BOATING TRENDS ON LAKE MINNETONKA, 1984 TO 2004

Monitoring boating conditions on Lake Minnetonka is a cooperative research activity of the Lake Minnetonka Conservation District, and the Minnesota Department of Natural Resources Boating Safety Program, and Trails and Waterways Division

Report prepared by:
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SUMMARY

INTRODUCTION

Lake Minnetonka is one of the busiest recreation boating lakes in the State of Minnesota. The Lake is situated at the fringe of the heavily built-up part of the Twin Cities metropolitan area, and is located where the most rapid metropolitan-wide population growth is occurring. From a population perspective, recreation pressure on the Lake can only be expected to continue to grow for the foreseeable future.

Recreational boating on Lake Minnetonka has been studied with a consistent methodology since 1984. The methodology includes aerial counts of boat numbers and types; aerial estimations of sources of the boats on the water (e.g., public accesses, marinas); and surveys of boaters about their activities, equipment and experience on the water. All studies cover the summer period from Memorial Day weekend to Labor Day. The Minnesota Department of Natural Resources (MN DNR) and the Lake Minnetonka Conservation District (LMCD) have designed and funded these studies. Within the MN DNR, funding has come from two programs: Water Recreation, and Boat and Water Safety. Private contractors have carried out the data collection for the studies.

This paper is a summary of the major patterns and trends on the Lake during the last two decades. Boating patterns are put into a larger context of boating in the Twin Cities and throughout Minnesota, so the particular characteristics of Lake Minnetonka boating can be effectively portrayed.

BOAT NUMBERS AND SOURCES

Boating in the Twin Cities metropolitan area — where Lake Minnetonka is located — is quite different than boating in the more rural parts of the state. The major difference is the far higher intensity of boating in the metro area. Intensities (boats per acre of water) on typical metro lakes exceed by a factor of four to five those in popular rural lake regions, such as the Brainerd Region. Within the metro area, the largest water bodies are the most popular, as indicated by their intensity of use. Minnetonka (14,034 acres) and the St. Croix River (8,215 acres—Arcola Sandbar to mouth) are the two largest and two most intensively used water bodies in the metro area.

Between 1984 and 2004 average boat numbers at peak times on weekend/holiday afternoons on Lake Minnetonka declined, and the decline is statistically significant. Prior to the 2004 study, there was evidence of a decrease in average weekend/holiday afternoon boat numbers from 1984 to 2000, but the decrease was not statistically significant. Stable boat numbers was the indication. Other trend studies from the 1980s to 1990s/early 2000s also pointed to stable boat numbers. The St. Croix River, too, had stable boat numbers from the early 1980s to the late 1990s. In short, the Lake Minnetonka boating decline is the first such indication from a boating study, and it will need to be followed in the future.

On weekdays on Lake Minnetonka, boat counts are fewer in number, and there is no evident trend in average boat numbers, either upward or downward. The 2004 average is lower than either 1996 or 2000, but the differences are not statistically significant.

It should be noted that — although the 2004 "average" boat counts are lower than previous years — maximum boat counts are higher. For both weekends/holidays and weekdays, 2004 had the highest daily boat counts ever recorded since 1984. Large number of boats still go out on the Lake, but apparently just not "on average".

The summer of 2004 was cooler than normal, and this may have diminished boating somewhat, but it does not appear to be a primary factor in accounting for the low number of boats. One other factor that could potentially contribute to lower boat numbers from the aerial counts is a temporal shift in boating use (e.g., a shift from weekends to weekdays, or from afternoons to mornings); this, however, does not appear to be a major factor in accounting for the low boat numbers.

The spatial distribution of boating on the Lake has been largely constant from 1984 to 2004. The southwest part of the Lake has the least number of boats relative to lake surface area, while the east and northwest have substantially higher boat numbers (60% to 80% higher).

The source of boats has changed over time. The long-term trend prior to the 2004 study was: increasing relative contribution from public access, decreasing contribution from commercial access (marinas, private ramps, boat rentals, dry stack), and stable contribution from all other sources, which are comprised of riparian residents, municipal dock users, homeowner association dock users and any others. With the completion of the 2004 study, the relative contribution from public access continued to go up as it had prior to 2004. However, the relative contribution from commercial access broke with the long-term pattern and increased, while the contribution from all other sources broke with the long-term pattern and decreased. It should be noted that all sources produced fewer boats in 2004 than 2000, but some decreased more than others, which shifted the relative contributions among the sources. For 2004, the sources contributions are approximately as follows: public access—30%, commercial access—35%, municipal docks—10%, and riparian residents and homeowner associations—25%.

CHARACTERISTICS OF THE BOATING TRIP

Boating activities have changed since the 1980s: boat riding has increased and fishing has decreased. An increase in boat riding and a decrease in fishing is a general trend, experienced throughout the Twin Cities and in both the Brainerd and Central Lake Regions.

When asked what boating opportunities are not adequate on the Lake, boaters from all sources judge opportunities to get off the water at a lakeshore wayside as the most inadequate. The next most inadequate are opportunities to beach a boat and access a restaurant from the water. These results for 2004 are virtually the same as those found in the 2000 study.

The type of watercraft is more substantial, more expensive than in the past. Runabouts and cruisers (has cabin) have increased over time, while fishing boats (utility boats without windshields, not related to the activity of fishing) have decreased.

Consistent with the trend in type of watercraft, boats are longer and more powerful today than they were in the past. Boat lengths have increased nearly 3 feet since 1992, and engine sizes have shown an increase of about 90 horsepower since 1984.

THE BOATING EXPERIENCE

Boating is an enjoyable experience on Lake Minnetonka. Nearly 60 percent of all boaters are "very satisfied" with their outing, and most of the rest are "satisfied". Dissatisfaction to any extent is small. Over time, satisfaction levels have increased.

Although satisfaction levels are high, boaters do experience problems on the water. The leading problem is Eurasian watermilfoil. The next two top-ranked problems have to do with other boaters: high wakes, and inconsiderate operation of boats.

For most problems, severity ratings changed little over the last few studies. Two problems, however, changed noticeably, and both became less severe since 1996. One of the problems is the use of personal watercraft and the other is the presence of Eurasian watermilfoil. Riparian residents led the decline in the severity rating of both watermilfoil and use of personal watercraft.

The intensity of boating (boats per acre of water) on Lake Minnetonka is high, even by boating standards in the Twin Cities metropolitan area. Crowding is a persistent problem on the Lake. Crowding, however, is not a growing problem on the Lake. Boaters judged conditions on the Lake in 1984 about the same as they do today.

Although Lake Minnetonka is perceived to be more crowded than other metropolitan lakes and rivers, less than 40 percent of boaters judge the number of boats on the Lake as "crowded" or "far too crowded." The majority of boaters describe the number of boats as "about right" or "few boats here." Most Lake Minnetonka boaters are experienced with conditions on the Lake, and most are not surprised by the number of boats they encounter.

BOATING SAFETY AND ENFORCEMENT

Lake Minnetonka is a congested place to boat and boating restrictions are commonly used to manage the congestion. Most boaters — when asked about the level of restriction on the water — think the amount of restriction is appropriate ("about right"). Few believe that it is "too restrictive." More believe it is "not restrictive enough." Nearly one-third of riparian residents (29%) believe it is "not restrictive enough."

Consistent with this perspective, boating restrictions are not commonly viewed in a negative light. Most boaters believe restrictions either do not affect their enjoyment of boating (54% of boaters) or add to their enjoyment (42%). Few believe restrictions detract from enjoyment (4%).

Boater sightings of enforcement officers on the Lake increased markedly from 1984 to a peak in 2000, after which sightings declined. In 2004, 45 percent of all boaters recall seeing an enforcement officer on their last outing. The level of enforcement effort is judged in 2004 by a majority of boaters as "about right" (52% of boaters). A much smaller portion thinks the effort is "too little" (14%) and even less think it is "too much" (4%). A sizable portion is unsure how to respond (30%), probably indicating that many boaters have little awareness of enforcement activities on the Lake.

Following the same trend as officer sightings, the portion of boaters reporting being checked by an enforcement officer rose steadily from less than 1 percent in 1984 to 3 percent in 2000, after which the portion declined to 2 percent in 2004. Nearly all boaters who were checked by enforcement officers gave the officers high marks for their professional behavior.

Boaters today are no more likely to have completed a boating safety course than boaters in the past. About one-third of boaters have completed such a course. A higher portion of boaters (49%) think that all boat operators should be required to complete a boating safety course. Some 39 percent of boaters believe motorboat operators should be required to have an operator's license. These portions are 10 to 20 percent higher than those found in the more rural Brainerd Lakes and Central Lakes Regions, suggesting that licensing and safety courses may be a more pressing concern in the metro area.

The types of beverages boaters have on board has changed little since it was first assessed in 1992. The portion of Minnetonka boaters with alcoholic drinks on board is above that found in the Brainerd Lakes and Central Lakes Region studies, and is similar to that found in the Mississippi River and Lake Superior studies.

Safety equipment has become more commonplace on boats since 1992. The increasing prevalence of safety equipment parallels the increasing size of the boats, a trend that was noted above.

PUBLIC ACCESS FACILITIES

As a group, the boaters who are launching through public access facilities are familiar with Lake Minnetonka and with the particular access they are using.

The geographic area from which boaters are drawn to Lake Minnetonka public accesses has not changed appreciably since 1984.

Boaters gave high marks to the public access facilities for landing and launching a boat in 2004, much higher marks than at any time in the past. In 2004, 71 percent gave "excellent" ratings and another 23 percent gave "good" ratings. The reason for the sharp increase in ratings between 2000

and 2004 is not fully known, but the increase is probably due — at least in part — to the opening of the large Grays Bay Access and closing of two smaller accesses on the same part of the Lake. The Grays Bay Access is a well-designed facility that can accommodate the large boats that access users are trailering today

Consistent with the increase in access ratings, the portion of boaters having a problem with the use of an access fell from 37 percent in 2000 to 28 percent in 2004. The primary use problem by far is the size of the access parking lot, which is the perennial leading problem on the Lake. Public accesses lots at Lake Minnetonka are routinely full to capacity. When they find the lot full, the large majority of boaters (94%) are able to boat on the Lake that day by going to another access, parking on the street/lot nearby, or waiting for a spot to open up in the lot. The next leading access use problem is small by comparison with the parking-space problem, and is an additional size-related concern: not enough maneuvering room on land near ramp for launching/landing. One item showed a marked decrease as a use problem from 2000 to 2004. "No dock" was a minor use problem in 2004, but it was the third-ranked problem in 2000.

When asked about improvements needed at the access site, boaters focused on the solution to their primary use problem, which is not enough parking spaces in the access lot. The 2004 improvement requests reflect two major differences from 2000 requests. The first concerns docks to ease launching, which fell from 33 percent of boaters in 2000 to 4 percent in 2004. The fall in dock requests parallels the drop in docks as an access use problem. The other item that changed was requests for better enforcement, which was the least requested improvement in 2000, but the third most requested in 2004.

On a similar topic, boaters were asked about the types of information they would want available at public access sites. Leading the list of requests — in both 2004 and 2000 — is information on boating restrictions, followed by information on boating hazards, and emergency information. Two items (depth map of lake and fishing information) show decreased requests between 2000 and 2004.

The potential use problems of one particular group were queried in the survey: boaters with disabilities that affect when and where they boat. Some 4 percent of access users (11 survey respondents) identified themselves as disabled. Most of these (all but two survey respondents) found the access suitable for their needs. Only one of the two boaters who found the access inadequate gave a reason for the inadequacy, which concerned the long distance from the parking spot to the launch site. This boater had an artificial knee; the boater did not park — for whatever reason — in a designated spot for people with disabilities.

Boaters were asked in the surveys if additional public access is needed on Lake Minnetonka. Few (13%) responded that more access is needed. Boaters intercepted at a public access during the study saw the highest need for more access (27%), but the large majority of such boaters still saw little additional need. Overall, the indication is that most boaters feel well supplied with public access at present.

Boaters who saw a need for more public access were asked where on the Lake additional access is needed. Most boaters specified a location (74%), while some simply responded "anywhere" (26%). Of those who identified a location, nearly two-thirds (63%) indicated the east side of the Lake.

PREVENTING THE SPREAD OF EXOTIC SPECIES

Eurasian watermilfoil is considered a leading problem by Lake Minnetonka boaters. In 1992, shortly after the plant's arrival in the Lake, public access boaters were not convinced that Eurasian watermilfoil represented a serious problem. At the same time, riparian residents were very concerned about the plant, and a sizable perceptual gap existed between the two groups. The gap has closed considerably since 1992, but has not closed fully. The trend for public access boaters is toward increasing problem severity ratings, while the trend for riparian residents is toward decreasing problem severity ratings.

Since 1996, boaters have been asked about the actions they take after removing a boat from Lake Minnetonka to help prevent the spread of exotic species such as Eurasian watermilfoil and zebra mussels. In 2004, 22 percent of Lake Minnetonka boaters report that they annually transport their boat between Lake Minnetonka and another body of water. Only 3 percent report transporting their boat between Minnetonka and the Mississippi River downstream of St. Paul, where the nearest zebra mussel infestation occurs.

Nearly all boaters who transport their boat between Lake Minnetonka and another body of water report doing a few simple things all the time. They conduct a visual inspection of their boat and equipment, clean off vegetation and mussels, and drain water from the boat. Actions that require special equipment or more effort are done less routinely. Such actions include rinsing the boat with hot water of high-pressure water, and allowing the boat to dry for five days. The frequency with which actions are taken has not changed a great deal since 1996.

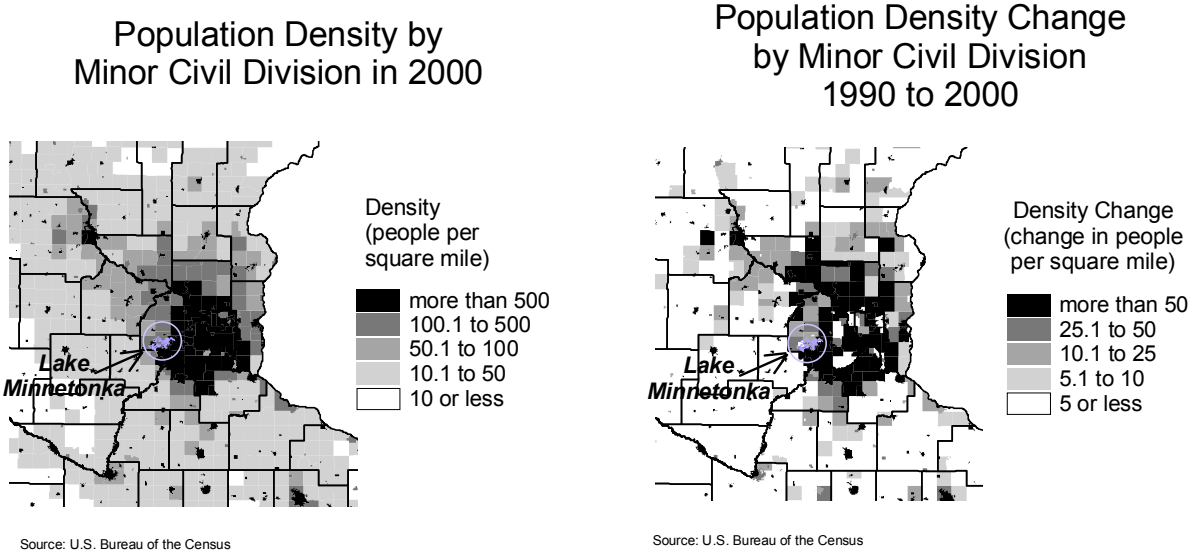
INTRODUCTION

Lake Minnetonka is one of the busiest recreation boating lakes in the State of Minnesota. Located in the Twin Cities metropolitan area, Lake Minnetonka has been a prime destination for outdoor enthusiasts for some time. Years ago, the Lake was in a rural setting, and it functioned as a vacation destination for railroad travelers from Twin Cities central cities. The cities have grown outwards over the years, and the Lake has shifted from serving vacationers to serving day users, who are both local residents and central-city dwellers.

