971). On creel survey days during the 1930s, there was sufficient C.C.C. personnel to record all, or nearly all, fishing trips made at Lake Winnibigoshish. During 1957-58, an airplane was used for making fishing pressure estimates at Lake Winnibigoshish. As Schupp (1964) stated, making pressure counts with aircraft every three hours is too expensive to be commonly used on Minnesota's large lakes. In 1964, Schupp published his creel design for estimating fishing pressure by counting anglers returning to lake access points as they finished their fishing trips. This method of estimating fishing pressure is still used on most of Minnesota's larger lakes, although sampling at a given access point may be adjusted by probabilities from previous creel surveys (Fleener 1971; Malvestuto et al. 1978). However, there are a few large lakes with very irregular shorelines where this method does not work as well as aerial counts (such as Namakan, Kabetogama, Rainy, and Vermilion).

A third statewide creel survey was designed to ascertain if the quality of fishing in specific types of waters could be determined over a span of years at a specific time of year (Peterson 1978). The strategy in this design was to collect needed harvest information when budgets were very tight. Sampling periods were scheduled when fishing was best for the target species and presumably the highest fishing pressure. For example, stream trout, walleye, northern pike, and largemouth bass sample periods all started on the opening day of their respective fishing seasons and went for several weeks. This series of seasonal creel surveys sampled more than 90 lakes and 38 rivers during 1971-75. Because of the survey design, no estimates of the total summer fishing pressure or harvest were possible. However, nearly the entire winter lake trout season was sampled each year.

The five years of statewide creel surveys were summarized by Peterson (1978).

Prior to 1975, most creel surveys conducted by the MNDNR had been completed by the Fisheries Research Unit or the Surveys and Inventories Unit. However, starting in the late 1970s Fisheries Management began to conduct an increasing number of creel surveys as individual lake management gained in popularity and lake management planning became the MNDNR Section of Fisheries' primary mode of operation (MNDNR 1983). The abandonment of the rough fish seining crews during this same time also allowed more personnel and funds to be used for creel surveys. As of 1980, administrative changes in how the MNDNR filed for Federal Aid in Sport Fish Restoration Funds also made reimbursement for creel surveys easier. The Lake Management Planning Guide (MNDNR 1983) further solidified the idea of managing each lake separately, and thus required more lake specific harvest information. This expansion of creel surveys continued into the 1990s, and during the mid-1990s increased again with several large research projects, a statewide evaluation of experimental harvest regulations, and the 1837 and 1854 Indian Treaty negotiations.

The first reported use of volunteers to actually conduct a creel survey was by Hale (1950a). A resort owner on Clearwater Lake maintained creel records for approximately a week after the survey period. Volunteer resort personnel were also instrumental in collecting creel information on four lakes in Cook County (Persons 1984a). Results suggested that the mean catch rate for resort anglers was generally higher than those observed by standard creel survey collection methods. This was attributed to the tendency of only successful anglers to report their catch rates. Volunteer creel clerks recruited from a Trout Unlimited club were used to help conduct a creel survey on the Middle Branch of the White-water River (Wiechman 1991). Suggestions for using volunteer help in creel surveys were listed by Wiechman (1991). Staff at the Aitkin Area Fisheries office successfully conducted surveys on two lakes by using volunteers (Van Epps 1988a, 1989b; Aitkin Area Fisheries 1995). In general, these studies all successfully used volunteers to assist with creel surveys. This method of collect-

ing pressure and catch information has probably been under utilized in Minnesota.

Unconventional or off-site (Pollack et al. 1994) angler contact methods also have a long history of use in Minnesota. All unconventional attempts to contact anglers and collect catch information were considered to be voluntary, self-reporting approaches. The earliest and most frequently used method combined a catch card (or form) with a drop-box (or drop-off location) or return postage-paid retrieval system. The earliest reported use of catch cards in Minnesota was described by Thaddeus Surber (Clark 1934) and Kuehn (1948). In both cases, the effort expended was large and the value of the information collected was small. A resurgence in use of the catch card method occurred in the 1950s (Hale 1952a, 1952b; Micklus and Clementson 1960; Micklus and Hale 1959; Moyle 1952d; Moyle and Franklin 1952, 1954, 1957; Wesloh 1961) and 1960s (Micklus and Johnson 1962; Wesloh and Olson 1962). Although several authors set up a return postcard system, drop-boxes were the customary method used during this period. Frequently these catch cards were used in conjunction with a standard creel survey as a supplemental way of collecting additional catch information. Catch cards continued to be used in creel surveys during the 1980s and 1990s, but with design changes incorporated to address specific questions and conditions. Drop-box systems have been frequently replaced with return postage-paid cards or letters (Hirsch and Gates 1983; Persons 1994a, 1996) or designed in association with controlled access points (Ingbritson 1983; Becker 1993; Domeier 1994b).

The first reported use of resort launch logs occurred in the late 1940s (Appleget 1950). After a 20-year absence, this off-site method was re-established with the formation of the Lake Winnibigoshish assessment program in 1972 (Osborn 1973c). Multi-trip catch records of individual anglers have been collected using angler diaries (Ebberts 1987; Hitchcock-Esch 1992; Younk and Cook 1992; Schmidt 1993). Diaries are frequently used for collecting species specific information in cooperation with organized angling groups. In Minnesota, off-site methods have been used to gather information on both lake and stream systems, during winter and summer seasons, and for a variety of fish species. Angler



cooperation, and therefore success of off-site methods has been variable, ranging from 0% to 63% for studies that reported response rates.

Creel surveys have been widely used to provide harvest or fishing mortality estimates for several fish species in Minnesota, but relatively little research by the MNDNR has examined the sampling methods, accuracy and calculation of creel survey estimates. During a survey, an assumption is made that the anglers being interviewed can provide an accurate estimate of time spent fishing. Research has demonstrated that an angler's estimate of their trip length may be wrong by as much as three hours, but when many trip lengths are combined, the total time estimated by these anglers is very close to the actual time spent fishing (Iowa Cooperative Fisheries Research Unit 1956; Johnson and Wroblewski 1962). Kuehn and Schumacher (1957) used a six-week long complete census from a stream to extract three systematically stratified samples for accuracy comparisons. They found fishing pressure estimates were near known values (consisting of car counts, mean anglers per party, and mean trip length), while harvest rates could vary, and therefore cause harvest estimates to vary as well. Johnson and Wroblewski (1962) found that estimates of catch per boat to have considerable error, but estimates of boat-hours contributed the largest source of error to harvest estimates. A comparison of harvest rates made from data collected by incomplete and complete angler fishing trips showed no difference at the 10% level of significance (Fierstine et al. 1978; Gustafson et al. 1978). Trout harvest rates (complete and incomplete trips) were compared and some difference found at the 95% significance level (Persons 1988). Hoenig and Heywood (1991) demonstrated how to use creel information from previous years to reduce the variance of the current survey, by using model predictions as auxiliary variables. Pierce and Bindman (1994) found that instantaneous angler counts (1-h intervals) do represent the actual fishing pressure on small Minnesota lakes.

Two products were recently developed to assist authors with analyzing and writing creel survey reports. First, GENCREEL (a computer analysis program) was developed to analyze most MNDNR creel surveys and it calculates many of the commonly reported creel survey statistics

(Bindman and Mach 1995). Second, Cook (1996) compiled a list of recommendations and formatting suggestions for authors writing creel survey reports that were conducted by the MNDNR.

The reporting of creel results by angler type (such as boat, bank, launch, etc.) or by fishing methodologies (lures, baits, or equipment) has been inconsistent through the years, even though the data may have been collected. Usually this type of information has been reported only when stratification was necessary for sampling or a methodology caused some concern about allocation of the catch. Without a doubt, the allocation issue that has caused the most concern in Minnesota has been the winter northern pike spearing season. The controversy over winter northern pike spearing has been around at least as long as creel surveys (Hiner 1943a). The first creel reports to examine winter darkhouse spearing were conducted in the late 1930s and early 1940s (Eddy 1940, 1941). Throughout the years many other reports have specifically examined the winter spear fishery (Appelget and Jones 1950; Moyle 1950b; Johnson and Peterson 1955; Johnson et al. 1957; Meier and Ostgarden 1987; Schupp 1981; Kessler 1990; Diedrich 1992). In addition, many other creel survey reports contain separate estimates of the spearing harvest.

