

Lake Lure Boating Management Plan

Review and Recommendations



**Prepared for
The Town of Lake Lure:
Lake Lure Town Council
Lake Lure Marine Commission
Lake Lure Advisory Committee**

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Lake Lure Boating Management Plan

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EXECUTIVE SUMMARY

The Town of Lake Lure is evaluating options for keeping boating density at a safe level, so that overall enjoyment of the lake will not be diminished by the ever increasing pressure of recreational pursuits on the lake. The intent of this process is to explore the range of possible management options, reduce that range to those approaches that are applicable and feasible in Lake Lure, and to seek a combination of controls that can be applied as equitably as possible to maximize lake use without compromising user safety. A very inclusive and public process has been conducted, with decisions made based on the best possible combination of science, economics, and social acceptability.

Lake Lure was formed in 1925 when the Rocky Broad River was dammed. The Town of Lake Lure was formed in 1927 and the associated community has been growing ever since, most notably in very recent years. Lake Lure covers 720 acres with several major arms and numerous smaller coves. Topography is steep, both around the lake and within the lake itself; water depth is substantial within 50 ft of shore except near inlets and in coves. The dam controls outflow and generates electricity. Full pool elevation is maintained in Lake Lure as much as possible. The vast majority of residences around the lake are tied into a sanitary sewer for wastewater management. The watershed of Lake Lure covers approximately 96 square miles of fairly hilly terrain. Erosion and sediment loading are issues, but many areas are outside of the control of the Town. Water quality in the Rocky Broad River, other tributaries, and in Lake Lure is not ideal, but supports the intended uses of the lake. Lake Lure undergoes thermal stratification during the growing season, and waters deeper than about 20 ft are devoid of oxygen during much of the summer. Lake Lure hosts minimal aquatic plant growths, owing to steep underwater sediment slopes and limited light penetration. Fish and other wildlife abound in and around Lake Lure.

Recreational facilities on the lake consist of a Town Beach complex, with swimming area, park and boat launch, as well as an accompanying marina. Most land around the lake is privately held. There are a number of additional beaches and several boat ramps, as well as private community marinas. The majority of boating activity comes from shorefront residences. Many lakefront homes have multiple boats and there are over 300 boat slips associated with private developments that abut the lake. Off-lake residents and even residents of other towns can purchase boat permits for Lake Lure.

The Town enacted a number of rules to moderate use of the lake and set boundaries on how some uses impact others. These rules have served the users fairly well, but have not decreased the desire to boat on the lake. A boat permit system has been in place for over 40 years, but has evolved to address issues of fairness and limited resource availability over time. Yet overall boat density on hot summer days is perceived as a rising threat and is not implicitly controlled by the permit system. Town liability for boating accidents is a very real concern. To approach management scientifically, we need to understand use patterns and carrying capacity at Lake Lure.

There are multiple ways to estimate carrying capacity, or the number of boats that can be on the lake without unacceptable impacts. The key factors in estimating carrying capacity for boats from a safety perspective include useable area for each type of boat, the use pattern for boats of different types, the feasible hours of operation for each boat type, and the available space. For commercial boats, where activities and schedules are more predictable, a reasonably complete estimate of carrying capacity can be developed. Members of the Lake Lure Marine Commission have done this using a proprietary model developed by those members, setting aside 30% of the total acre-hours for commercial uses. The commercial permits have accounted for 5% of the total permitted motorboats >10hp on Lake Lure over the past four years. Non-commercial uses have not been limited to the remaining 70% of acre-hours, but an exercise conducted as part of this effort indicates that motorboats with engines >10 hp should be subject to some control to maximize safety on the lake.

While variability can be high and the current permit system does not adequately control peak density, problems are infrequent when fewer than 1000 permits are issued for motorboats >10 hp. Allowing more permits while maintaining a safe lake is possible with secondary controls, a variety of which have been evaluated in this review, but all of which were generally unacceptable to the lake user population through a questionnaire and meetings.

Quantitative data were collected for boat use patterns, both through a questionnaire and by direct observation during the summer of 2006. Carrying capacity estimates were generated and are sometimes exceeded on summer weekends and holidays with nice weather between the hours of 11 AM and 5 PM, mainly as a function of operation of boats >10 hp for high speed activities. There is some evidence of self regulation of larger boats, but peak densities do achieve possible danger levels, especially for untrained or inexperienced powerboat operators. Risks are low during most weekdays and any day with rainy weather.

There is a very wide range of potential management options that could be applied at Lake Lure. The key is to select options that represent the least intrusive and most equitable means to ensure safety to the greatest feasible degree. The objective is to maximize safety and enjoyment of the lake. Those goals may seem antagonistic at times, as some of the enjoyment comes from inherently risky activities, but the overall enjoyment of the lake by the greatest number of people does depend on facilitating a safe experience. Management options are divided into four major categories (Access Control, Time Zoning, Space Zoning, and Training and Behavioral Modification) plus an enforcement category that applies to all of the others. The associated options are reviewed in this report in some detail.