Today, Lake Minnetonka is situated at the fringe of the heavily built-up part of the Twin Cities, as evidenced by the density of population surrounding the Lake (Figure 1). It is also located where the most rapid metropolitan-wide growth is occurring, and should be expected to occur in the ensuing years. From a population perspective, recreation pressure on the Lake can only be expected to continue to grow for the foreseeable future.

Figure 1

Population Patterns In and About the Greater Twin Cities Metropolitan Area



Recreational boating on Lake Minnetonka has been studied with a consistent methodology since 1984 (Table 1). The methodology includes aerial counts of boat numbers and types; aerial estimations of sources of the boats on the water

Table 1

Lake Minnetonka Recreational Boating Studies
(all studies extend from Memorial Day weekend to Labor Day)

Year	Aerial Boat Counts	Boater Surveys	Funder	Comments
1984	Weekend/holiday and weekday counts	Surveys of boaters from public access, commercial access, and lake homes	MNDNR	Part of a larger Twin Cities boating study
1986	Weekend/holiday counts		LMCD	
1987	Weekend/holiday counts		LMCD	
1992	Weekend/holiday and weekday counts	Surveys of boaters from public access, commercial access, and lake homes	LMCD & MNDNR	
1994	Weekend/holiday counts		LMCD & MNDNR	
1996	Weekend/holiday and weekday counts	Surveys of boaters from public access, commercial access, and lake homes	LMCD & MNDNR	Coordinated with a larger Twin Cities boating study
1998	Weekend/holiday counts		LMCD & MNDNR	
2000	Weekend/holiday and weekday counts	Surveys of boaters from public access, commercial access, and lake homes	LMCD & MNDNR	
2004	Weekend/holiday and weekday counts	Surveys of boaters from public access, commercial access, lake homes, and municipal docks	LMCD & MNDNR	

(e.g., public accesses, marinas); and surveys of boaters about their activities, equipment and experience on the water. All studies cover the summer period from Memorial Day weekend to Labor Day. The Minnesota Department of Natural Resources (MN DNR) and the Lake Minnetonka Conservation District (LMCD) have designed and funded these studies. Within the MN DNR, funding has come from two programs: Water Recreation, and Boat and Water Safety. Private contractors have carried out the data collection for the studies.

This paper is a summary of the major patterns and trends on the Lake during the last two decades. Boating patterns are put into a larger context of boating in the Twin Cities (MN DNR, 1997) and throughout Minnesota (MN DNR, regional boating studies, 1999 to 2004), so the particular characteristics of Lake Minnetonka boating can be effectively portrayed. The report is presented as follows:

- Boat numbers and sources, including trends in spatial pattern of boating on the Lake.
- Characteristics of the boating trip, including trends in boating activities, types of watercraft, and sizes of watercraft.
- The boating experience, including trends in boating satisfaction, problems encountered on the water, and crowding.

- Boating safety and enforcement, including trends in boater's awareness of enforcement officers on the water, and boater's opinions on the level of boating restrictions and enforcement presence.
- Public access facilities, including ratings of public access facilities, problems in the use of facilities, improvements boater's would like to see at facilities, and need for additional facilities.
- Preventing the spread of exotic species, including trends in the perception of Eurasian watermilfoil as a problem on the Lake.

Detailed methodological descriptions are minimized in this summary paper, and only general descriptions of methods are presented. Appendix A has a fuller description of methodology. Each study has a detailed methodological document available for review.

Efforts have been made to keep the studies comparable over time, and this has largely been accomplished. However, one particular point needs to be made concerning trends analysis. Trends results based on boater survey information only include surveys with boaters from public accesses and riparian residences, because these are the two sources of boaters that have been done in a consistent fashion over the period from 1984 to 2004. The exclusion of other sources of boater limits but does not preclude trend analysis. There are many evident trends exhibited by boaters from public accesses and riparian residences that are clearly of a general nature. Such trends are presented throughout the paper. Appendix A gives a more detailed description of this particular point.

BOAT NUMBERS AND SOURCES

Boating in the Twin Cities metropolitan area — where Lake Minnetonka is located — is quite different than boating in the more rural parts of the state. The major difference is the far higher intensity of boating in the metro area. Intensities (boats per acre of water) on typical metro lakes exceed by a factor of four to five those in popular rural lake regions (e.g., Brainerd Lakes Region) (see MN DNR, 1997 and 1999). Compounding this higher boating intensity in the metro area is the portion of boats that are moving and add to congestion, since a moving boat consumes more space than a stationary one. In the metro area, the portion moving is twice that of the Brainerd area (two-thirds moving versus one-third). Recreation boating, like many aspects of urban living, involves having a lot of other people around.

Within the metro area, the largest water bodies are the most popular, as indicated by their intensity of use (boats per acre of water). Minnetonka (14,034 acres) and the St. Croix River (8,215 acres — Arcola Sandbar to mouth) are the two largest and two most intensively used water bodies. Together these two water bodies account for 43 percent of metro-wide boating in 1996 but only 30 percent of metro-wide water surface area on boating lakes and rivers (lakes/rivers over 100 acres with permanent fish populations). The St. Croix River had a higher intensity of boating use than Lake Minnetonka in the 1990s.

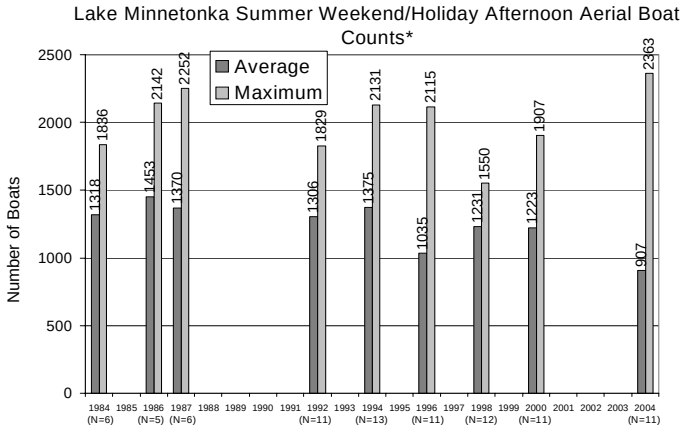
Between 1984 and 2004 average boat numbers at peak times on weekend/holiday afternoons on Lake Minnetonka declined, and the decline is statistically significant (Figure 2)(see Appendix B for details on statistical tests). Prior to the 2004 study, there was evidence of a decrease in average weekend/holiday afternoon boat numbers from 1984 to 2000, but the decrease was not statistically significant. Stable boat numbers was the indication. Other trend studies from the 1980s to 1990s/early 2000s also pointed to stable boat numbers (MN DNR, regional boating studies, 1997, 1999 and 2002). The St. Croix River, too, had stable boat numbers from the early 1980s to the late 1990s (Figure 3). In short, the Lake Minnetonka boating decline is the first such indication from a boating study, and it will need to be followed in the future.

On weekdays on Lake Minnetonka, boat counts are fewer in number, and there is no evident trend in average boat numbers, either upward or downward (Figure 4)(see Appendix B for details on statistical tests). The 2004 average is lower than either 1996 or 2000, but the differences are not statistically significant. The low average in 1992 is due mainly to earlier flight times in mid afternoon, prior to peak numbers that occur in late afternoon when the boat counts are supposed to be scheduled. The 1992 weekday flight times were a mistake; flights were conducted at the same time as the mid-afternoon weekend/holiday flight times.

It should be noted that — although the 2004 “average” boat counts are lower than previous years — maximum boat counts are higher. For both weekends/holidays and weekdays, 2004 had the highest daily boat counts ever recorded since 1984. Large number of boats still go out on the Lake, but apparently just not “on average”.

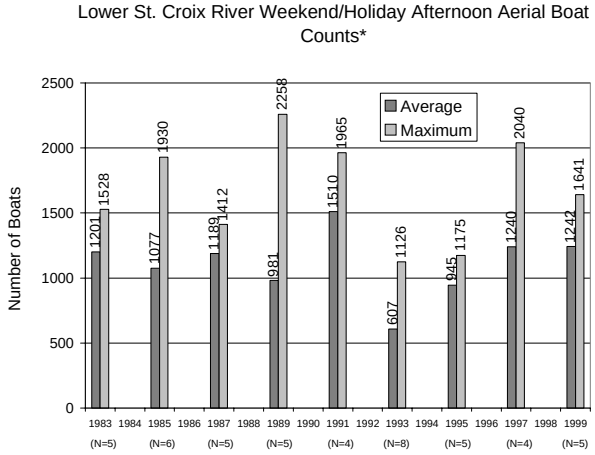
Another good indicator of the low “average” number of boats in 2004 comes from the public access boat counts. During the aerial flights, empty boat trailers are counted at the public accesses lots (and at overflow sites) to determine the

Figure 2



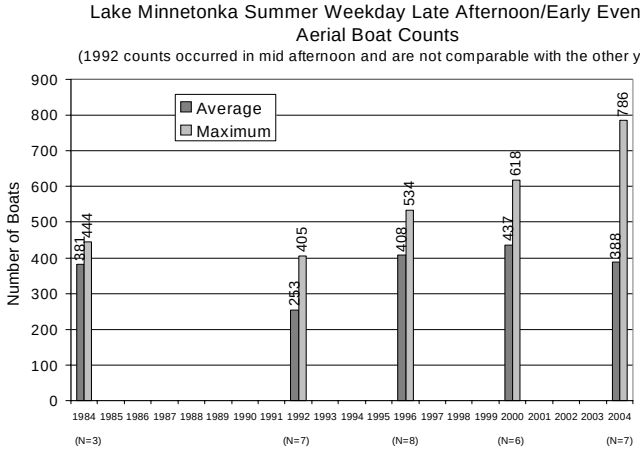
* excludes 5 inclement weather counts between 1984 and 2004

Figure 3



*counts beginning between noon and 6 p.m. Source of data is MWBAC, 1983 to 1999.

Figure 4



contribution of public access to all boats on the water. The count is relatively straightforward and, thus, is considered one of the more accurate boating measures in the studies. Public access contributes some 25 to 30 percent of all boats on the Lake.

Between the 2000 and 2004 study, the large Grays Bay public access opened, and increased *net* public access capacity to launch boats on the Lake (two smaller public accesses were closed when Grays Bay was opened). Capacity utilization is traditionally high for Lake Minnetonka public accesses, and the added capacity from Grays Bay would be expected to increase boats on the water from the accesses. The additional capacity, however, did not lead to an increase in boats from public access. The number of boats from public access actually fell from 2000 to 2004 on both weekend/holidays (7% decrease) and weekdays (5% decrease), providing further indications that 2004 was a low boating year.

It is well known that warmer days bring out more boats on Lake Minnetonka. The summer of 2004 was cooler than normal, and this may have diminished boating somewhat, but it does not appear to be a primary factor in accounting for the low number of boats. Although cooler, the 2004 summer was not without precedence in the boating studies (Table 2). Compared with 2004, the summer of 1992 was cooler and 1994 was comparable in terms of general warmness, and both years had substantially more boats on the Lake. Furthermore, the actual

Table 2

Weather for study years and weekend/holiday boat-count flight dates*

		Warmness of summer (cooling degree days in June, July, August)		*Warmness of weekend/holiday boat-count dates*	
Study year	Average number of boats on summer weekend/holiday afternoons	Number of CDDs**	Rank in last 100 years (1=warmest)	Average daily maximum temperature (^{o}F)	Median daily maximum temperature (^{o}F)
1984	1318	672	38	77.2	80
1986	1453	549	66	79.2	77
1987	1370	760	23	83.2	83
1992	1306	248	100	75.1	75
1994	1375	476	82	80.9	80
1996	1035	491	77	79.9	80
1998	1231	566	64	80.2	81
2000	1223	588	57	80.0	82
2004	**907**	**418**	**92**	**79.1**	**81**

*Source: Twin Cities weather data from Minnesota Climatology Working Group (MN DNR and University of MN); data at http://climate.umn.edu/doc/twin_cities/twin_cities.htm .

** CDD is cooling degree days, and is computed daily from the average daily temperature less 65 ^{o}F; the minimum daily CDD value is 0.

afternoon temperature on the dates of the 2004 flights were similar to many other years.

One other factor that could potentially contribute to lower boat numbers from the aerial counts is a temporal shift in boating use; this, however, does not appear to be a major factor in accounting for the low number of boats. The preceding boat counts occurred at peak times, which are mid afternoons for weekend/holidays and late afternoon for weekdays. It is possible that the decline at peak times is not indicative of declining boat numbers at all times. The decline could be, for example, due to boaters avoiding the peaks and shifting their use to lower use periods, whether from weekend/holidays to weekdays, or from the mid afternoon to morning or evenings on weekend/holiday.

An indicator of such temporal boating shifts is monitored in the boating studies through the riparian resident boating patterns derived from their boater survey. If any source of boaters has the fewest impediments to shifting their boating to less-congested (or any other) times, riparian residents would be a leading candidate. They can boat anytime they are at home, with little time devoted to transporting themselves and their boat to and from the Lake.

The riparian residents, in all survey years, were asked to indicate the date and time of their last boating outing. There was no pattern to when residents received their surveys initially or remails to nonrespondents, so there is no apparent bias in when they were asked about their most recent boating outing. Information on the most recent outing was analyzed for day of week, and time of day changes from 1984 to 2004.