Traditional creel surveys describe fishing in terms of fish harvest, either harvest per unit of time, or harvest per surface area of water. However, it is often difficult to relate harvest to how an angler may enjoy fishing, perceive the quality of fishing, or enjoy their fishing trip. The first attempt to survey the satisfaction of Minnesota anglers was a post card survey of anglers who lived near the Whitefish Chain of Lakes (Bonde 1961). This was at a time when, traditionally, harvest was the rule for anglers (Scidmore and Wroblewski 1973) and for an angler to have good fishing, several desires had to be satisfied: the desired species of fish must be catchable when the angler wanted to fish; they had to be of a large size; and caught at a high rate (Johnson 1949b). Starting in the mid-1980s, there was a concerted effort to examine the fishing quality. Ingbritson (1983), Nelson (1983), Gilbertson (1983b), and Persons (1984c) were among the first authors to report fishing quality indices and angler attitudes in creel surveys. Nelson (1983) developed a modification of the standard Weithman-Anderson

index that was used in many succeeding creel reports. Ever since the Weithman-Anderson index has been used in Minnesota, there have been nagging questions about the consistency with which creel clerks asked the fishing quality questions, and how the anglers interpreted the questions being asked. Recent research has shown that simply asking anglers to rate their fishing quality (or trip quality) on a numeric scale provided reliable results, and was much easier to comprehend than the original Weithman-Anderson index (Weichman 1990; Spencer 1994). Most recent creel surveys have used the numerical scale (with 1-10 being the most popular) for a variety of fishing quality, trip quality, and other angler attitudinal questions.

Many MNDNR creel surveys have estimates of other recreational surface use besides angling, such as waterskiing, sailing, canoeing, and paddle boating. Most of these recreational use estimates have been made on lakes within the seven metropolitan counties around St. Paul and Minneapolis. However, this type of information has also been valuable elsewhere in Minnesota, and continues to be reported in an increasing percentage of MNDNR creel surveys.

#### **FISHING LICENSE SALES AND BOAT REGISTRATION**

A variety of fishing license types have been offered by the MNDNR since the turn of the century (Tables 1 and 2). The first documented fishing license required in Minnesota was in 1911 for nonresident anglers. The inception of a resident fishing license occurred 16 years later in 1927. However, the first fishing related fee was enacted (1903) when the legislature passed a law permitting the use of fish houses. Upon submitting an application and a one dollar fee, an individual could use a fish house for the taking of pickerel, suckers, and redhorse from 15 December to 1 April. Although identified in the game and fish laws as a fish house permit rather than a fishing license, this is the earliest reference to a fee for noncommercial anglers. Since fishing licenses have been required, the types of licenses sold, numbers sold, license prices, and number of estimated licensed anglers have consistently increased (Tables 1-7).

Annual estimates of the licensed anglers fishing Minnesota waters were possible for most years since 1927 (Table 3). The number of estimated anglers should be considered a minimum number since it excludes anglers less than 16 years old and anglers older than 64 (from 1974-1987) who were exempt from buying a fishing license. Moyle (1954b) was the first person to examine the number of anglers fishing in Minnesota when he examined the trends for the first 40 years of license sales. As Moyle (1954b) pointed out, several national events have noticeably influenced license sales in Minnesota (Figure 1). World War II had the greatest observable influence on license sales causing them to plummet. He also reported that fishing pressure had tripled since fishing licenses were required. Since Moyle's original analysis of anglers, a gradual increase in licensed anglers has occurred for the last 40 years (Figure 1). Presently there are 3.4 anglers for every angler that was fishing during the 1920s (Table 7).

Although the number of anglers has continued to increase, the percentage of the Minnesota population purchasing a fishing license has slowly decreased since the peak year of 1950 (Figure 2 and Table 3). The proportion of nonresidents (when compared to residents) fishing Minnesota waters increased from 1927 to 1978, and since 1979 has decreased to about 22.5% where it has remained constant (Figure 2). The number of nonresidents fishing in Minnesota peaked during the 1970s with 8.1 nonresident anglers for every nonresident angler during the 1920s. Since licenses have been required, the absolute increase in licensed anglers is 292% for resident anglers, 716% for nonresident anglers, and 336% for all anglers (Table 7).

Increases in fishing license fees appear to have very little effect on resident individual, resident combination, total resident, or total nonresident license sales. License sales the year of, or the year after an increase had no consistent variation. License sales may increase or decrease after a fee increase is implemented, although the difference in sales was usually less than  $\pm 6\%$ . Generally, resident individual license sales still increased after a fee raise. Conversely, resident combination and total nonresident licenses sales dropped slightly with fee increases. The decrease in combination license sales associated with a fee

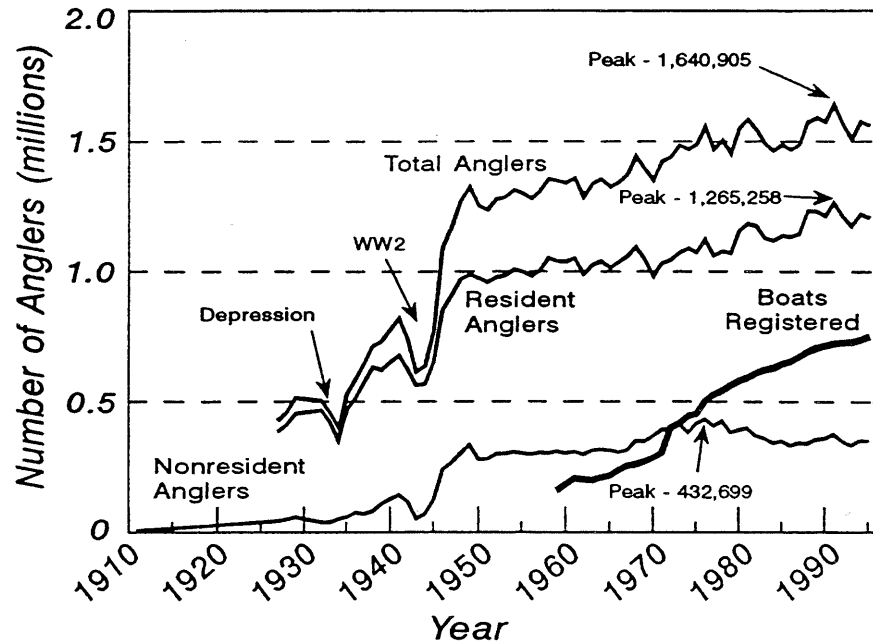


Figure 1. Number of resident, nonresident, and total licensed anglers who purchased Minnesota fishing licenses. Nonresident licenses were first required in 1911 and resident licenses in 1927. The total number of boats registered in Minnesota (first required in 1959) is also plotted on this graph.