Little if any change is evident in riparian resident boating over the years. The portion of boating that occurs on weekdays versus weekend/holidays fluctuates around the 50-50 level, which is common for outdoor recreation activities (Table 3). Within both weekdays and weekend/

Table 3

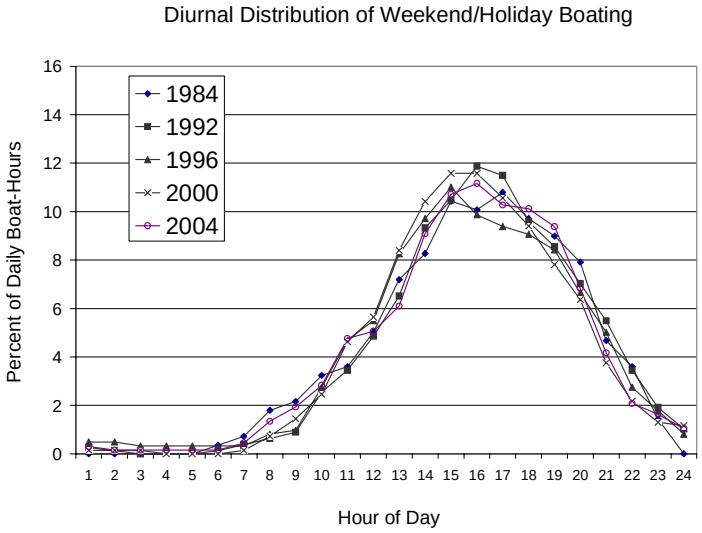
Distribution of Riparian Resident Boating Trips by Day of Week

Day of week	1984 (percent)	1992 (percent)	1996 (percent)	2000 (percent)	2004 (percent)	Average 1984 to 2004 (percent)
Weekends/holidays	45	58	47	53	54	51
Weekdays	55	42	53	47	46	49
Total percent	100	100	100	100	100	100
Number of respondents	*131*	*288*	*285*	*297*	*301*	

holidays the diurnal profiles of use from one year to the next are similar, and there is no apparent trend over time (Figure 5). The portion of boating that occurs within a window centered on the peak has stayed largely constant over time for both weekdays and weekend/holidays (Table 4). In short, there is no evidence that a shift in boating to lower-use (or higher-use) periods has occurred for riparian residents. This conclusion probably applies to the other sources of boaters, too, but the survey data are not adequate for a similar analysis. For public access boating, the study design selects the dates and times to intercept boaters as they exit or enter the Lake. Thus, the dates and times of boating outings are not

Figure 5

Daily Boating Patterns of Riparian Residents on Lake Minnetonka, 1984 to 2004



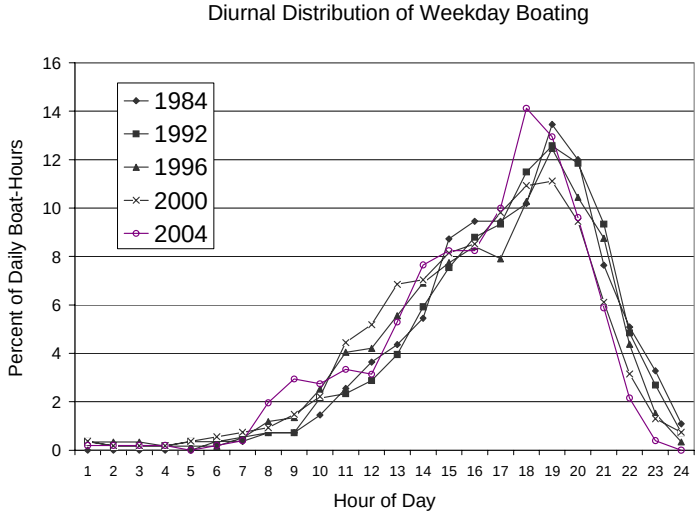


Table 4

Percent of Daily Riparian-Resident Boat-Hours That Occur Near the Boating Peak

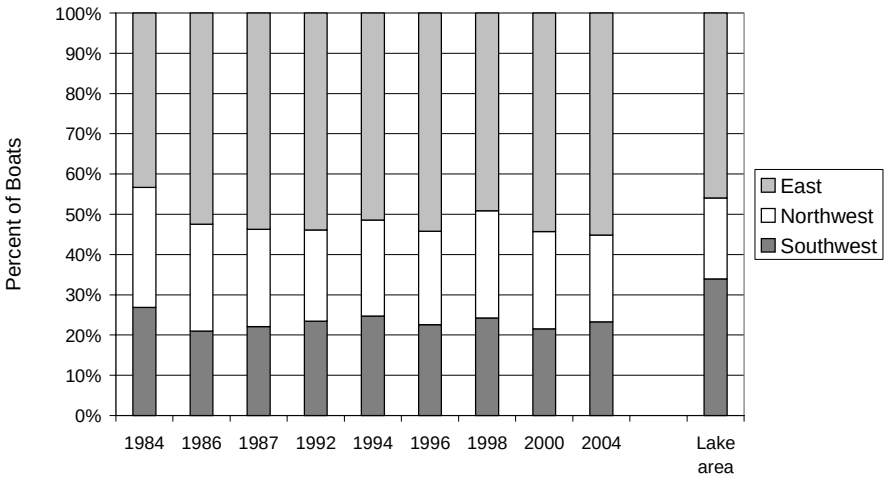
Day of week	Hour window around peak	1984 (percent)	1992 (percent)	1996 (percent)	2000 (percent)	2004 (percent)	Average 1984 to 2004 (percent)
Weekends/holidays	14:00 to 19:00	49	53	49	54	51	51
Weekdays	17:00 to 22:00	53	55	50	47	53	51

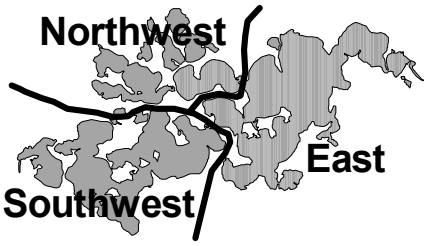
random like they are for riparian residents. If the municipal dock and marina surveys continue to be done as in 2004, each could be analyzed in the future for shifting temporal patterns like the riparian surveys.

The spatial distribution of boating on the Lake is largely constant over time (Figure 6). There is no major shift, for example, from the northwest part of the Lake to other places over time for either weekend/holidays or weekdays. A minor shift to the east part of the Lake is evident, however, for weekdays. The southwest part of the Lake has the least number of boats relative to lake surface area, while the east and northwest have substantially higher boat numbers (60% to 80% higher). Between weekend/holidays and weekdays there is remarkable stability in the distribution of use. Across all study years, the southwest averages 23 percent of all boats on the Lake for both weekend/holidays and weekdays, respectively; for the northwest the average is 25 percent for both weekend/holidays and weekdays; and the east averages from 52 to 53 percent for weekend/holidays and weekdays, respectively. The conclusion about the stability of the spatial pattern of use extends to the finer geographic scale of the 42 Lake management areas. In other words, largely the same portion of boats on weekend/holidays and weekdays are found in each of the 42 management areas from one study year to the next.

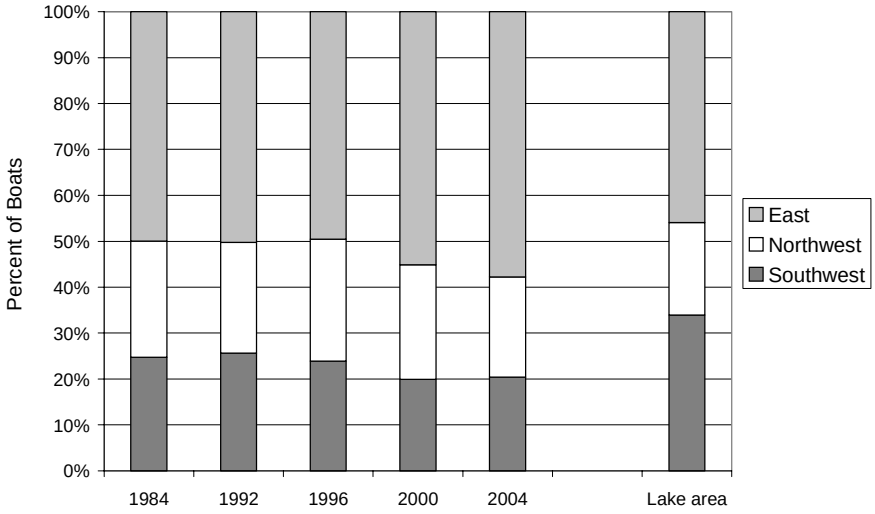
Figure 6

Geographic Distribution of Boats on Weekend/Holiday Afternoons





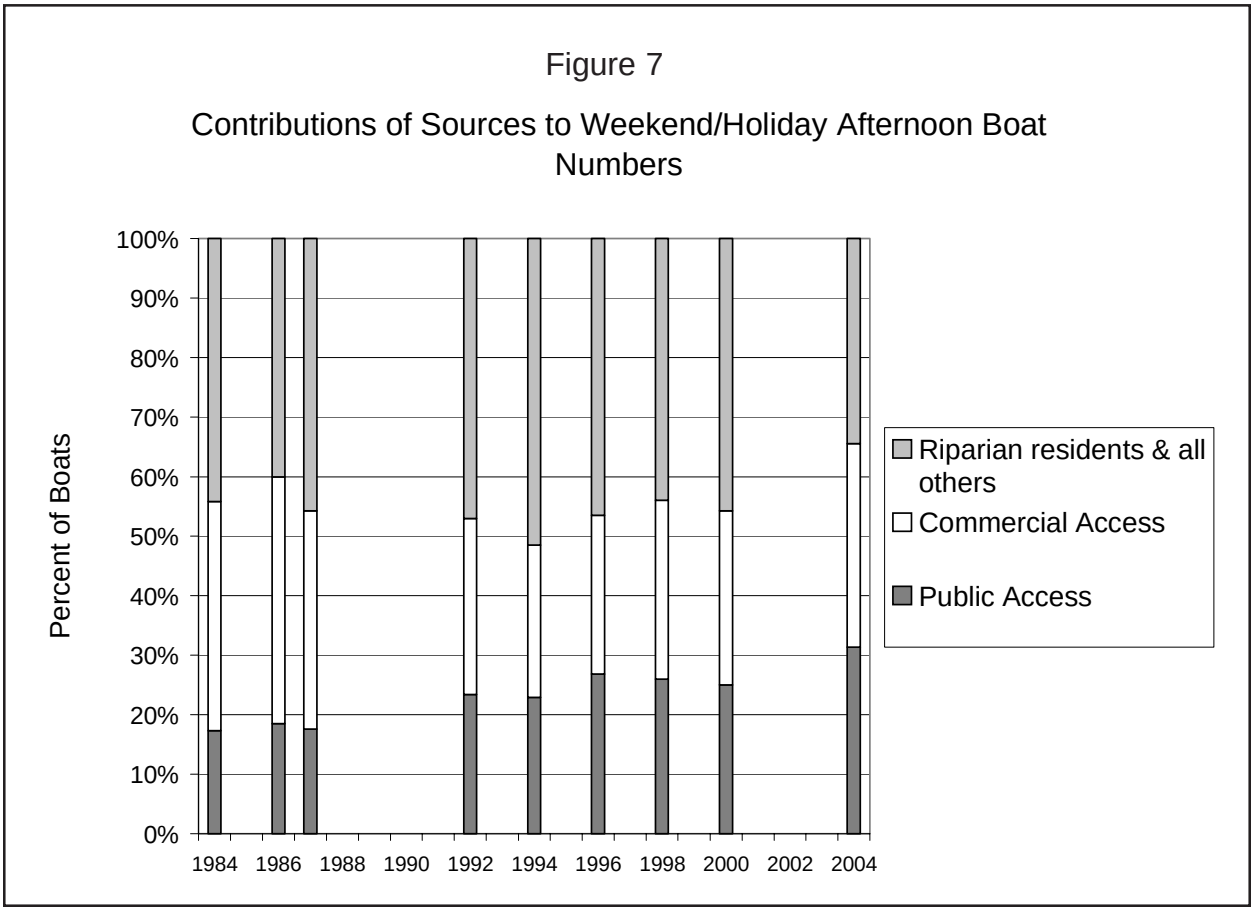
Geographic Distribution of Boats on Weekday Late Afternoons/Early Evenings



The source of boats has changed over time (Figure 7). The long-term trend prior to the 2004 study was: increasing relative contribution from public access, decreasing contribution from commercial access (marinas, private ramps, boat rentals, dry stack), and stable contribution from all other sources, which are comprised of riparian residents, municipal dock users, homeowner association dock users and any others.

With the completion of the 2004 study, the relative contribution from public access continued to go up as it had prior to 2004 (Figure 7). However, the relative contribution from commercial access broke with the long-term pattern and increased, while the contribution from all other sources broke with the long-term pattern and decreased. It should be noted that all sources produced fewer boats in 2004 than 2000, but some decreased more than others, which shifted the relative contributions among the sources. For 2004, the sources contributions are approximately as follows: public access—30%, commercial access—35%, municipal docks—10%, and riparian residents and homeowner associations—25%.

Figure 7

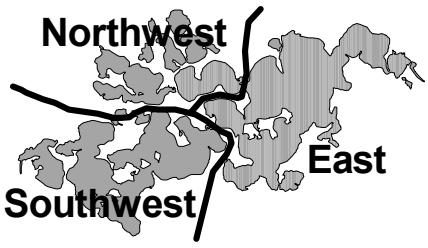


Between 2000 and 2004, the public access contribution to boating became more concentrated in the east part of the Lake, and less concentrated in the southwest part of the Lake (Table 5). The primary cause of the shift was probably the opening of the large Grays Bay public access on the east end of Lake. The new access replaced two smaller accesses on the same part of the Lake. The Grays Bay access accounted for one-third of all public access launchings on weekend/holidays and weekdays in 2004.

Table 5

Geographic changes in boats launched from public accesses on Lake Minnetonka
(based on aerial counts of empty boat trailers at public access facilities)

	---- *Weekend/holiday boats launched* ----			--------- *Weekday boats launched* ---------		
Access location on Lake	2004 study (percent)	2000 study (percent)	Difference (2004-2000)	2004 study (percent)	2000 study (percent)	Difference (2004-2000)
East	39%	28%	11%	41%	36%	4%
Northwest	37%	42%	-5%	40%	36%	4%
Southwest	24%	30%	-6%	19%	27%	-8%
Total percent	100%	100%	0%	100%	100%	0%
Average number of boats	*284*	*306*	*-22*	*111*	*116*	*-5*



CHARACTERISTICS OF THE BOATING TRIP

Boating activities have changed since the 1980s. The major change is a decrease in fishing and an increase in boat riding (Figure 8). The public access change from 1984 to 2004 is particularly marked: fishing fell from about 60 percent to 20 percent of outings, while boat riding rose from approximately 25 percent to 60 percent of outings. By the 2000 study, boating riding had overtaken fishing as the primary pursuit of boaters launching through public access. [Note: the large increase in the "other" activity category in 2004 is a survey technique problem that should be rectified the next time the study is done.]

An increase in boat riding and a decrease in fishing is a general trend, experienced throughout the Twin Cities and in both the Brainerd and Central Lake Regions (MN DNR, 1997, 1999 and 2002).

When asked what boating opportunities are not adequate on the Lake, boaters from all sources judge opportunities to get off the water at a lakeshore wayside as the most inadequate (Figure 9). The next most inadequate are opportunities to beach a boat and access a restaurant from the water. These results for 2004 are virtually the same as those found in the 2000 study.

Figure 8

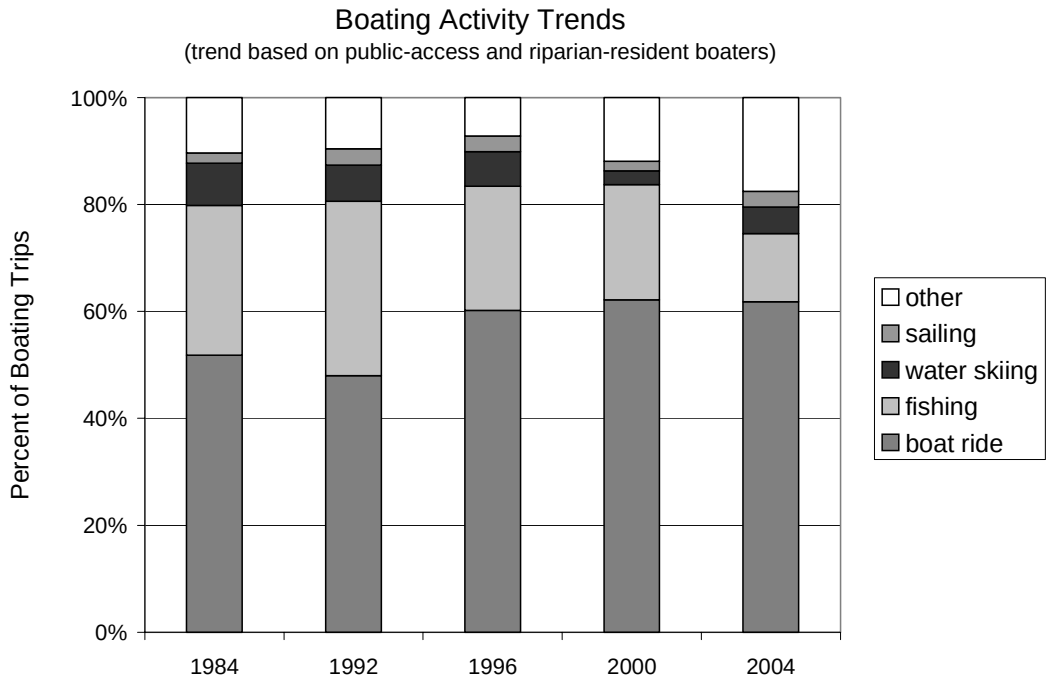
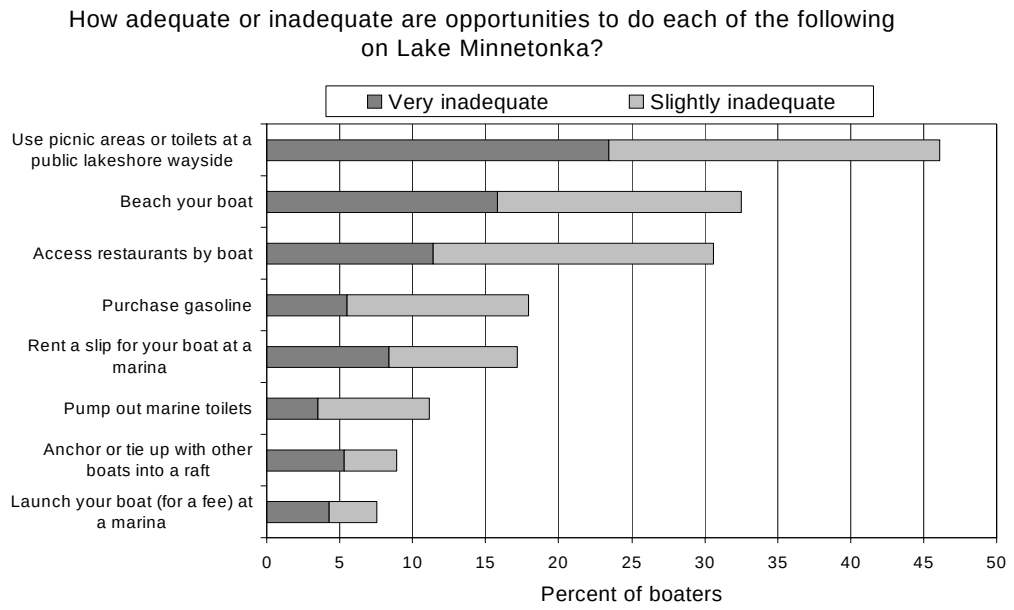
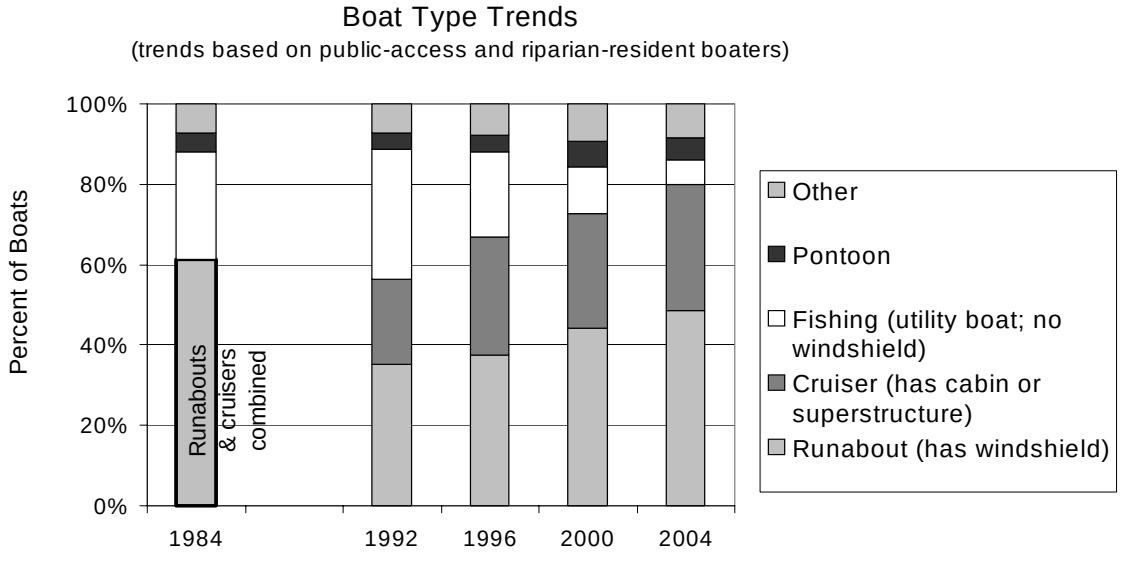


Figure 9



The type of watercraft is more substantial, more expensive than in the past. Runabouts and cruisers (has cabin) have increased over time, while fishing boats (utility boats without windshields, not related to the activity of fishing) have decreased (Figure 10). Note that in 1984 runabouts and cruisers are combined.

Figure 10



Consistent with the trend in type of craft, boats are longer today than they were in the past (Table 6). Lengths have increased nearly 3 feet since 1992. Engine sizes, too, have shown an increase, up about 90 horsepower since 1984. Lake Minnetonka — similar to other large water bodies in the Twin Cities such as the St. Croix River — is well known for having big boats powered by big motors. And the sizes continue to grow.

Table 6

Trends in Average Boat Length and Motor Size
(trends based on public-access and riparian-resident boaters)

	1984	1992	1996	2000	2004
Boat Length (feet)	(no data)	19.7	20.3	21.6	22.4
Motor Size (horsepower)	126	143	156	176	214

Most boaters (66%) on Minnetonka come from the 14 lakeside communities that comprise the Lake Minnetonka Conservation District (LMCD)(see Table 7). The only boating source that draws substantially from outside the LMCD communities is public access. Public access boaters travel some 10 to 15 miles on average to use the Lake.

Table 7

Origin and Travel Distance of Lake Minnetonka Boating Use

		Source of boating use			
Origin	All boating (percent)	Public access (percent)	Marina (percent)	Municipal dock (percent)	Riparian resident (percent)
LMCD communities*	66%	16%	72%	100%	100%
Elsewhere	34%	84%	28%	0%	0%
Total percent	100%	100%	100%	100%	100%

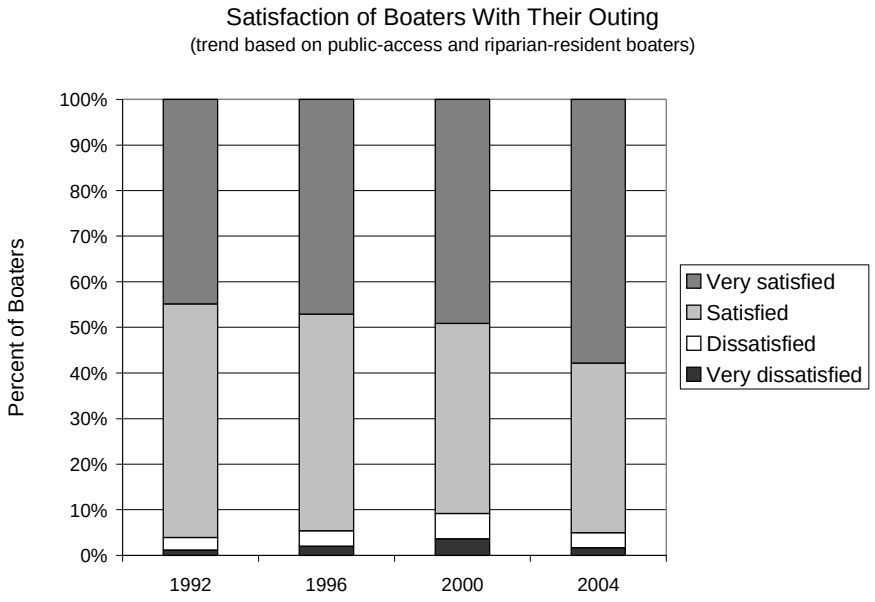
		Source of boating use			
Travel distance to Lake	All boating	Public access	Marina	Municipal dock	Riparian resident
Mean miles	5.9	13.3	6.0	<1	<1
Median miles	1	10	2	<1	<1

* 14 Lakeside communities that comprise the Lake Minnetonka Conservation District.

THE BOATING EXPERIENCE

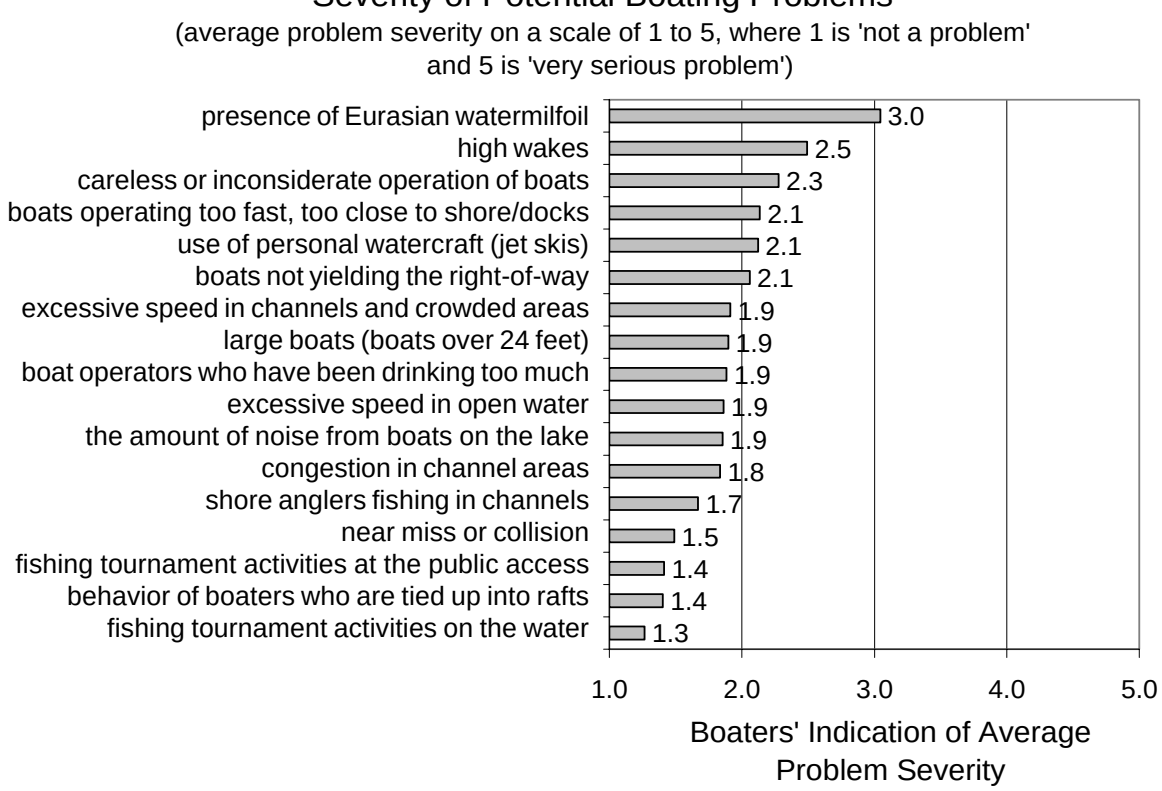
Boating is an enjoyable experience on Lake Minnetonka. Nearly 60 percent of all boaters are "very satisfied" with their outing, and most of the rest are "satisfied" (Figure 11). Dissatisfaction to any extent is small. Over time, satisfaction levels have increased. The increase in trip satisfaction is probably due, in part, to the decrease in fishing over time. Anglers, as a group, normally give lower trip satisfaction ratings than other boaters,

Figure 11



Although satisfaction levels are high, boaters do experience problems on the water (Figure 12). In the survey boaters were asked to rate 17 potential problems on a five-point scale from not a problem (1), to a slight problem (2) to a moderate problem (3) to a serious problem (4) to a very serious problem (5). The leading problem is Eurasian watermilfoil, which stands well above the others (more is said about the perception of Eurasian watermilfoil as a problem in the section below on exotic species). The next two top-ranked problems have to do with other boaters: high wakes, and inconsiderate operation of boats. These are followed by boats operating too fast, use of personal watercraft, boats not yielding the right of way. Other potential problems are of a lesser severity. This ranking of problems is widely shared across the different sources of boaters, activities of boaters, and day of week of the boating outing.