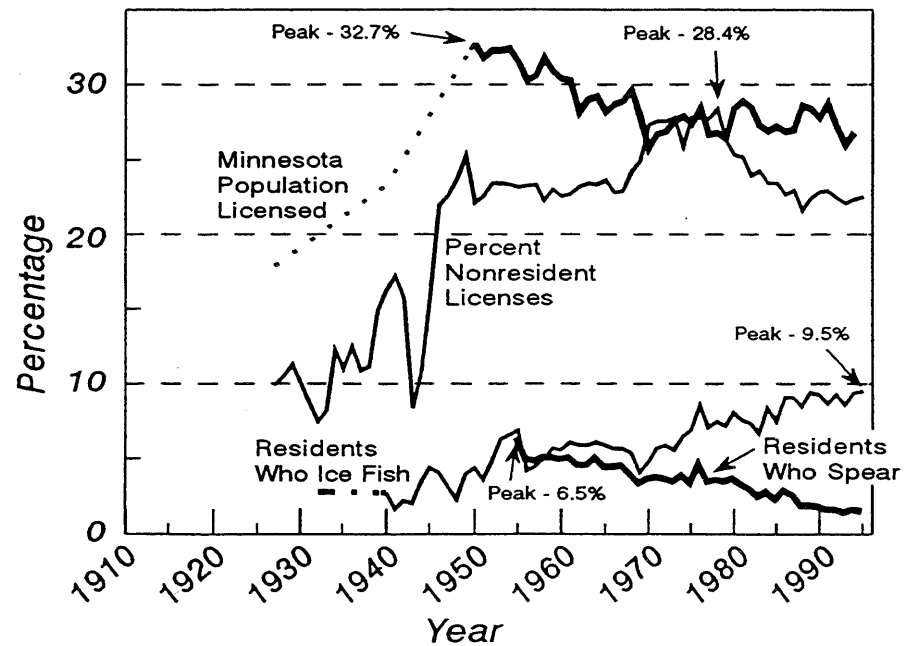


Figure 2. Percent of all Minnesota residents who purchased a fishing license, and percentage of Minnesota resident anglers who purchased a fish house or spearing license. The percentage of fishing licenses sold that were purchased by nonresidents is also shown.



increase, partially explains the positive change in individual license sales. This apparent switch in license types purchased offsets each other, so the total sales are nearly equal after a fee increase. However, the revenue generated by license sales would actually decrease because of the switch to a cheaper license option, not including the associated fee increase. This analysis suggests many other factors besides license price will influence whether or not an angler will purchase a fishing license, after a fee increase.

Currently two fishing methodologies require a special license, darkhouse spearing and white-fish netting, and both harvest methods are declining in participation (Figure 2, Table 4). Conversely, fishing pressure from ice fishing is increasing based on the number of fish house licenses sold (Figure 2, Tables 4 and 7). Increases in fish house license sales have consistently outpaced increases in anglers numbers (Table 7). The percentage of Minnesota anglers that partake in ice fishing has been increasing, based on the annual proportion of fish house licenses sold compared to the number of licensed anglers (Table 4). The proliferation of better ice fishing equipment such as the portable fish house, better fish house heaters, affordable power ice-augers, ATV's, and snowmobiles has undoubtedly contributed to the popularity of ice fishing.

Throughout the years, numerous fishing license exemptions and price reductions have been made to satisfy unique circumstances. Minnesota residents serving in the Armed Forces have been exempt from buying a fishing license, and nonresidents serving in the military have had the option of buying a Minnesota resident license, both since 1943. Nonresident full-time students attending school in Minnesota have also had the option of purchasing a resident fishing license since 1960. Minnesota's senior citizens (age 65 and older) were not required to buy a fishing license from 1974 to 1984. Free fishing licenses have been issued to the blind and recipients of supplemental security income for the aged (since 1955, and changed to a permanent license in 1992), mentally retarded (permanent license since 1970), Minnesota veterans with 100% service connected disability (permanent license since 1972), disabled (since 1974 and expanded in 1978 to include residents receiving aid from the Railroad Retirement Act of 1937 and former employees of the

U.S. Postal Service receiving disability pay), patients of a U.S. Veteran's Administration Hospital or State mental hospital (since 1974), inmates of a State Correctional Institution (since 1974), residents of nursing homes (since 1989, and expanded to adult day care programs in 1992), and residents (under the age of 20) of a drug or alcohol residential treatment facility (since 1992). "Take a Kid Fishing Weekend" was initiated in 1986, allowing resident adults to fish without a license when in the presence of a child under the age of 16. The "Take A Mom Fishing Weekend" was introduced in 1991, and designed for mothers to fish without a license. Both weekend events were established to introduce and encourage more children and mothers to participate in the sport of fishing.

Several specific licenses have been required to fish in certain geographic areas of Minnesota. From 1937-1945, a nonresident license, good for 5 days and costing \$1.00, was required for Big Stone Lake. Before 1945 (from an unknown starting date to 1944), a tip-up license was required for the Mississippi River and its tributaries, between St. Anthony Falls and the St. Croix River. Negotiations with the Leech Lake Band of Chippewa during the early 1970s eventually resulted in a restricted and unrestricted category for each fishing license type. The unrestricted license (or restricted license with an affixed Leech Lake Reservation Stamp) allowed non-Leech Lake Band members to fish on the Leech Lake Indian Reservation. This split system was in effect from 1974-1981, after which time the State of Minnesota began making payments to the Leech Lake Indian Reservation thus eliminating the two category license system.

Two fishing licenses sold during the 1980s had unusual characteristics that are worth emphasizing. First, in 1982 a "Golden License" was offered for \$100 in celebration of the MNDNR's 50th anniversary. This resident license was only offered for one year and was equivalent to buying all hunting and fishing licenses (except waterfowl stamps). Then, starting in 1988, a 1 day fishing license was created that anyone, resident or non-resident, could purchase.

Starting in 1959 a registration system was implemented by the MNDNR for many types of boats (Figure 1 and Table 8). Canoes and kayaks were added to the list of watercraft requiring

registration in 1972. Since watercraft registration has been required, the absolute numbers of boats registered continues to increase. Boat ownership in Minnesota has increased from 1 boat for every 17 residents (1963) to 1 boat per 6 residents. The rate of increase in boat registration has outpaced the rate of increase in fishing license sales, for each decade examined (Table 7). We believe this upward trend represents the statewide increase in the popularity of all outdoor water sports, including fishing. Numbers of some boat types are still increasing (boats 16 feet and longer, canoes, and personal watercraft), while numbers of other types are either declining (boats smaller than 16 feet), or remain relatively constant such as sailboats (Table 8). Since 1991, personal watercraft registration has been recorded separately and currently has the fastest rate of growth of any watercraft type.

Table 1. Number of resident fishing licenses sold in Minnesota since 1927, listed by license type.

Year	Individual Individual Sportsman <sup>a</sup>	Combination <sup>b</sup> Combination Sportsman	Senior Citizen <sup>c</sup>	Disability Angling <sup>d</sup>	Individual Senior Permanent <sup>e</sup>	Total Resident Angling <sup>f</sup>
1927	---	---				---
1928	---	---				---
1929	---	---				---
1930	---	---				---
1931	---	---				---
1932	246,507	109,528				356,035
1933	290,572	64,591				355,163
1934	286,259	32,648				318,907
1935	423,810	23,453				447,623
1936	---	---				---
1937	---	---				---
1938	---	---				---
1939	---	---				---
1940	---	---				---
1941	387,125	145,290		7,130		539,545
1942	296,137	163,301		10,699		470,137
1943	239,291	161,813		9,482		410,586
1944	238,461	164,724		8,401		411,586
1945	258,619	195,454		6,003		460,076
1946	339,061	255,670		7,608		602,339
1947	---	---		3,953		---
1948	348,919	311,206		5,123		665,248
1949	350,861	319,172		4,756		674,789
1950	312,690	330,905		4,762		648,357
1951	278,958	339,524		5,383		623,865
1952	279,093	349,957		7,222		636,272
1953	275,724	354,132		6,752		636,608
1954	279,379	363,862		6,041		649,282
1955	271,732	363,781		3,387		638,900
1956	261,483	360,072		2,608		624,163
1957	258,551	372,274		2,672		633,497
1958	271,154	390,879		2,891		664,924
1959	263,436	387,868		2,778		654,082
1960	258,517	390,072		2,439		651,028
1961	264,022	393,127		2,308		659,457
1962	237,391	375,827		2,046		615,264
1963	245,804	389,801		1,922		637,527
1964	246,094	396,525		1,785		644,404
1965	237,319	388,150		1,656		627,125
1966	240,455	398,292		1,293		640,040
1967	243,437	407,848		1,350		652,635
1968	241,134	409,410		1,270	34,497	686,311
1969	238,022	396,910		883	15,582	651,397
1970	265,420	352,852		1,144	9,807	629,223
1971	286,030	368,125		1,042	8,351	663,548
1972	289,218	372,379		1,061	8,847	671,505



Table 1. Continued.