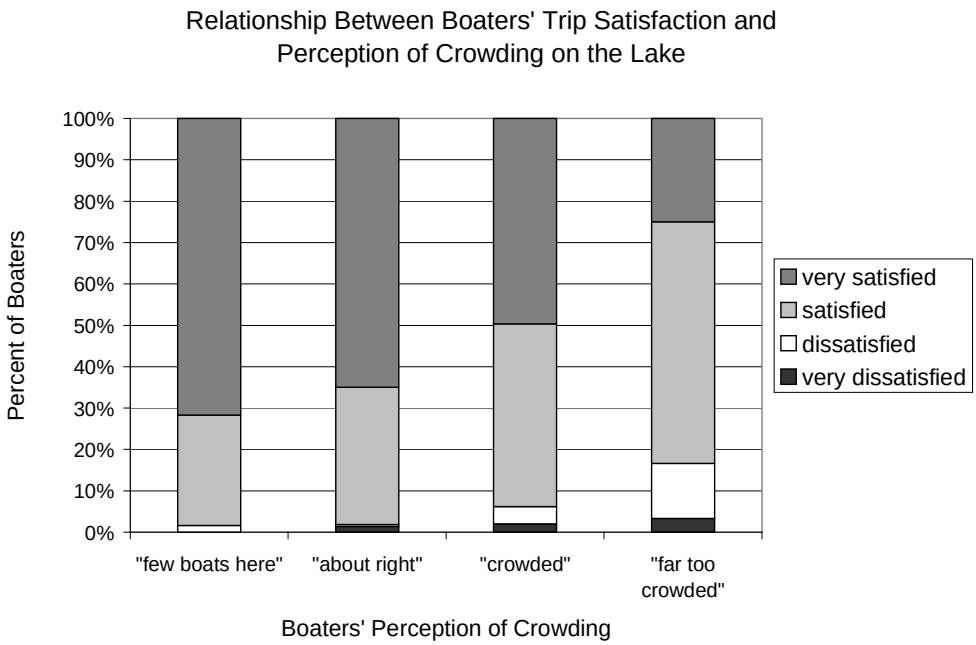
Figure 12



For most problems, severity ratings changed little over the last few studies. Two problems, however, changed noticeably, and both became less severe since 1996. One of the problems is the use of personal watercraft. It was the second ranked problem in 1996 (average problem rating of 2.7), was third ranked in 2000, and was fifth ranked in 2004. The other problem is the presence of Eurasian watermilfoil. Although it continues to be the top-ranked problem, it has seen a steady drop in average severity from 3.6 in 1996 to 3.3 in 2000 to 3.0 in 2004. Riparian residents led the decline in the severity rating of both watermilfoil (see later section on exotic species) and use of personal watercraft.

As noted above, the intensity of boating (boats per acre of water) on Lake Minnetonka is high, even by boating standards in the metropolitan area. Crowding is a persistent problem on the Lake. Perceptions of crowding affect boater satisfaction: the higher the level of crowding, the less satisfied boaters become (Figure 13). The physical configuration on the Lake — with its numerous narrow channels between bays that bring boaters in close proximity of on another — seems to

Figure 13



magnify the problem. The St. Croix River, which has a higher boating intensity than Lake Minnetonka, has a much lower level of perceived crowding by boaters (MN DNR, 1997). The St. Croix River is a broad band of water without the many narrow constrictions that exist on Lake Minnetonka.

Crowding, however, is not a growing problem on the Lake (Figure 14). Boaters judged conditions on the Lake in 1984 about the same as they do today. Crowding perceptions for the last three studies (1996, 2000 and 2004) are nearly the same.

It is important to note that — although the Lake is perceived to be more crowded than other metropolitan lakes and rivers — less than 40 percent of boaters judge the number of boats on the Lake as “crowded” or “far too crowded.” The majority of boaters describe the number of boats as “about right” or “few boats here.”

A factor that has a substantial influence on perceptions of crowding is the number of boats that boaters expect to encounter. When boaters encounter more boats than expected, perceptions of crowding rise rapidly (Figure 15). Most boaters are experienced and understand boating conditions on the Lake. And most are not surprised by the number of boats they encounter (Figure 16). The largest group

Figure 14

Trend in Boaters' Perception of Crowding on the Lake
(trend based on public-access and riparian-resident boaters)

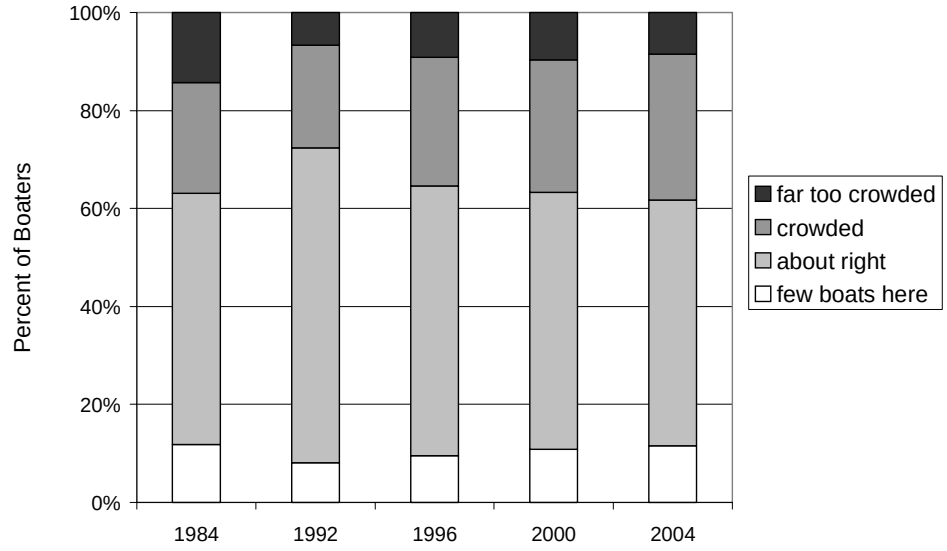


Figure 15

Relationship Between Boaters' Perception of the Number of Boats Actually Encountered Versus Usually Encountered, and Perception of Crowding on the Lake

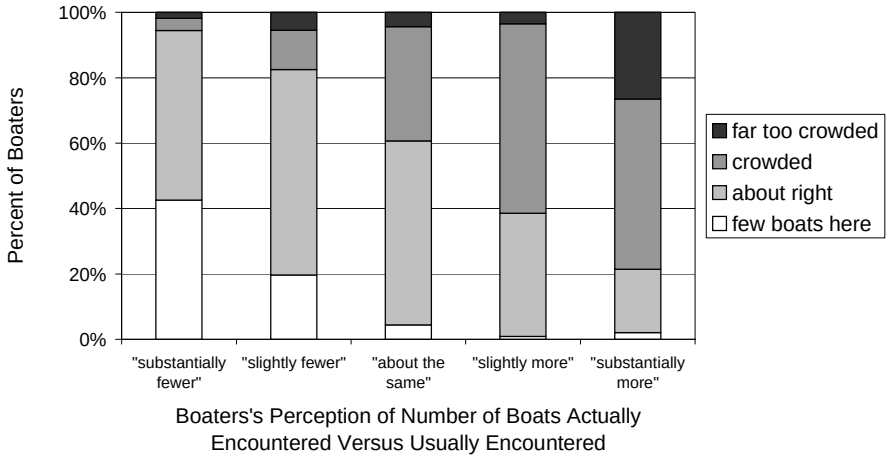
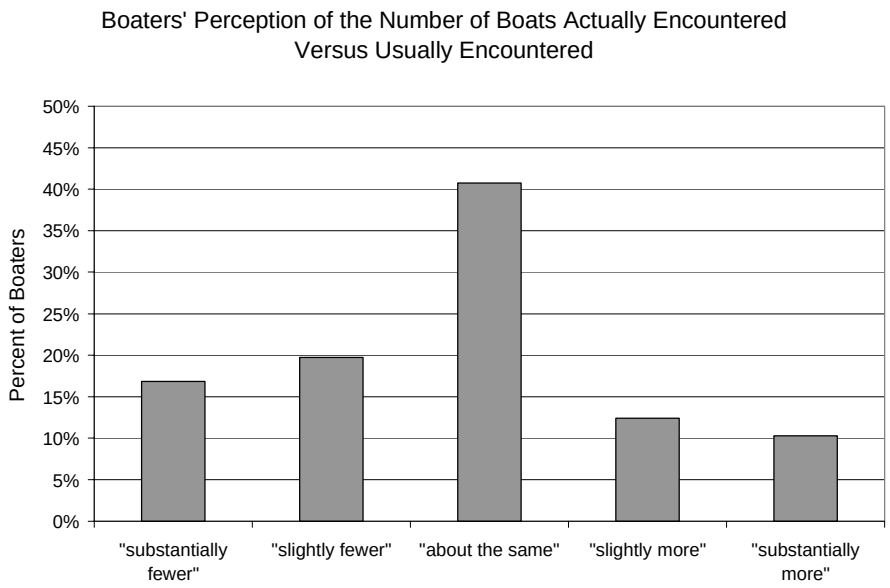


Figure 16



of boaters encounter “about the same” number of boats as usual, and many of the rest encounter either “slightly more” or “slightly less”. A smaller portion of boaters are surprised by the number of boats and indicated “substantially more” or “substantially less”.

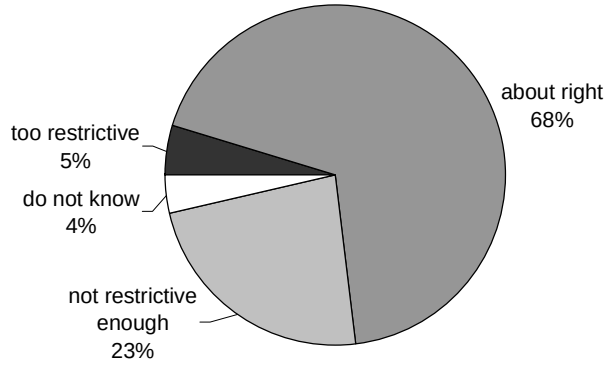
The boaters who are surprised by the high number of boats they encounter, and thus tend to perceive conditions as more crowded, are <u>not</u> a less experienced boating group. In fact, there is no relationship between years boated on Lake Minnetonka and a boater’s rating of the number of boats compared with the usual number. A typical boater has boated an average of 19 years on the Lake. Those boaters who judge the number of boats they encounter as “substantially less” than usual have boated for 18 years on the Lake, while those who judged the number as “about the same” have boated for 19 years, and those who judge the number as “substantially more” have boated for 20 years. Similarly, perceived crowding is unrelated to the years someone has boated on the Lake. Perhaps encountering an exceptional number of boats is a random event that surprises even experienced boaters.

BOATING SAFETY AND ENFORCEMENT

Lake Minnetonka is a congested place to boat and boating restrictions are commonly used to manage the congestion. Most boaters — when asked about the level of restriction on the water — think the amount of restriction is appropriate ("about right") (see (Figure 17). Few believe that it is "too restrictive." More believe it is "not restrictive enough." Nearly one-third of riparian residents (29%) believe it is "not restrictive enough."

Figure 17

Overall, do think special boating restrictions on Lake Minnetonka are too restrictive, about right, or not restrictive enough?
(percent of boaters indicating response)



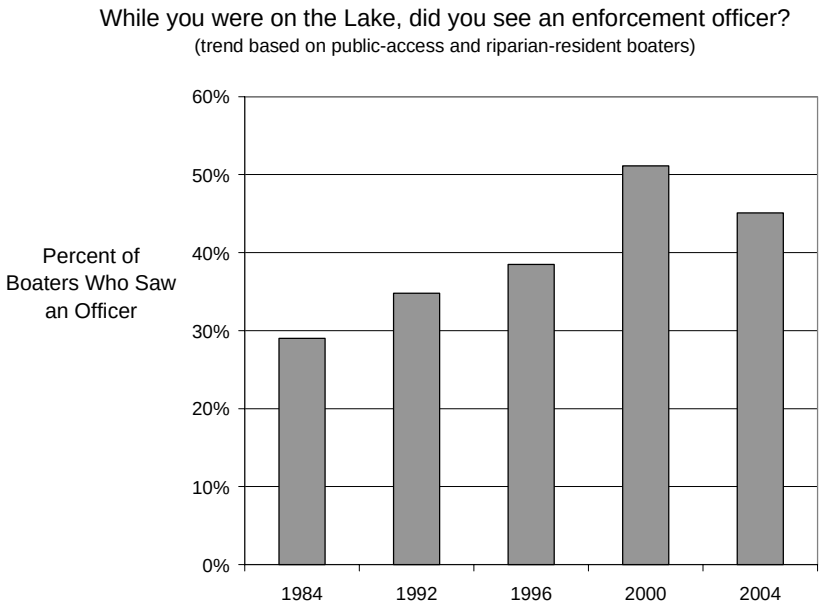
Consistent with this perspective, boating restrictions are not commonly viewed in a negative light. Most boaters believe restrictions either do not affect their enjoyment of boating (54% of boaters) or add to their enjoyment (42%). Few believe restrictions detract from enjoyment (4%).

Boaters are well aware of the pervasive restrictions on Lake Minnetonka concerning speed/quiet water and transport of exotic species from the Lake. Over 90 percent are aware of these restrictions. And a solid majority (66+%) believes these are needed. In addition, about half of boaters believe special restrictions on personal watercraft are needed.

Boater sightings of enforcement officers on the Lake increased markedly from 1984 to a peak in 2000, after which sightings declined (Figure 18). In 2004, 45 percent of all boaters recall seeing an enforcement officer on their last outing.

Following the same trend as officer sightings, the portion of boaters reporting being checked by an enforcement officer rose steadily from less than 1 percent in 1984 to 3 percent in 2000. The portion declined to 2 percent in 2004.

Figure 18



Boaters who were checked by enforcement offices gave the officers high marks for their professional behavior. Nearly 40 percent (38%) rated the officer's behavior as "excellent" and another 46 percent rated the behavior as "good." Fewer boaters gave "fair", "poor" or "very poor" ratings (15%). These ratings are based on a small sample size (16 survey respondents), and only the most general conclusions should be drawn from the results. The only other time these ratings were collected was 2000, and the results (based again on a small sample of 20 survey respondents) was largely the same: most boaters (89%) gave positive ratings of "excellent" or "good".

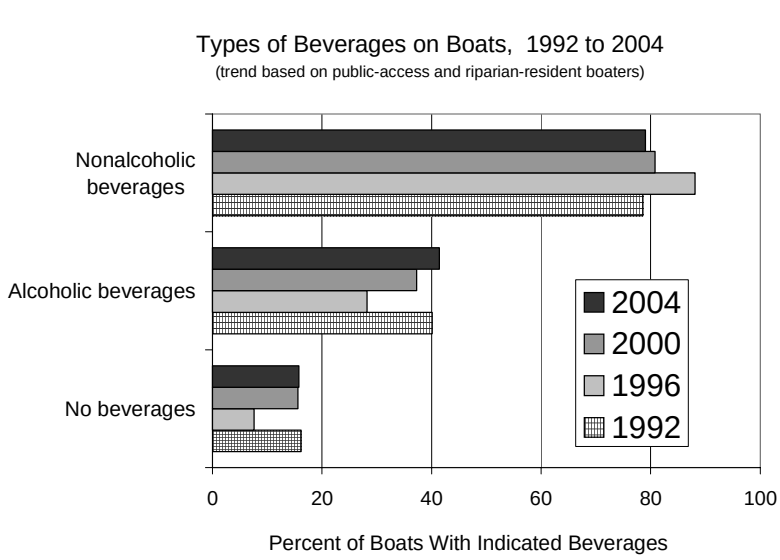
In 2004, the level of enforcement effort is judged by a majority of boaters as "about right" (52% of boaters). A much smaller portion thinks the effort is "too little" (14%) and even less think it is "too much" (4%). A sizable portion is unsure how to respond (30%), probably indicating that many boaters have little awareness of enforcement activities on the Lake.