Year	Individual Sportsman <sup>a</sup>	Combination <sup>b</sup>	Combination Sportsman	Senior Citizen <sup>c</sup>	Disability Angling <sup>d</sup>	Individual Senior Permanent <sup>e</sup>	Total Resident Angling <sup>f</sup>
1973	306,241	381,099			812	2,981	691,133
1974	318,593	385,423		NA	965		704,981
1975	314,071	379,987		NA	306		694,364
1976	343,293	390,247		NA	361		733,901
1977	335,701	363,114		NA	328		699,143
1978	322,147	315,447	45,678	NA	339		715,636
1979	325,875	304,370	49,151	NA	333		716,888
1980	355,608	319,761	58,073	NA	381		779,515
1981	365,931	306,077	73,520	NA	1,994		805,950
1982	385,404	302,270	66,939	NA	1,295		807,836
1983	378,106	291,829	60,909	NA	---		777,675
1984	378,368	292,240	56,969	NA	---		771,588
1985	383,653	299,594	56,345	NA	727		784,121
1986	390,607	295,029	55,220	NA	---		784,486
1987	396,598	290,538	60,775	NA	---		794,365
1988	371,186	286,409	63,501	107,049	---		883,551
1989	365,625	280,702	68,351	106,601	---		885,041
1990	353,366	266,815	74,453	106,074	---		873,599
1991	366,937	273,528	79,293	111,428	---		912,437
1992	349,172	256,408	80,137	107,185	---		876,905
1993	335,988	245,295	79,093	105,569	---		851,308
1994	361,662	253,016	79,429	107,572	1,177		890,430
1995	355,896	246,263	82,849	101,857	971		880,017

<sup>a</sup> A sportsman license is a combination of fishing and small game hunting licenses.

<sup>b</sup> A combination angling license is for a husband and wife.

<sup>c</sup> Minnesota residents 65 and older were not required to buy a fishing license from 1974-1987.

<sup>d</sup> Permanent fishing licenses have been issued without charge to Minnesota residents who had a qualifying disability. Licenses issued to individuals receiving assistance for the aged are also reported in this category.

<sup>e</sup> From 1968-1973 Minnesota residents 70 years old and older were able to buy a lifetime fishing license.

<sup>f</sup> Prior to 1947, the minimum age for a resident to buy a fishing license was 18, since 1947 the minimum age has remained at 16.

Table 2. Number of nonresident fishing licenses sold in Minnesota since 1911, listed by license type.

Year	Individual	Family <sup>a</sup>	Combination 14 Day	Individual 7 Day	Individual 3 Day	Individual 2 Day	Individual 1 Day <sup>b</sup>	Total Nonresident Angling <sup>c</sup>
1911	4,689							4,689
1912	---							---
1913	---							---
1914	---							---
1915	---							---
1916	---							---
1917	---							---
1918	---							---
1919	---							---
1920	26,333							26,333
1921	---							---
1922	---							---
1923	---							---
1924	---							---
1925	---							---
1926	---							---
1927	42,388							42,388
1928	48,178							48,178
1929	57,733							57,733
1930	---							---
1931	---							---
1932	37,645							37,645
1933	37,338							37,338
1934	49,254							49,254
1935	58,175							58,175
1936	73,244							73,244
1937	70,337							70,337
1938	---							---
1939	---	---						---
1940	62,186	32,262						94,448
1941	64,446	38,332						102,778
1942	53,003	31,800						84,803
1943	27,486	11,979						39,465
1944	36,676	15,730						52,406
1945	59,449	30,893						90,342
1946	103,535	67,826						171,361
1947	---	---						---
1948	122,420	89,327						211,747
1949	130,239	102,345						232,584
1950	277,022	NA						277,022
1951	279,206	NA						279,206
1952	299,509	NA						299,509
1953	301,068	NA						301,068
1954	307,094	NA						307,094
1955	301,606	NA						301,606

Table 2. Continued.

Year	Individual	Family <sup>a</sup>	Combination 14 Day	Individual 7 Day	Individual 3 Day	Individual 2 Day	Individual 1 Day <sup>b</sup>	Total Nonresident Angling <sup>c</sup>
1956	297,867	NA						297,867
1957	305,776	NA						305,776
1958	301,868	NA						301,868
1959	310,720	NA						310,720
1960	302,462	NA						302,462
1961	144,812	82,008						226,820
1962	122,462	88,173						210,635
1963	126,041	93,978						220,019
1964	124,764	95,795						220,559
1965	122,487	95,684						218,171
1966	273,398	NA				33,255		306,653
1967	280,068	NA				34,305		314,373
1968	128,840	85,330			50,118			264,288
1969	118,136	86,014			57,141			261,291
1970	105,075	92,835			78,384			276,294
1971	105,912	98,812			89,103			293,827
1972	104,735	100,280			91,523			296,538
1973	108,059	104,588			95,683			308,330
1974	101,746	96,705			85,826			284,277
1975	109,650	105,390			94,055			309,095
1976	115,392	109,458			98,391			323,241
1977	107,307	100,204			99,685			307,196
1978	114,787	103,550			104,418			322,755
1979	107,976	93,792			86,047			287,815
1980	113,750	91,173			96,736			301,659
1981	116,154	94,486			94,446			305,086
1982	66,078	92,797		94,306	NA		24,567	277,748
1983	62,306	90,353		93,640	NA		24,723	271,022
1984	54,305	87,350		94,470	NA		19,958	256,083
1985	56,386	87,930		97,396	NA		19,688	261,400
1986	63,278	74,412		62,261	58,219		NA	258,170
1987	65,506	58,936	17,223	60,836	51,387		11,735	265,623
1988	62,210	45,846	30,222	58,708	41,188		24,983	263,157
1989	63,765	45,272	33,659	61,075	43,392		30,452	277,615
1990	65,834	43,614	34,680	62,350	43,492		31,543	281,513
1991	71,272	44,286	36,646	64,336	42,645		35,530	294,715
1992	52,660	38,939	35,127	68,803	44,106		37,400	277,035
1993	48,487	36,390	33,321	66,846	42,861		35,444	263,349
1994	50,282	37,384	33,676	68,207	49,368		41,833	280,750
1995	50,708	36,347	33,957	69,889	48,653		41,375	280,929

<sup>a</sup> Family licenses include children under the age of 16 presently, prior to 1986 these were called "combination licenses" and included only a husband and wife. First offered in 1939, this license type has been sporadically not available (NA) some years.

<sup>b</sup> Since 1987, one day fishing licenses have been available for purchase by either Minnesota residents or nonresidents.

<sup>c</sup> The first available records indicate that since 1918, 16 years old was the minimum age for nonresidents to purchase a Minnesota fishing license.

Table 3. Number of fishing license sales (residents and nonresidents), number of licensed anglers, percentage of fishing licenses purchased by nonresidents, and the percentage of Minnesota population who purchased fishing licenses.