Boaters today are no more likely to have completed a boating safety course than boaters in the past. The percentage who responded that they have taken a formal course in boating safety has remained between 33 percent and 35 percent for all five survey years (1984, 1992, 1996, 2000 and 2004—trend based on public-access and riparian-resident boaters). Although not increasing, this exceeds by a sizable margin the portion of boaters (18%-20%) in the more rural Brainerd Lakes and Central Lakes Region that have taken such a course (MN DNR, 1999 and 2002).

Nearly half (49%) of boaters think that all boat operators should be required to complete a boating safety course. A smaller portion (38%) believe motorboat operators should be required to have an operator's license. Although neither of these is a majority of boaters, the portions are 10 to 20 percent higher than those found in the more rural Brainerd Lakes and Central Lakes Regions (MN DNR, 1999 and 2002), suggesting that licensing and safety courses may be a more pressing concern in the metro area.

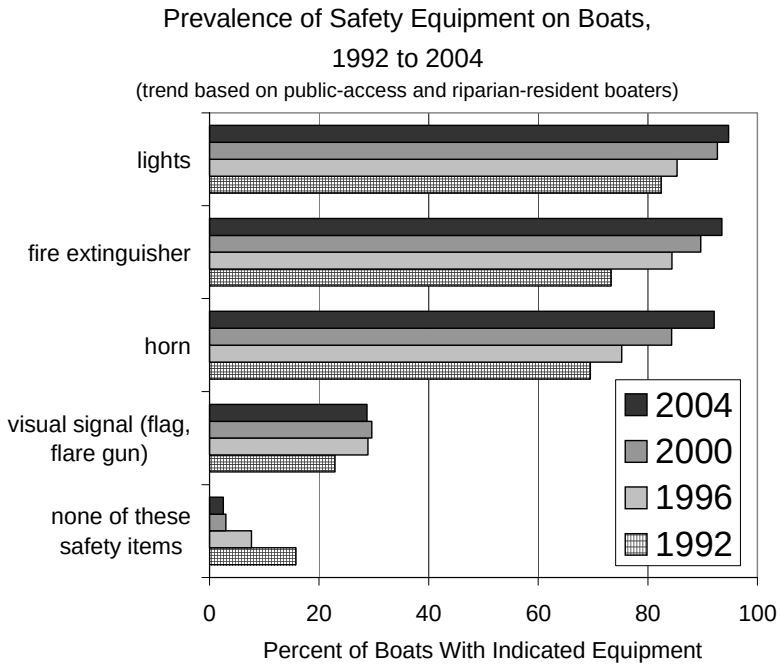
Since 1992, the surveys have asked boaters about the types of beverages they have on board. Minnesota enacted a law after the 1984 study that makes it illegal to operate a motorboat after consuming too much alcohol. Results from the most recent study are similar to previous studies (Figure 19—trend based on public-access and riparian-resident boaters). In 2004 for all sources of boaters, 45 percent have alcoholic drinks (beer, wine, etc.) on board, 83 percent have nonalcoholic drinks (soda, coffee, water, etc.), and 13 percent have no drinks on board. The portion with alcoholic drinks is above that found in the Brainerd Lakes Region study (24%) and Central Lakes Region study (21%), and is similar to that found in the Mississippi River (37%) and Lake Superior (43%) studies (see MN DNR, 1999, 2002, 2003 and 2004).

Figure 19



Safety equipment has become more commonplace on boats since 1992 (Figure 20). The increasing prevalence of safety equipment parallels the increasing size of the boats, a trend that was noted above. No safety equipment other than personal flotation devices is required for smaller boats (less than 16 feet) operated during daylight hours.

Figure 20



PUBLIC ACCESS FACILITIES

As a group, boaters who are launching through public access facilities are familiar with Lake Minnetonka. Half have boated on the Lake for over eight years. And the vast majority has some familiarity with the access at which they received the survey, since 89 percent have used the access some time in the past.

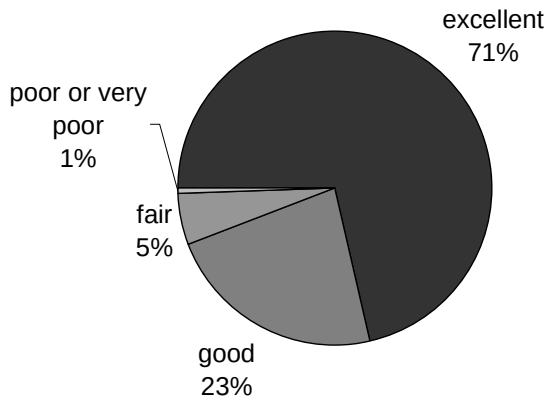
The geographic area from which boaters are drawn to Lake Minnetonka public accesses has not changed appreciably since 1984. The median distance of travel from home is two miles less in 2004 than in 1984 (10 miles versus 12 miles) and the mean distance is also two miles less (13 miles versus 15 miles).

Boaters gave high marks to the public access facilities for landing and launching a boat in 2004, higher marks than at any time in the past. In 2004, 71 percent gave "excellent" ratings and another 23 percent gave "good" ratings (Figure 21). Only 6 percent gave ratings of "fair", "poor" or "very poor". In contrast, for the

ratings in 2000 (which are similar to studies preceding 2000), 38 percent gave "excellent" ratings. 37 percent gave "good" ratings, and 25 percent gave ratings of "fair", "poor" or "very poor". The reason for the sharp increase in ratings between 2000 and 2004 is not fully known, but the increase is probably due — at least in part — to the opening of the large Grays Bay Access and closing of two smaller accesses on the same part of the Lake. The Grays Bay Access is a well-designed facility that can accommodate the large boats that access users are trailering today.

Figure 21

How would you rate this access for launching and landing a boat?
(percent of boaters indicating response)

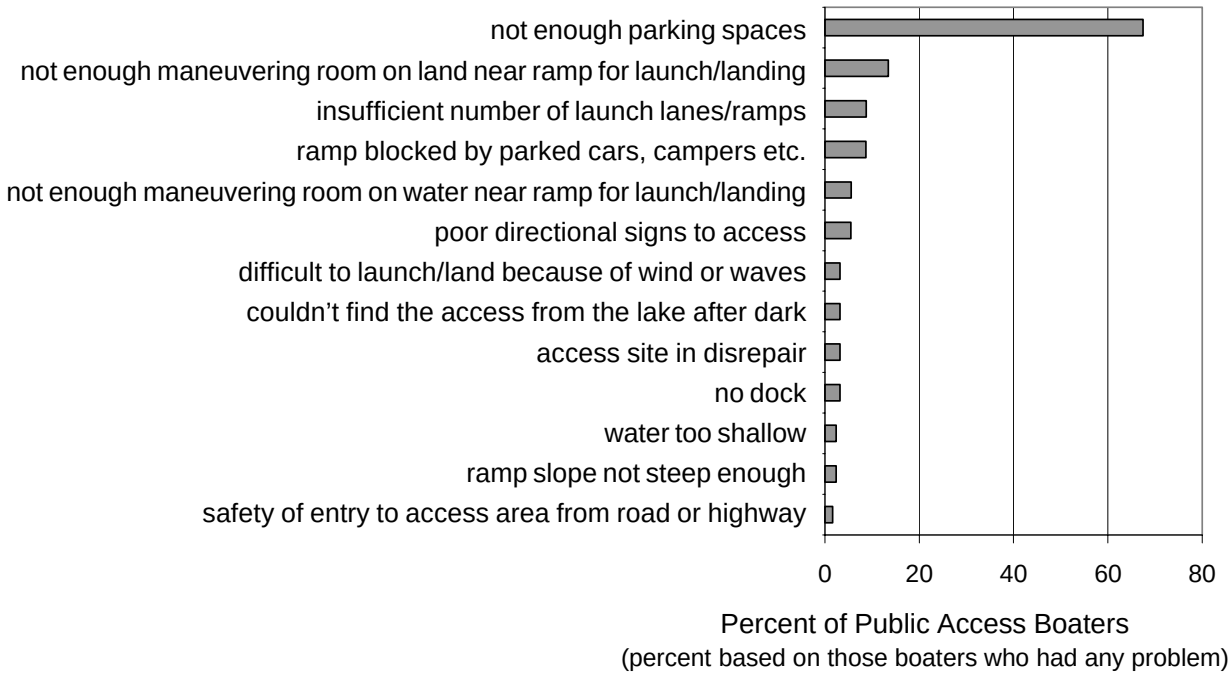


Consistent with the increase in access ratings, the portion of boaters having a problem with the use of an access fell from 37 percent in 2000 to 28 percent in 2004. The primary use problem by far is the size of the access parking lot (Figure 22), which is the perennial leading problem on the Lake. Public accesses lots at Lake Minnetonka are routinely full to capacity; 65 percent of the boaters interviewed have found the access at which they were surveyed full at least once in the last 12 months. When they find the lot full, the large majority of boaters (94%) are able to boat on the Lake that day by going to another access, parking on the street/lot nearby, or waiting for a spot to open up in the lot.

The next leading access use problem is small by comparison with the parking-space problem, and is an additional size-related concern: not enough maneuvering room on land near ramp for launching/landing. One item showed a marked decrease as a use problem from 2000 to 2004. "No dock" was a minor use problem in 2004 (indicated by 3% of boaters who had any use problem), but it was the third-ranked problem in 2000 (indicated by 14% of boaters who had any use problem).

Figure 22

Problems Boaters Had With the Public Access
(excludes boaters who did not have a problem)

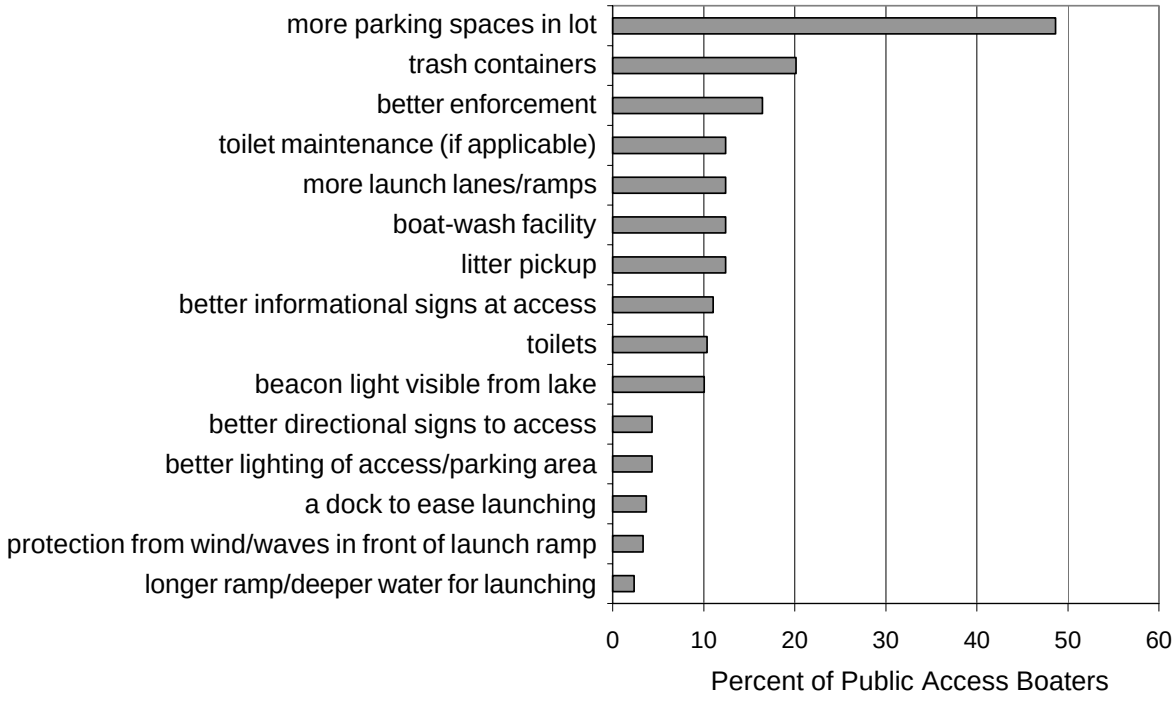


When asked about improvements needed at the access site, boaters focused on the solution to their primary use problem, which is not enough parking spaces in the access lot (Figure 23). This is followed by requests for trash containers and better enforcement. None of the other potential improvements is requested by over 15 percent of access users.

The 2004 improvement requests reflect two major differences from 2000 requests. The first concerns docks to ease launching. Dock requests fell from 33 percent of boaters in 2000 to 4 percent in 2004. The fall in dock requests parallels the drop in docks as an access use problem, which was noted above. The other item that changed was requests for better enforcement. Requests for better enforcement rose from 5 percent of boaters in 2000 to 16 percent in 2004. Better enforcement was the least requested improvement in 2000. It rose to the third most requested in 2004.

Figure 23

Improvements Boaters Feel Are Needed at the Public Access

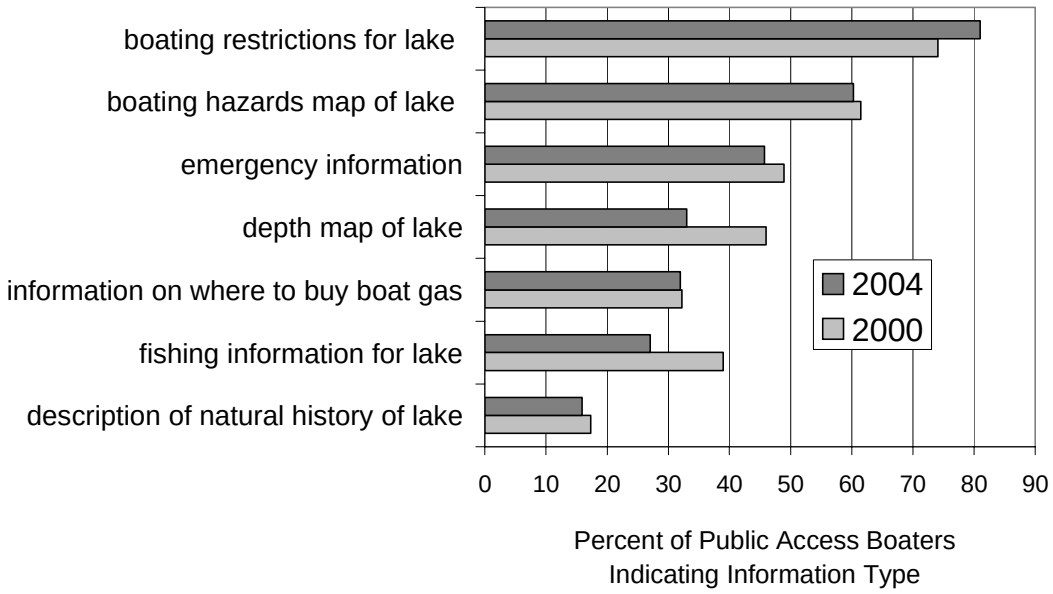


On a similar topic, boaters were asked about the types of information they would want available at public access sites. Leading the list of requests — in both 2004 and 2000 — is information on boating restrictions, followed by information on boating hazards, and emergency information (Figure 24). Two items (depth map of lake and fishing information) show decreased requests between 2000 and 2004. Requests for fishing information may be tracking with the decline in portion of access uses who fish. For anglers, fishing information is a high-ranked item; it is ranked third after the top two on Figure 23. For non-anglers, fishing information is ranked where it is on Figure 23, which is second from the bottom, just above natural-history information.