Year	Resident Fishing License Sales	Nonresident Fishing License Sales	Total Fishing License Sales	Licensed Resident Anglers <sup>a</sup>	Licensed Nonresident Anglers <sup>a</sup>	Total Licensed Anglers <sup>a</sup>	Percent Nonresident Anglers	Minnesota Population	Percent of Minnesota Population Licensed
1911		4,689	4,689		4,689	4,689		---	
1912		---	---		---	---		---	
1913		---	---		---	---		---	
1914		---	---		---	---		---	
1915		---	---		---	---		---	
1916		---	---		---	---		---	
1917		---	---		---	---		---	
1918		---	---		---	---		---	
1919		---	---		---	---		---	
1920		26,333	26,333		26,333	26,333		2,387,125	
1921		---	---		---	---		---	
1922		---	---		---	---		---	
1923		---	---		---	---		---	
1924		---	---		---	---		---	
1925		---	---		---	---		---	
1926		---	---		---	---		---	
1927	---	42,388	---	386,171	42,388	428,559	9.9	---	---
1928	---	48,176	---	411,484	48,176	459,660	10.5	---	---
1929	---	57,733	---	454,728	57,733	512,461	11.3	2,563,953	17.7
1930	---	---	---	---	---	---	---	---	---
1931	---	---	---	---	---	---	---	---	---
1932	356,035	37,645	393,680	465,563	37,645	503,208	7.5	---	---
1933	355,163	37,338	392,501	419,754	37,338	457,092	8.2	---	---
1934	318,907	47,254	368,161	351,555	49,254	400,809	12.3	---	---
1935	447,623	58,175	505,438	470,716	58,175	528,891	11.0	---	---
1936	---	73,244	---	512,470	73,244	585,714	12.5	---	---
1937	---	70,337	612,622	575,383	70,337	645,720	10.9	---	---
1938	---	---	666,812	632,723	79,222	711,945	11.1	---	---
1939	---	---	665,050	621,581	108,445	730,026	14.9	---	---
1940	---	94,448	---	650,834	126,710	777,544	16.3	2,792,300	23.3

Table 3. Continued.

Year	Resident Fishing License Sales	Nonresident Fishing License Sales	Total Fishing License Sales	Licensed Resident Anglers <sup>a</sup>	Licensed Nonresident Anglers <sup>a</sup>	Total Licensed Anglers <sup>a</sup>	Percent Nonresident Anglers	Minnesota Population	Percent of Minnesota Population Licensed
1941	539,545	102,778	642,323	677,705	141,110	818,815	17.2	---	---
1942	470,137	84,803	554,940	622,739	116,603	739,342	15.8	---	---
1943	410,586	39,465	450,051	562,917	51,444	614,361	8.4	---	---
1944	411,586	52,406	463,992	567,909	68,136	636,045	10.7	---	---
1945	460,076	90,342	550,418	649,527	121,235	770,762	15.7	---	---
1946	602,339	171,361	773,700	850,401	239,187	1,089,588	22.0	---	---
1947	---	---	---	906,302	264,080	1,170,382	22.6	---	---
1948	665,248	211,747	876,995	971,331	301,074	1,272,405	23.7	---	---
1949	674,789	232,584	907,373	989,205	334,929	1,324,134	25.3	---	---
1950	648,357	277,022	925,379	974,500	277,022	1,251,522	22.1	2,982,483	32.7
1951	623,865	279,206	903,071	958,006	279,206	1,237,212	22.6	3,010,000	31.8
1952	636,272	299,509	935,781	979,007	299,509	1,278,516	23.4	3,030,000	32.3
1953	636,608	301,068	937,676	983,988	301,068	1,285,056	23.4	3,050,000	32.3
1954	649,282	307,094	956,376	1,007,103	307,094	1,314,197	23.4	3,113,000	32.4
1955	638,900	301,606	940,506	999,294	301,606	1,300,900	23.2	3,172,000	31.5
1956	624,163	297,867	922,030	981,627	297,867	1,279,494	23.3	3,240,000	30.3
1957	633,497	305,776	939,273	1,003,099	305,776	1,308,875	23.4	3,274,000	30.6
1958	664,924	301,868	966,792	1,052,912	301,868	1,354,780	22.3	3,313,000	31.8
1959	654,082	310,720	964,802	1,039,172	310,720	1,349,892	23.0	3,366,000	30.9
1960	651,028	302,462	953,490	1,038,661	302,462	1,341,123	22.6	3,413,864	30.4
1961	659,457	226,820	886,277	1,050,276	308,828	1,359,104	22.7	3,470,000	30.3
1962	615,264	210,635	825,899	989,045	298,808	1,287,853	23.2	3,513,000	28.2
1963	637,527	220,019	857,546	1,025,406	313,997	1,339,403	23.4	3,531,000	29.0
1964	644,404	220,559	864,963	1,039,144	316,354	1,355,498	23.3	3,558,000	29.2
1965	627,125	218,171	845,296	1,013,619	313,855	1,327,474	23.6	3,592,000	28.2
1966	640,040	306,653	946,693	1,037,039	306,653	1,343,692	22.8	3,617,000	28.7
1967	652,635	314,373	967,008	1,059,133	314,373	1,373,506	22.9	3,659,000	28.9
1968	686,311	264,288	950,599	1,094,451	349,618	1,444,069	24.2	3,703,000	29.6
1969	651,397	261,291	912,688	1,047,424	347,305	1,394,729	24.9	3,758,000	27.9
1970	629,223	276,294	905,517	981,256	369,129	1,350,385	27.3	3,806,103	25.8
1971	663,548	293,827	957,375	1,030,934	392,639	1,423,573	27.6	3,860,000	26.7



Table 3. Continued.

Year	Resident Fishing License Sales	Nonresident Fishing License Sales	Total Fishing License Sales	Licensed Resident Anglers <sup>a</sup>	Licensed Nonresident Anglers <sup>a</sup>	Total Licensed Anglers <sup>a</sup>	Percent Nonresident Anglers	Minnesota Population	Percent of Minnesota Population Licensed
1972	671,505	296,538	968,043	1,043,267	396,818	1,440,085	27.6	3,877,000	26.9
1973	691,133	308,330	999,463	1,071,834	412,918	1,484,752	27.8	3,890,000	27.6
1974	704,981	284,277	989,258	1,089,791	380,982	1,470,773	25.9	3,904,100	27.9
1975	694,364	309,095	1,003,459	1,074,351	414,485	1,488,836	27.8	3,921,000	27.4
1976	733,901	323,241	1,057,142	1,124,148	432,699	1,556,847	27.8	3,954,000	28.4
1977	699,143	307,196	1,006,339	1,062,257	407,400	1,469,657	27.7	3,980,000	26.7
1978	715,636	322,755	1,038,391	1,076,761	426,305	1,503,066	28.4	4,024,000	26.8
1979	716,888	287,815	1,004,703	1,070,409	381,607	1,452,016	26.3	4,060,000	26.4
1980	779,515	301,659	1,081,174	1,157,349	392,832	1,550,181	25.3	4,075,970	28.4
1981	805,950	305,086	1,111,036	1,185,547	399,572	1,585,119	25.2	4,099,048	28.9
1982	807,836	277,748	1,085,584	1,177,045	370,545	1,547,590	23.9	4,133,334	28.5
1983	777,675	271,022	1,048,697	1,130,413	361,375	1,491,788	24.2	4,145,667	27.3
1984	771,588	256,083	1,027,671	1,120,797	343,433	1,464,230	23.5	4,161,484	26.9
1985	784,121	261,400	1,045,521	1,140,060	349,330	1,489,390	23.5	4,192,973	27.2
1986	784,486	258,170	1,042,656	1,134,735	332,582	1,467,317	22.7	4,214,013	26.9
1987	794,365	265,623	1,059,988	1,145,678	341,782	1,487,460	23.0	4,245,870	27.0
1988	883,551	263,157	1,146,708	1,233,461	339,225	1,572,686	21.6	4,306,550	28.6
1989	885,041	277,615	1,162,656	1,234,094	356,546	1,590,640	22.4	4,353,113	28.4
1990	873,599	281,513	1,155,112	1,214,867	359,807	1,574,674	22.9	4,375,099	27.8
1991	912,437	294,715	1,207,152	1,265,258	375,647	1,640,905	22.9	4,416,292	28.7
1992	876,905	277,035	1,153,940	1,213,450	351,101	1,564,551	22.4	4,469,450	27.2
1993	851,308	263,349	1,114,657	1,175,696	333,060	1,508,756	22.1	4,517,416	26.0
1994	890,430	280,750	1,171,180	1,222,875	351,810	1,574,685	22.3	4,567,267	26.8
1995	880,017	280,929	1,160,946	1,209,129	351,233	1,560,362	22.5	4,609,500	26.2

<sup>a</sup> All family and combination fishing licenses were multiplied by two to calculate the number of anglers. Children who were not required to buy a fishing license are not included in these numbers.