The potential use problems of one particular group were queried in the survey: boaters with disabilities that affect when and where they boat. Some 4 percent of access users (11 survey respondents) identified themselves as disabled, which includs boaters with a hip and a knee replacements. Most of these (all but two survey respondents) found the access suitable for their needs, but most did not park in the designated spots for people with disabilities. Only one of the two

Figure 24

Boaters' Opinions on the Type of Information That Should Be Available at Public Accesses



boaters who found the access inadequate gave a reason for the inadequacy, which concerned the long distance from the parking spot to the launch site. This boater had an artificial knee; the boater did not park — for whatever reason — in a designated spot for people with disabilities.

Boaters were asked in the surveys if additional public access is needed on Lake Minnetonka. Few (13%) responded that more access is needed (Table 8). This proportion rises to 17 percent if only access users in the last 12 months are con-

Table 8

Percent of boaters who believe additional free public boat access is needed on Lake Minnetonka

		Source of boater			
Boater group	All boaters (percent)	Public access (percent)	Marina (percent)	Municipal dock (percent)	Riparian resident (percent)
All boaters	13%	27%	8%	8%	4%
Boaters who used public access on Lake in last 12 months	17%	27%	13%	8%	5%

sidered (see Table 9 for access use by source of boater). Boaters intercepted at a public access during the study saw the highest need for more access (27%), but the large majority of such boaters still saw little additional need (Table 8). Overall, the indication is that most boaters feel well supplied with public access at present.

Table 9

Users of free public access on Lake Minnetonka in last 12 months

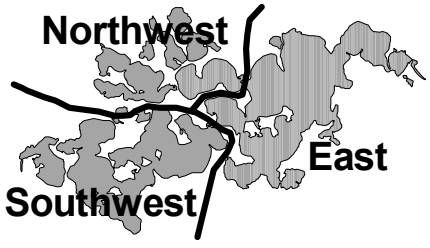
Item	All boaters (percent)	Source of boater: Public access (percent)	Marina (percent)	Municipal dock (percent)	Riparian resident (percent)
Percent who are users	66%	100%	38%	66%	60%
If used, times used in last 12 months:					
Mean times	5.3	6.5	6.0	3.6	3.2
Median times	2	2	2	2	2

Boaters who saw a need for more public access were asked where on the Lake additional access is needed. Most boaters specified a location (74%), while some simply responded "anywhere" (26%). Of those who identified a location, nearly two-thirds (63%) indicated the east side of the Lake (Table 10). Half of the east side locations were specifically "Excelsior", and one-quarter were specifically "Wayzata". Wayzata and Excelsior were the only two frequently specified and specifically named locations.

Table 10

Location of need for additional public accesses on Lake Minnetonka

Location on Lake	Percent indicating location
East	63%
Northwest	14%
Southwest	22%
Total percent	100%

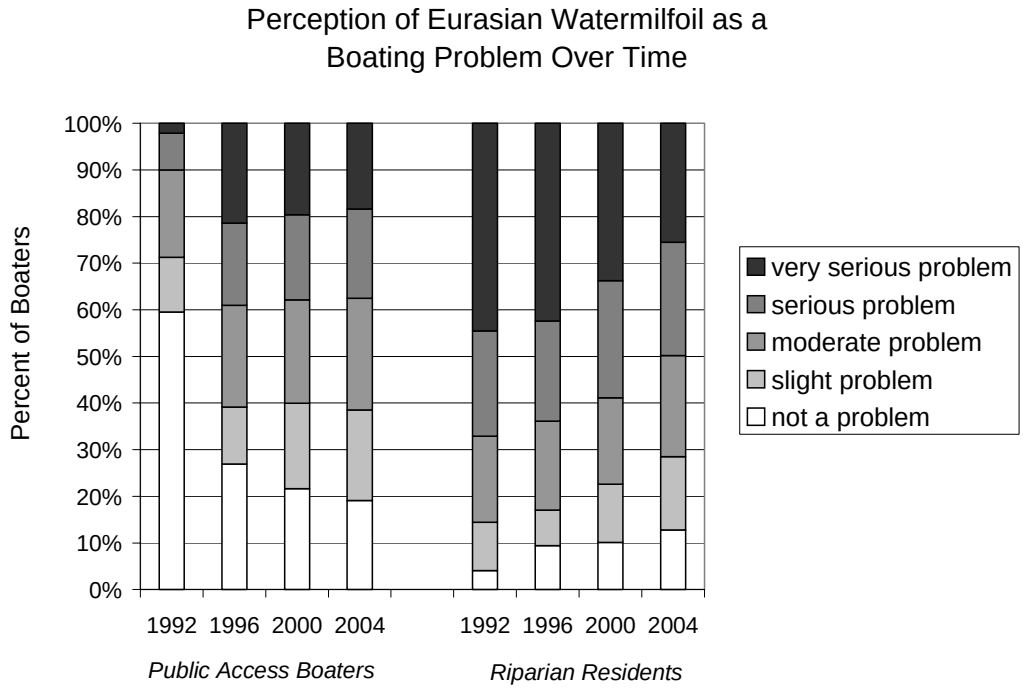


PREVENTING THE SPREAD OF EXOTIC SPECIES

Eurasian watermilfoil is considered a leading problem by Lake Minnetonka boaters, as noted previously. Shortly after the plant's arrival in the Lake in 1992, boaters were asked about the degree to which the plant was a problem. Since that time, surveys have repeated the same question in order to monitor boater opinion.

Public access boaters were not convinced in 1992 that Eurasian watermilfoil represented a serious problem (Figure 25). At the same time, riparian residents were very concerned about the plant, and a sizable perceptual gap existed between the two groups. The gap has closed considerably since 1992, but has not closed fully. The trend for public access boaters is toward increasing problem severity ratings, while the trend for riparian residents is toward decreasing problem severity ratings.

Figure 25



Since 1996, boaters have been asked about the actions they take after removing a boat from Lake Minnetonka. The actions queried are ones that help prevent the spread of exotic species such as Eurasian watermilfoil and zebra mussels. Eurasian watermilfoil has been present in Lake Minnetonka for over a decade. The Lake is not currently infested with zebra mussels.

In 2004, 22 percent of Lake Minnetonka boaters report that they transport their boat between Lake Minnetonka and another body of water (Table 11). Only 3 percent report transporting their boat between Minnetonka and the Mississippi River downstream of St. Paul, where the nearest zebra mussel infestation occurs.

Table 11

Percent of boaters who transported their boat between Lake Minnetonka and indicated waters in the last 12 months

		Source of boater			
Indicated waters	All boaters (percent)	Public access (percent)	Marina (percent)	Municipal dock (percent)	Riparian resident (percent)
Any other body of water	22%	41%	14%	18%	13%
Mississippi River downstream of St. Paul, Minnesota	3%	8%	1%	1%	2%

Nearly all boaters who transport their boat between Lake Minnetonka and another body of water report doing a few simple things all the time. They conduct a visual inspection of their boat and equipment, clean off vegetation and mussels, and drain water from the boat (Table 12). Actions that require special equipment or more effort are done less routinely. Such actions include rinsing the boat with hot water of high-pressure water, and allowing the boat to dry for five days. The frequency with which actions are taken has not changed a great deal since 1996.

Table 12

Percent of Boaters Indicating Frequency of Action Taken to Prevent the Spread of Exotic Species

(only includes actions of boaters who transport their boat to/from Lake Minnetonka; excludes non-applicable actions, such as bait disposal by non-anglers)

	Frequency of Action Taken			
	Almost always (percent)	Sometimes (percent)	Never (percent)	Total (percent)
Actions taken after removing boat from water				
Conduct visual inspection of boats and equipment	100	0	0	100
Clean vegetation or mussels from boat and equipment	100	0	0	100
Drain water from boats, including live wells, bilge and bait containers before going onto another lake	95	4	1	100
Dispose of leftover bait or minnows on shore	70	10	20	100
Flush motors cooling system with clean water	14	20	65	100
Actions taken before launching in a different body of water				
Allow boat to dry for 5 days	42	35	23	100
Rinse boat with hot water or high pressure water	22	27	52	100

REFERENCES

Lake Minnetonka boating studies, funded by the Lake Minnetonka Conservation District (LMCD) and/or the Minnesota Department of Natural Resources (MN DNR):
1984, funded by MN DNR.
1986 and 1987, funded by LMCD.
1992, 1994, 1996, 1998, 2000 and 2004, funded by LMCD and MN DNR.

Minnesota Department of Natural Resources (MN DNR), Regional boating studies:
1997. Boating in the Twin Cities Metropolitan Area: Current Status (1996) and Trends Since 1984.
1999. Boating in North Central Minnesota (Brainerd Lakes Region): Status in 1998 and Trends Since 1985.
2002. Boating in Central Minnesota: Status in 2001 and Trends Since 1987.
2003. Boating on the Minnesota Portion of Lake Superior, Summer 2002.
2004. Recreational Boating Study of the Mississippi River, Pools 4 to 9, Summer 2003.

Minnesota-Wisconsin Boundary Area Commission (MWBAC). Recreational boating studies (ever two years from 1983 to 1999) of the Lower St. Croix National Scenic Riverway. Later years include recreational boating data for the Mississippi River from the Twin Cities of Lock and Dam 10. All studies published by the Minnesota-Wisconsin Boundary Area Commission.

U. S. Department of Commerce, Bureau of the Census. Population counts for minor civil divisions in Minnesota for 1990 and 2000.

APPENDIX A

METHODOLOGY

The studies involve aerial boat counts (including aerial source determinations) and boater surveys. All studies are conducted during the period from Memorial Day weekend to Labor Day. Not all studies include surveys, and not all studies include weekday aerial boat counts and source determinations:

Lake Minnetonka Recreational Boating Studies
(all studies extend from Memorial Day weekend to Labor Day)

Year	Aerial Boat Counts	Boater Surveys	Funder	Comments
1984	Weekend/holiday and weekday counts	Surveys of boaters from public access, commercial access, and lake homes	MNDNR	Part of a larger Twin Cities boating study
1986	Weekend/holiday counts		LMCD	
1987	Weekend/holiday counts		LMCD	
1992	Weekend/holiday and weekday counts	Surveys of boaters from public access, commercial access, and lake homes	LMCD & MNDNR	
1994	Weekend/holiday counts		LMCD & MNDNR	
1996	Weekend/holiday and weekday counts	Surveys of boaters from public access, commercial access, and lake homes	LMCD & MNDNR	Coordinated with a larger Twin Cities boating study
1998	Weekend/holiday counts		LMCD & MNDNR	
2000	Weekend/holiday and weekday counts	Surveys of boaters from public access, commercial access, and lake homes	LMCD & MNDNR	
2004	Weekend/holiday and weekday counts	Surveys of boaters from public access, commercial access, lake homes, and municipal docks	LMCD & MNDNR	

The description of methods is broken into four parts:

1. Counting and classifying boats on the water.
2. Estimating the contribution of various sources to boats on the water.
3. Surveying boaters about their activities and experiences.
4. Survey data for trend analysis.

1. Boats are counted and classified from the air. Counts are made at peak boating times on weekend/holidays (mid afternoon) and weekdays (late afternoon, early evening). Counts are made for each of 42 Lake Minnetonka management areas. Boats are classified according to craft type and movement (creating a visible wake or not). Boats that are anchored, beached or at transient docks are consider “in

use" and are counted.

In earlier analyses of weekend/holiday boat numbers on the Lake, it was determined that a better representation of the trend would occur if a few marginal boating days were excluded. The reasoning in 1998 was: in the 1990s, excepting 1994, average boat numbers have been lower than in the 1980s (Figure A-1a). The reason for these lower averages is a few "marginal" boating days, days when the weather was rainy, windy and raw and when the number of boats on the water was exceptionally low. Such marginal boating days were not encountered in the boat counts of the 1980s, and are likely to have been excluded by scrubbing flights on marginal weather days, a practice that ended by the 1990s. If these few exceptionally low days (the four days identified on Figure A-2) are eliminated from the averages, the "fair weather" averages in the 1990s look very similar to those in the 1980s (Figure A-1b). The "fair weather" trend displayed on Figure A-1b is probably a more accurate depiction of Lake Minnetonka trends than the "all counts" trend displayed on Figure A-1a.

This "fair weather" filter (i.e., exclude any boat counts less than 400) was continued in 2000 and 2004. In 2000, no counts were excluded, and in 2004, one count was excluded (=286 boats). The weekend/holiday boat count data presented in this study are the "fair weather" data as defined here.

2. At the time of the aerial flights, source contributions are determined. For public accesses, a count is made of the number of empty trailers and trailerless vehicles capable of carrying a boat at access parking lots and adjoining overflow parking places on roads and in other lots.

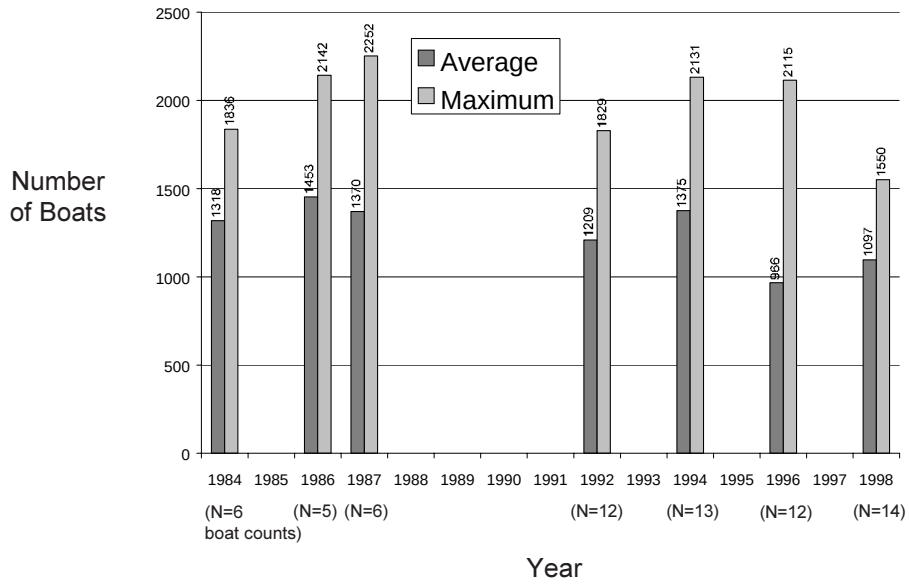
At marinas, empty slips are counted from the air. The number of slips normally empty is determined by occupancy flights, conducted on weekday mornings. The number of normally empty slips is subtracted from the empty slip counts made during flight to determine the likely number of boats on the Lake from slips during the flight. The number of boats on the Lake from private launches, rentals, and dry stacks was derived from operator reports of boats sourced for the day of the flight and diurnal distribution curves that indicate the probability that a boat out during a day is out during the flight time that day.