Table 4. Number of Minnesota resident anglers compared with miscellaneous fishing license sales (numbers) by the Minnesota Department of Natural Resources since 1932<sup>a</sup>. Percentages were calculated based on licenses sold and do not include minors (under age 16) who are not required to buy fishing licenses. The number of nonresident fish house license sales is also included in this table.

Year	Licensed Minnesota Resident Anglers	Darkhouse Spearing License	Percent Minnesota Residents Who Spear	Minnesota Resident Fish House	Percent Minnesota Residents Who Ice Fish <sup>b</sup>	Resident Fish House Rental	Nonresident		Total Fish House Licenses	Whitefish Netting <sup>c</sup>	Trout Stamp <sup>d</sup>
							Fish House Season	7 Day Fish House			
1932	465,563			12,913	2.8				12,913	3,425	
1933	419,754			11,708	2.8				11,708	3,065	
1934	351,555			12,586	3.6				12,586	2,738	
1935	470,716			9,076	1.9				9,076	4,043	
1936	512,470			---	---				---	---	
1937	575,383			---	---				---	---	
1938	632,723			---	---				---	---	
1939	621,581			---	---				---	---	
1940	650,834			17,709	2.7				17,709	1,410	
1941	677,705			10,511	1.6				10,511	1,681	
1942	622,739			13,977	2.2				13,977	1,166	
1943	562,917			11,260	2.0				11,260	1,949	
1944	567,909			19,071	3.4				19,071	2,557	
1945	649,527			28,380	4.4				28,380	2,295	
1946	850,401			34,654	4.1				34,654	3,204	
1947	906,302			---	---				---	3,081	
1948	971,331			22,528	2.3				22,528	3,375	
1949	989,205			39,421	4.0				39,421	3,648	
1950	974,500			43,030	4.4				43,030	3,741	
1951	958,006			34,699	3.6				34,699	3,507	
1952	979,007			47,667	4.9				47,667	4,191	
1953	983,988			61,586	6.3				61,586	4,554	
1954	1,007,103			---	---				62,734	4,590	
1955	999,294	64,835	6.5	68,452	6.9				68,452	3,896	
1956	981,627	50,363	5.1	40,900	4.2				40,900	3,887	
1957	1,003,099	50,534	5.0	45,194	4.5				45,194	3,849	
1958	1,052,912	54,557	5.2	52,421	5.0				52,421	4,287	
1959	1,039,172	54,514	5.2	59,683	5.7				59,683	4,091	

Table 4. Continued.

Year	Licensed Minnesota Resident Anglers	Darkhouse Spearing License	Percent Minnesota Residents Who Spear	Minnesota Resident Fish House	Percent Minnesota Residents Who Ice Fish <sup>b</sup>	Resident Fish House Rental	Nonresident		Total Fish House Licenses	Whitefish Netting <sup>c</sup>	Trout Stamp <sup>d</sup>
							Fish House Season	7 Day Fish House			
1960	1,038,661	52,802	5.1	58,370	5.6				58,370	4,216	
1961	1,050,276	55,118	5.2	64,175	6.1				64,175	4,122	
1962	989,045	46,827	4.7	58,080	5.9				58,080	4,099	
1963	1,025,406	47,879	4.7	60,772	5.9				60,772	3,697	
1964	1,039,144	53,691	5.2	63,015	6.1	1,969			63,015	3,716	
1965	1,013,619	46,743	4.6	59,846	5.9	1,848			61,694	3,578	
1966	1,037,039	47,348	4.6	59,478	5.7	1,821			61,299	3,505	
1967	1,059,133	49,372	4.7	60,773	5.7	1,823			62,596	3,677	
1968	1,094,451	45,387	4.1	59,159	5.4	1,742			60,901	3,770	
1969	1,047,424	36,790	3.5	43,184	4.1	1,430			44,614	3,875	
1970	981,256	37,000	3.8	46,785	4.8	1,391			48,176	4,305	
1971	1,030,934	40,186	3.9	58,766	5.7	1,526			60,292	4,372	
1972	1,043,267	40,070	3.8	61,250	5.9	1,590			62,840	4,134	
1973	1,071,834	39,002	3.6	60,047	5.6	1,459			61,506	4,867	
1974	1,089,791	43,722	4.0	71,088	6.5	1,464			72,552	5,126	
1975	1,074,351	37,385	3.5	74,428	6.9	1,587			76,015	5,243	
1976	1,124,148	52,766	4.7	96,777	8.6	1,740			98,517	4,567	
1977	1,062,257	37,849	3.6	75,529	7.1	1,493			77,022	4,256	
1978	1,076,761	39,593	3.7	80,348	7.5	1,586			81,934	4,213	
1979	1,070,409	38,142	3.6	77,200	7.2	1,530			78,730	4,240	
1980	1,157,349	43,634	3.8	93,764	8.1	1,458	72		95,294	4,664	
1981	1,185,547	40,334	3.4	89,613	7.6	1,314	94		91,021	4,377	
1982	1,177,045	36,218	3.1	86,876	7.4	1,296	118		88,290	3,983	42,512
1983	1,130,413	29,340	2.6	75,600	6.7	1,244	185		77,029	3,040	47,339
1984	1,120,797	32,933	2.9	94,172	8.4	1,270	223		95,665	2,398	49,432
1985	1,140,060	27,625	2.4	85,165	7.5	1,149	186		86,500	2,207	83,519
1986	1,134,735	34,420	3.0	102,730	9.1	1,172	280		104,182	2,145	93,282
1987	1,145,678	30,926	2.7	104,575	9.1	1,163	309		106,047	2,028	90,176
1988	1,233,461	24,509	2.0	104,570	8.5	1,237	346		106,153	1,533	93,604
1989	1,234,094	24,577	2.0	115,901	9.4	1,379	363		117,643	1,439	97,582
1990	1,214,867	23,604	1.9	113,567	9.3	1,571	500		115,638	1,380	93,118

Table 4. Continued.

Year	Licensed Minnesota Resident Anglers	Darkhouse Spearing License	Percent Minnesota Residents Who Spear	Minnesota Resident Fish House	Percent Minnesota Residents Who Ice Fish <sup>b</sup>	Resident Fish House Rental	Nonresident		Total Fish House Licenses	Whitefish Netting <sup>c</sup>	Trout Stamp <sup>d</sup>
							Fish House Season	7 Day Fish House			
1991	1,265,258	21,888	1.7	109,831	8.7	1,506	576		111,913	1,090	87,859
1992	1,213,450	21,182	1.7	112,723	9.3	1,519	642		114,884	1,196	85,869
1993	1,175,696	17,957	1.5	100,634	8.6	1,496	678		102,808	1,137	84,929
1994	1,222,875	20,770	1.7	115,116	9.4	1,514	665	953	118,248	1,177	90,793
1995	1,209,129	18,929	1.6	114,277	9.5	1,606	693	1,290	117,866	1,040	90,844

<sup>a</sup> Two license types are not reported in this table. From 1937-1945 there was a nonresident license specific to Big Stone Lake that was good for 5 days and cost \$1.00. Prior to 1945 (unknown starting date to 1944), there was a tip-up license required for the Mississippi River and its tributaries between St. Anthony Falls and the St. Croix River.

<sup>b</sup> This column presents an estimate of the percentage of Minnesota anglers that ice fish. It was calculated by the ratio of resident ice house licenses sold divided by the number of resident anglers in a given year. While this percentage is not exact, it does probably reflect overall trends in numbers of ice anglers.

<sup>c</sup> This column lists the number of whitefish netting license sold, the number of inland herring license sold are not listed in this table.

<sup>d</sup> Trout stamps are required to be purchased by all non-resident licensed anglers, and licensed resident anglers between the ages of 16-64.

Table 5. History of fishing license price changes that applied to Minnesota residents. Only those years in which there was a price fluctuation(s) or new license options added are shown.

Year	Individual	Individual Sportsman	Combination	Combination Sportsman	Senior Citizen <sup>a</sup>	Ind. Senior Permanent	Spear	Fish House	Fish House Rental	Whitefish Netting <sup>b</sup>	Trout Stamp <sup>c</sup>
1914								\$1.00		-	
1917								\$1.00		\$1.00	
1927	---		---					\$1.00		\$1.00	
1930	\$0.50		\$1.00					\$1.00		\$1.00	
1941	\$1.00		\$1.50					\$1.00		\$1.00	
1947	\$1.50		\$2.00					\$1.00		\$1.00	
1955	\$1.50		\$2.00				\$1.00	\$1.00		\$1.00	
1961	\$2.25		\$2.75				\$1.00	\$1.00		\$1.00	
1964	\$2.25		\$2.75				\$1.00	\$2.00	\$3.00	\$1.00	
1968	\$2.25		\$2.75			\$2.25	\$1.00	\$2.00	\$3.00	\$1.00	
1970	\$4.00		\$6.00			\$4.00	\$3.00	\$3.00	\$6.00	\$1.00	
1974	\$4.00		\$6.00		NC		\$3.00	\$3.00	\$6.00	\$1.00	
1977	\$5.00		\$8.00		NC		\$5.00	\$3.00	\$10.00	\$3.00	
1978	\$5.00	\$11.00	\$8.00	\$14.00	NC		\$5.00	\$3.00	\$10.00	\$3.00	
1982	\$6.50	\$16.00	\$10.50	\$20.00	NC		\$7.50	\$3.00	\$13.00	\$3.00	\$3.00
1984	\$9.00	\$18.50	\$13.00	\$22.50	NC		\$10.00	\$7.50	\$17.50	\$5.50	\$3.00
1985	\$9.00	\$18.50	\$13.00	\$22.50	NC		\$7.50	\$5.00	\$17.50	\$5.50	\$3.00
1986	\$9.00	\$18.50	\$13.00	\$22.50	NC		\$7.50	\$5.00	\$15.00	\$5.50	\$5.00
1988	\$12.00	\$20.00	\$16.00	\$26.00	\$4.00		\$12.00	\$8.00	\$18.00	\$7.50	\$5.00
1991	\$13.00	\$21.50	\$17.50	\$28.00	\$4.50		\$13.00	\$9.00	\$20.00	\$8.00	\$5.00

<sup>a</sup> There was no charge (NC) for Minnesota residents 65 or older from 1974-1987. From 1988-1994, senior citizens could apply for a rebate of the license purchase price. Since 1995, there has been no rebate available for this license type.

<sup>b</sup> This is the price of a license per 100 feet of net. From 1946-1978 Minnesota residents were allowed to fish with two 100 foot nets, at double the license price. Since 1979, a whitefish netter has been limited to using 100 feet of net.

<sup>c</sup> When first issued, trout stamps were required for anglers between the ages of 18 and 64. Since 1985, trout stamps have been required for anglers between the ages of 16 and 64. Anglers with a one day license have not been required to purchase a trout stamp since 1989.

Table 6. History of fishing license price changes that applied to nonresidents fishing in Minnesota. Only those years in which there was a price fluctuation(s) or new license options added are shown.

Year	Individual	Combination	Combination 14 Day	Individual 7 Day	Individual 3 Day	Individual 2 Day	Individual 1 Day <sup>a</sup>	Season Fish House	7 Day Fish House
1911	---								
1914	\$1.00								
1922	\$2.00								
1923-29	---								
1930	\$3.00								
1937	\$4.00								
1939	\$3.00	\$4.50							
1947	\$4.00	\$4.50							
1950	\$4.00	NA							
1961	\$5.25	\$8.25							
1966	\$5.25	NA				\$3.00			
1968	\$5.25	\$9.00			\$3.00				
1970	\$6.50	\$10.00			\$3.00				
1977	\$10.00	\$15.00			\$5.00				
1980	\$10.00	\$15.00			\$5.00			---	
1982	\$15.00	\$20.00		\$10.50	NA		\$5.00	\$15.00	
1984	\$17.50	\$22.50		\$13.00	NA		\$7.50	\$17.50	
1986	\$18.50	\$30.00		\$15.50	\$12.50		---	\$17.50	
1987	\$18.50	\$30.00	\$25.00	\$15.50	\$12.50		\$7.00	\$17.50	
1988	\$20.50	\$33.00	\$25.00	\$17.50	\$14.50		\$7.00	\$22.00	
1991	\$22.50	\$36.00	\$27.50	\$19.00	\$16.00		\$7.50	\$24.00	
1992	\$27.50	\$37.50	\$27.50	\$19.00	\$16.00		\$7.50	\$24.00	
1994	\$27.50	\$37.50	\$27.50	\$19.00	\$16.00		\$7.50	\$24.00	\$16.50

<sup>a</sup> Since 1987, one day fishing licenses have been available for purchased by either Minnesota residents or nonresidents.



Table 7. Mean number of anglers, fish houses, and boats registered in Minnesota by decade. The percent change in these decade values is presented by comparing to the previous decade and also by the absolute change since the first decade for which records were available. The last table segment presents the number of licenses by decade for each license in the 1920s (or for a fish house in the 1930s or boat in the 1960s).

Decade	Resident Anglers	Nonresident Anglers	Total Anglers	Fish Houses	Boats Registered
<b>Decade Means</b>					
1920	417,461	49,432	466,893		
1930	506,218	64,208	570,426	11,571	
1940	744,887	176,451	921,338	21,946	
1950	997,871	298,174	1,296,044	51,637	
1960	1,039,420	317,225	1,356,645	59,552	231,454
1970	1,062,501	401,498	1,463,999	71,758	444,006
1980	1,165,918	358,722	1,524,640	96,782	641,543
1990	1,216,879	353,776	1,570,656	113,560	734,123
<b>Percent Change from Previous Decade</b>					
1930	21.3%	29.9%	22.2%		
1940	47.1%	174.8%	61.5%	89.7%	
1950	34.0%	69.0%	40.7%	135.3%	
1960	4.2%	6.4%	4.7%	15.3%	
1970	2.2%	26.6%	7.9%	20.5%	91.8%
1980	9.7%	-10.7%	4.1%	34.9%	44.5%
1990	4.4%	-1.4%	3.0%	17.3%	14.4%
<b>Absolute Increase Since Licenses Were Required<sup>a</sup></b>					
1930	121.3%	129.9%	122.2%		
1940	178.4%	357.0%	197.3%	189.7%	
1950	239.0%	603.2%	277.6%	446.3%	
1960	249.0%	641.7%	290.6%	514.7%	
1970	254.5%	812.2%	313.6%	620.2%	191.8%
1980	279.3%	725.7%	326.5%	836.4%	277.2%
1990	291.5%	715.7%	336.4%	981.4%	317.2%
<b>Number of Licenses Sold for Each License Sold in the 1920s<sup>a</sup></b>					
1930	1.2	1.3	1.2		
1940	1.8	3.6	2.0	1.9	
1950	2.4	6.0	2.8	4.5	
1960	2.5	6.4	2.9	5.1	
1970	2.5	8.1	3.1	6.2	1.9
1980	2.8	7.3	3.3	8.4	2.8
1990	2.9	7.2	3.4	9.8	3.2

<sup>a</sup> Fish houses are based on a fish house license sold in the 1930s, and boats are based on 1960s registration. Resident and nonresident angler values are based on anglers who purchased a fishing license in the 1920s.

Table 8. Number of boats registered in Minnesota by boat type and number of Minnesota residents per registered boat.