For municipal docks and homeowner association docks, counts of likely boats away from the docks and on the Lake are made during the flights. Dock locations are photographed during the flights and the number of empty dock spaces

Figure A-1a & b
Lake Minnetonka boat counts, 1984 to 1998

a. Based on all counts:

Lake Minnetonka Weekend/Holiday Afternoon Aerial Boat Counts



b. Based on "fair weather" counts only (excludes 4 of 69 counts):

Lake Minnetonka Weekend/Holiday Afternoon Aerial Boat Counts

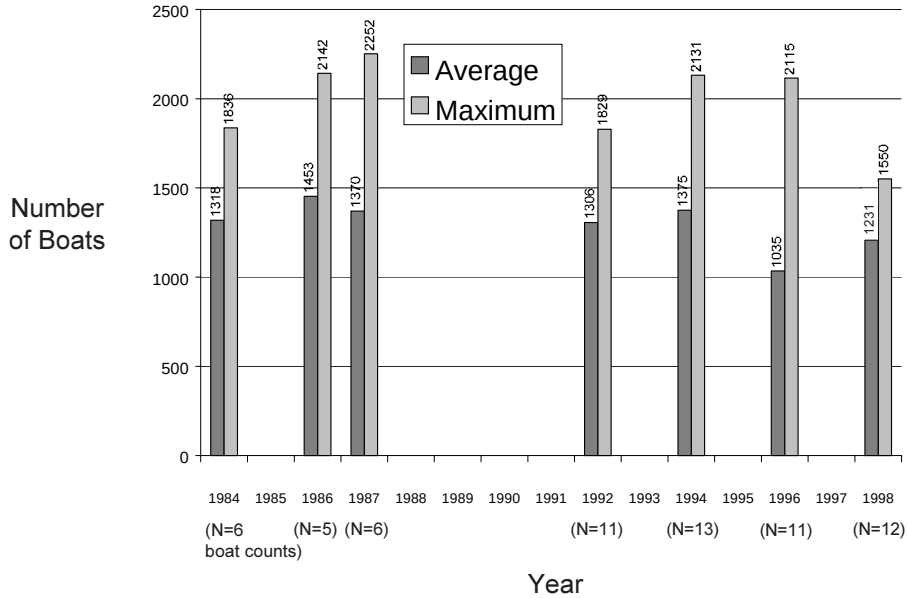
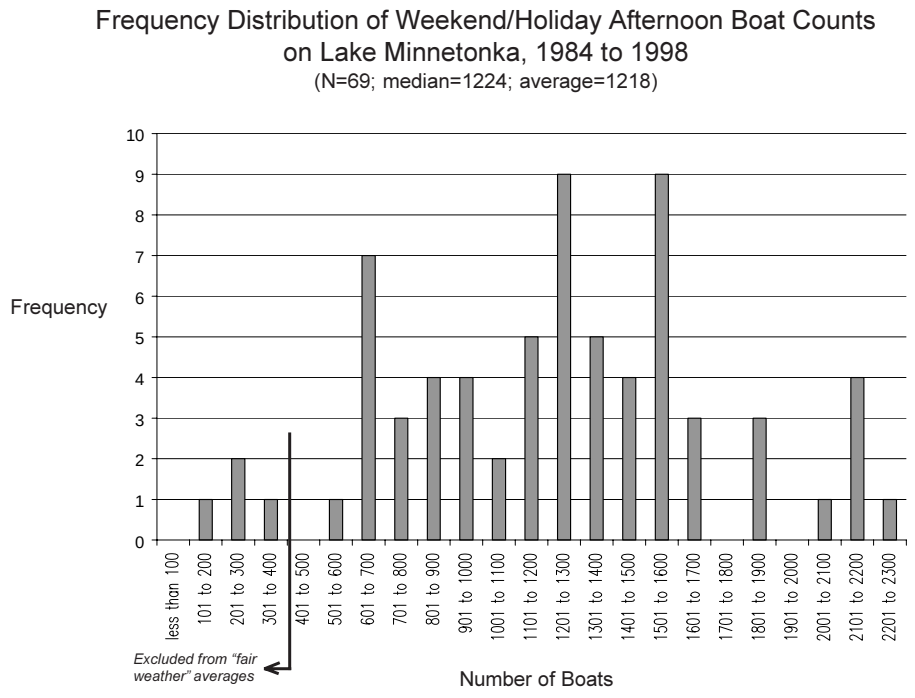


Figure A-2



is determined. As with marina slips, occupancy flights on weekday mornings are conducted to determine the number of dock spaces that are normally unoccupied. The number of normally empty dock spaces is subtracted from the empty dock space counts made during flight to determine the likely number of boats on the Lake from dock spaces during the flight.

3. Prior to 2004, surveys were conducted for three sources of boaters: public access boaters, commercial access boaters (marina, private access users), and riparian residents. In 2004, municipal dock boaters were added as a fourth source of boaters. All surveys were in-person interviews in 1984. For 1992 to 2004, riparian residents were surveyed entirely by mail, including remails to nonrespondents. Names and addresses were obtained from Hennepin and Carver County property tax records in 2004; prior to 2004 only Hennepin County tax records were utilized. For 1992, public and commercial access boaters were interviewed in-person as they ended their boating trip. In 2000, public and commercial access boaters were intercepted as they begin or end their boating trip and were asked to fill out a self-administered mail-back survey. Remails were made to nonrespondents. For 1996, public and commercial access surveys were a

combination of in-person interviews (as in 1992) and self-administered mail back surveys (as in 2000). For 2004, public access boaters were intercepted as they begin or end their boating trip and were asked to fill out a self-administered mail-back survey; remails were made to nonrespondents. Names and addresses of 2004 municipal dock renters were obtained from the municipalities with such facilities, and a mail survey (with one remail) was conducted. Commercial surveys in 2004 were done with a new methodology. For some marinas, prepackaged/pre-stamped surveys (missing only the mailing label) were delivered to cooperating marina operators, and the operators added a mailing label and dropped the surveys in the mail. Other marina operators provided mailing labels and the mailing was accomplished by the contractor. Only one mailing was done to seasonal slip renters. This new methodology was adopted to minimize problems of intrusion at marinas, which has been a perennial problem for this type of work on Lake Minnetonka and elsewhere. The methodology, as noted, is restricted to seasonal slip holders.

Since survey sampling is not proportional to boating use, surveys are weighted to reflect the contribution of each source to total boating. Weights are done by source and day of week (weekends/holidays and weekdays). Total boats on the water by day of week, and source contributions to total boats on the Lake are used as the basis for the sample weights (see topic 2 above).

Surveys were conducted in 1984, 1992, 1996, 2000 and 2004. Survey returns by source and day of week are weighted to reflect these relative day of week and source contributions:

Relative day of week and source contributions for sample weight calculations

	1984		1992 to 2000		2004	
Source of boater	Weekend/holidays	Weekdays	Weekend/holidays	Weekdays	Weekend/holidays	Weekdays
Public access	100	100	125	125	150	150
Commercial access	175	175	150	150	150	150
Riparian residents (& HOA)	150	150	150	150	125	125
Municipals	75	75	75	75	75	75
Total	500	500	500	500	500	500

4. Trends results based on boater survey information only include surveys with boaters from public accesses and riparian residences, because these are the two sources of boaters that been done in a consistent fashion over the period from 1984 to 2004. The exclusion of other sources of boater limits but does not preclude trend analysis. There are many evident trends exhibited by boaters from public accesses and riparian residences that are clearly of a general nature.

For commercial access boaters, the 2004 survey data came from seasonal slip holders. Prior to 2004, the survey data came from two types of marina boaters: seasonal slip holders and marina customers who trailer their boats, pay a fee, and launch through a ramp facility. Prior to 1996, the two types of marina customers cannot be separated in the survey returns, and the two types of boaters have different kinds and sizes of boats; they participate in different activities, and have different experiences on the water.

Municipal dock boaters were only surveyed in 2004.

APPENDIX B

STATISTICAL TESTS OF BOAT-NUMBER TRENDS

A number of statistical tests were performed to determine if boat numbers had changed (at .05 level of statistical significance) on Lake Minnetonka during the period of record from 1984 to 2004. Similar tests performed prior to the 2004 study found no statistical differences for weekend/holidays or weekdays.

General conclusions from statistical tests:
A. For weekend/holidays there is evidence of a statistically significant decline in boat numbers over the years 1984 to 2004.

B. For weekdays, there is no evidence of statistically significant change in boat numbers over the years 1984 to 2004.

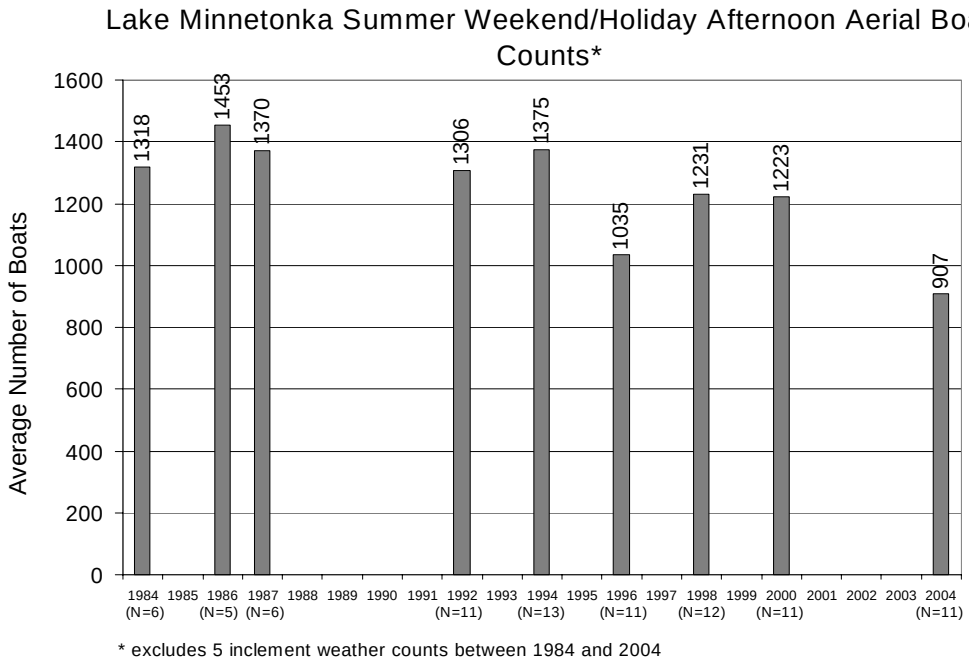
Details of statistical tests:
A. For weekend/holiday counts, the following tests were conducted:

1. Linear regression analysis on yearly average number of boats as a function of year from 1984 to 2004 (see Figure B-1).
Result: The decline in boat numbers from 1984 to 2004 is statistically significant.

2. Linear regression analysis on daily number of boats as a function of year (1984 to 2004) and daily maximum temperature of the boat-count date.
Result: In the same regression equation, both daily maximum temperature (positive relationship) and year (negative relationship) are statistically significant predictors of daily boat numbers. This indicates that there is a statistically significant downward trend in boat numbers between 1984 and 2004 even when possible daily temperature biases over the years are accounted for.

3. Difference of means test between 2004 daily boat numbers and pooled 1984-87, 1992-94, and 1998-2000 boat numbers. Neighboring years were pooled based on similar average yearly values.
Result: 2004 boat numbers are significantly different from pooled 1992-94 and 1984-87 boat numbers, but are not significantly different from pooled 1998-2000 boat numbers.

Figure B-1

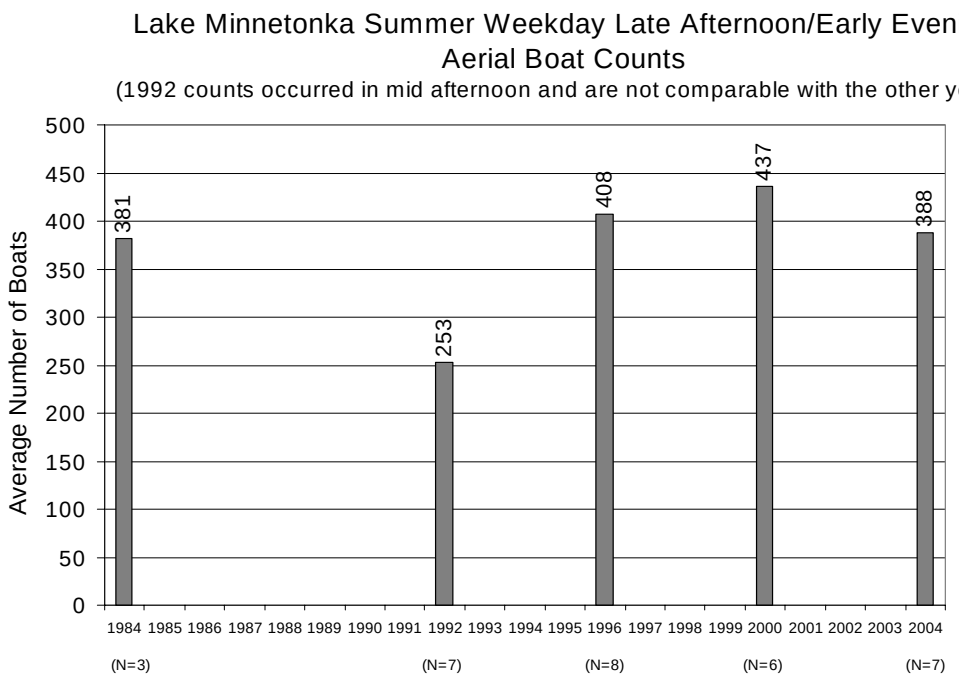


B. For weekday counts, the following tests were conducted:

1. Linear regression analysis on yearly average number of boats as a function of year from 1984 to 2004 (excludes 1992, when aerial boat counts were made at a different time)(see Figure B-2).
Result: No statistically significant trend in boat numbers.

2. Difference of means test between 2004 daily boat numbers and 1984 boat numbers and pooled 1996-2000 boat numbers. Neighboring years were pooled based on similar average yearly values.
Result: 2004 boat numbers are not significantly different from 1984 boat numbers and pooled 1996-2000 boat numbers.

Figure B-2


Lake Minnetonka Summer Weekday Late Afternoon/Early Evening
Aerial Boat Counts
(1992 counts occurred in mid afternoon and are not comparable with the other years)
Average Number of Boats
500
450
400
350
300
250
200
150
100
50
0
381
253
408
437
388
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004
(N=3)
(N=7)
(N=8)
(N=6)
(N=7)