Year	Boat Type						Total Boat Registration	Residents per Boat
	Boats under 16 feet	Boats over 16 feet	Sailboats and Sailboards	Canoes and Kayaks	Personal Watercraft	Other Boats		
1959-60							157,767	21.3
1961-62							206,049	16.8
1963							198,715	17.8
1964							209,654	17.0
1965							215,695	16.7
1966							237,630	15.2
1967							252,795	14.5
1968	184,995	74,988					259,983	14.2
1969	192,917	78,197					271,114	13.9
1970	204,081	80,577					284,658	13.4
1971	218,458	86,126					304,584	12.7
1972 <sup>a</sup>	249,544	101,178	7,645	41,675		858	400,900	9.7
1973	248,139	100,823	10,689	56,183		1,267	417,101	9.3
1974	254,590	102,475	13,789	72,285		1,624	444,763	8.8
1975	255,553	105,288	14,535	76,330		1,627	453,333	8.6
1976	277,023	118,271	17,682	88,432		1,936	503,344	7.9
1977	284,085	126,112	19,470	94,717		1,939	526,323	7.6
1978	284,439	132,691	20,810	101,322		1,940	541,202	7.4
1979	293,948	143,785	20,937	103,356		1,824	563,850	7.2
1980	296,969	149,424	22,002	110,160		1,839	580,394	7.0
1981	300,755	164,125	20,920	105,779		1,821	593,400	6.9
1982	302,785	160,529	23,894	121,004		1,965	610,177	6.8
1983	303,799	167,203	24,731	125,229		1,910	622,872	6.7
1984	299,637	173,831	25,579	128,361		1,883	629,291	6.6
1985	286,204	182,842	22,881	131,380		22,014	645,321	6.5
1986	287,179	192,399	22,783	134,171		18,747	655,279	6.4
1987	294,608	204,856	22,299	137,036		21,280	680,079	6.2
1988	289,736	220,115	23,995	136,657		22,025	692,528	6.2
1989	288,618	233,076	23,927	139,909		20,555	706,085	6.2
1990	276,180	242,301	23,738	141,996		30,587	714,802	6.1
1991	275,790	250,888	19,657	141,668	7,715	27,354	723,072	6.1
1992	271,731	257,003	21,843	143,326	9,017	24,232	727,152	6.1
1993	265,217	263,034	20,842	144,621	10,611	23,791	728,116	6.2
1994	264,228	271,328	19,889	145,089	13,740	23,882	738,156	6.2
1995	260,493	279,393	19,067	147,451	18,484	24,008	748,896	6.2
1996	254,440	287,355	18,577	150,221	23,913	24,162	758,666	6.1

<sup>a</sup> Watercraft registration was expanded to include sailboats, canoes and kayaks in 1972.

## SUBJECT CATEGORIES AND DEFINITIONS

**Age and Growth:** references that contain a discussion of age, growth, size (length or weight) at age, or techniques and structures used to determine ages and estimate growth.

**Angler Attitude:** includes those references that deal with fishing quality, fishing trip quality, and the Weithman-Anderson index.

**Angler Behavior, Ethics, and Compliance:** articles dealing with how anglers behave (i.e., where and how often they fish), angling or angler ethics, and regulation violation rates.

**Angler Characteristics:** those articles that discuss any demographic characteristics of anglers or descriptions of their fishing gear.

**Angler Motivations, Preferences, and Perceptions:** includes those references that deal with why anglers fish, what type of experience they are seeking, species sought, perceptions of fishing, or preferences of several fisheries management options or regulations.

**Border Waters:** creel surveys from waters on any of Minnesota's borders.

**BWCAW AND VNP:** creel surveys that include waters within the Boundary Waters Canoe Area Wilderness or Voyageurs National Park.

**Catch and Release:** those creel surveys that specifically discuss the viability or practice of catch and release fishing.

**Creel Accuracy:** articles that deal with the accuracy or precision of creel survey methods.

**Creel Estimates Statewide:** references that contain statewide estimates of catch or fishing pressure.

**Creel Formulas:** those creel survey studies that contain the expansion formulas used in calculating the fishing pressure or harvest estimates.

**Creel Questionnaire Design:** those studies that contain an example field sheet used to collect creel survey or angler attitude data.

**Creel Sampling Access Based:** creel survey which specifically mention that they were access based.

**Creel Sampling Aerial Survey:** those creel surveys that used aircraft as some part of estimating fishing pressure (this does not in-

clude the annual aerial winter fish house counts in Minnesota, for these studies see fish house counts).

**Creel Sampling Angler Return Card:** includes those creel surveys where a creel clerk gave anglers a return card to be completed at the end of a fishing trip.

**Creel Sampling Charter Boats, Fishing Guides and Launches:** lists the creel survey reports that discuss some aspect or relative success of hiring a fishing guide (includes estimates from large lake launches, fishing guides, and Lake Superior charter boats).

**Creel Sampling Complete Census:** a listing of those articles that completely censused the recreational fishery.

**Creel Sampling Instantaneous Counts:** includes all references that specifically mentioned using instantaneous counts to estimate fishing pressure or recreational surface use.

**Creel Sampling Mail Survey:** those articles that discuss using mail surveys to sample the angling catch or attitude of Minnesota's anglers, including examples of the survey instrument.

**Creel Sampling Probability:** creel surveys that used probabilities to determine sampling efforts.

**Creel Sampling Resort Based:** creel surveys that were based or conducted from a privately owned resort(s).

**Creel Sampling Roving:** those creel surveys that used a roving creel clerk(s).

**Creel Sampling Stratified Random:** a listing of creel surveys of which used some form of stratified random sampling procedures.

**Creel Sampling Systematic:** creel surveys that used a systematic approach to sampling.

**Creel Sampling Volunteer Reporting and Data Collection:** those studies that used angler diaries or volunteers to collect creel survey information.

**Creel Survey Design:** those creel reports which give very specific details on the sampling design or include a survey sampling schedule.

**Economic:** references that discuss the cost of creel surveys or present the value and economic impact of the recreational fishery.

**Fishery Urban:** those creel surveys from highly urbanized areas.

**Fish House Counts:** includes all references that present the number of fish houses present during the winter on Minnesota's waters.

**Great Lakes:** references that refer to the Great Lakes (specifically Lake Superior) or the North Shore.

**Historical Accounts or Comparisons:** includes early historical information, as well as creel survey reports which make comparisons with earlier estimates.

**Lake and Reservoir:** creel surveys that were conducted on lakes and reservoirs, excluding lakes in the Large Lake Program.

**Large Lake:** creel surveys that were conducted only on lakes included in Minnesota's Section of Fisheries Large Lake Program.

**Length-Weight Relationships:** includes all references that discuss or present length-weight relationships.

**License:** confined to papers dealing with fishing license sales and trends.

**Marking:** papers that discuss marking fish, the techniques used, mark identification, associated side-effects, or recovery by anglers.

**Mine Pit:** those creel surveys that were conducted in abandoned iron-ore, gravel, or granite quarry pits.

**Mississippi River:** all creel surveys conducted along the Mississippi River in Minnesota, from Lake Itasca to Pool 9.

**Movement and Migrations:** vertical and horizontal fish movements, and distribution within a water body, including location of tag returns by anglers.

**Popular Articles:** includes angler accounts or how to fish information. Most often these appeared in outdoor magazines, the *Minnesota Volunteer*, or government handouts for the public.

**Population Studies:** measurement of population parameters including abundance, mortality, population estimates, exploitation, survival, maturity schedules, recruitment, year-class strength, standing crop, production, and yield.

**Recreational Surface Use:** surveys which included estimates of other recreational surface use of lakes and rivers (boating, water skiing, sailing, etc.).

**Regulations:** reports that discuss special regulations or present creel survey estimates by regulation (these regulations include size limits, seasons, catch limits, gear restrictions, and others).

**River:** surveys that were conducted on streams and rivers, excluding references from the Mississippi River.

**Spearing:** creel surveys that discuss specifically the winter spear fishery for northern pike.

**Species Listings:** groupings by fish species when a particular fish was discussed in some detail beyond normal creel survey results.

**Stocking:** locale, numbers and rates, as well as the assessment of stocking as a management tool and the return of stocked fish to the anglers creel.

**Tournament Fishing:** includes references that deal with various aspects or catch by tournament anglers or from smaller local fishing contests.

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