A considerable amount of public discussion was conducted and input was considered in developing a proposed management plan. A number of adjustments are feasible and appear appropriate based on the work done in 2006. The following relatively simple, albeit possibly controversial, adjustments are recommended for implementation in preparation for the 2007 boating season:

- Maintain all existing rules with regard to permitting and safety controls for boats on Lake Lure, most notably the no wake zone restrictions (areas and time).
- Maintain the commercial boat permitting system as it is now administered, with minor adjustments as warranted. Allocating some portion of the commercial acre-hour allotment to a controlled rental operation and limiting rental property permits for boats >10 hp to weekday use only are options.
- Limit the number of permits issued for non-commercial motorboats >10 hp to be used during the peak season to 1000, including weekly peak-season permits (15 weekly permits = 1 annual permit). Grant permits on a priority system based on permit holders from 2006, followed by date of application by new permit holders, with an application deadline for past permit holders of May 15th, and only one permit for a boat >10 hp granted to all new applicants.
- When all permits for boats >10 hp have been assigned, provide up to 250 “weekday only” permits for this class of boats.
- Do not place a permit limit on boats <10 hp or fishing boats of any motor size during peak season for any boats during the non-peak season until such time as observation data indicate a need.
- Promote education of boaters through the permit system and require all permit holders to sign an acknowledgement form indicating that they understand the Lake Lure rules and will be responsible for the operation of their permitted boat(s).
- Require operators of motorboats >10 hp to complete a safety course, and require operators under the age of 16 to be supervised by an onboard person competent (by training) in boating safety.
- Provide a police boat patrol on the lake to enforce the rules, focusing on education and cooperation by boaters first, followed by penalties for violations as warranted.
- At a minimum, the patrol boat should be on the lake between 11 AM and 7 PM on all weekend days and holidays with suitable weather between Memorial Day weekend and Labor Day weekend, and on anticipated busy weekdays during summer. Wider coverage would be desirable, if affordable, but these represent the critical enforcement days and hours based on boat density.
- Hire a boating education and enforcement officer dedicated to Lake Lure. Ideally, a dedicated staff member would be provided all year long, and would handle permit applications, education, training sessions, and coordination of on-lake activities. This person might be the primary on-lake enforcement officer, or may just coordinate police assignments and fill in as needed.
- A call number should be established for reporting boating safety problems or related issues to a dispatcher who can reach the patrol boat for a rapid response.
- Enforce a safe operating distance of 75 ft among boats (and among boats and people) when either boat is moving faster than no wake speed. This provides a density dependent mechanism to minimize safety risks as boat density increases. It may eliminate high speed activities during some peak use periods in parts of the lake.

The primary benefits of this plan include:

- Promotes physical and temporal separation of some uses to maximize safety.
- Encourages the distribution of lake use in its current pattern, known to present limited and predictable safety risks.

- Protects the privilege of those now holding permits.
- Allows only educated and trained boat operators.
- Provides an appropriate level and focus of enforcement.
- Provides a density-dependent mechanism for controlling higher risk activities.

The negative aspects of this plan include:

- As the Town grows, not everyone can hold a permit for a boat >10 hp on Lake Lure.
- Requires capable boaters to take official training.
- Requires a different approach and more effort by the police force.
- May curtail high speed activities that many enjoy during busy periods.

More major adjustments may not be necessary, but would warrant considerably more public input if implementation was pursued. No secondary access limitations (e.g., boat flag system) are recommended at this time, although it could be revisited in the future if safety problems related to crowding are perceived to persist.

It should be remembered that getting more big boats on the lake represents a diminishment of utility and quality for other uses as well as a safety risk. However, given that the focus of recreational boat use on Lake Lure involves boats >10 hp, recommendations for permit system changes emphasize greater use of off-peak resource hours by larger boats. This may warrant further discussion going forward.

In order to gain appropriate information, the Town should conduct periodic assessments of boat use patterns, much as performed in this analysis. Both questionnaire surveys and observational data are needed.

Additional options and alternatives are discussed, but this plan is believed to provide the necessary tools to protect lake users into the indefinite future. We believe that the suggested plan elements are sufficient to manage boat density and safety indefinitely, if implemented properly and monitored for any needed adjustments periodically.

Introduction

The Town of Lake Lure takes its name from Lake Lure, its crown jewel. Boating is a major attraction on the lake. A number of safety issues have been raised, but there is general agreement that boating safety is only an occasional concern at this time. Some Lake Lure enthusiasts might well ask “Do we really need to institute boating controls beyond what we have now?” The answer appears to be “Yes” and the rationale lies in the consequences of waiting until the problem becomes more serious, even if we do not know just how long it will take to become a more common threat.

The potential for injury or death rises with high powered boating density, particularly in the absence of operator training, and the Town bears considerable liability for what happens on the lake. Actions have been taken in the past to reduce the number of high powered boats on the lake when risk was perceived as intolerable, including limiting towing activities by organized groups from outside the area and instituting the current permitting system. Having averted clear problems in the recent past, the Town is now evaluating options for keeping boating density at a safe level, so that overall enjoyment of the lake will not be diminished by the ever increasing pressure of recreational pursuits on the lake.

The intent of this process is to explore the range of possible management options, reduce that range to those approaches that are applicable and feasible in Lake Lure, and to seek a combination of controls that can be applied as equitably as possible to maximize lake use without compromising user safety. To this end, the Town retained the services of a small team of consultants from Wiggins Environmental Services LLC and ENSR Corporation to assist with the review of options and development of a boating management plan. An initial report represented a summary of available information, management options and considerations offered through a full day workshop involving the Town Council, Marine Commission and Lake Advisory Committee.

A very inclusive and public process was then followed to seek input from concerned lake users. While meetings were well attended, the total attendance still represented only a small portion of the affected user population. A questionnaire survey was performed to reach a larger segment of the community, which it did. Additionally, data were collected regarding boat use of the lake over the period from Memorial Day weekend to Labor Day weekend, to determine the level and mix of uses, potential periods of capacity exceedence, and specific behaviors that may increase the risk of accidents.

The accumulated data and public input were considered in reviewing possible management options in greater detail, with recommendations made based on the best possible combination of science, economics, and social acceptability.

Lake Lure Background

Lake Lure was formed in 1925 when the Rocky Broad River was dammed with the intent of creating the lake, mainly for real estate purposes. The Town of Lake Lure was formed in 1927 and the associated community has been growing ever since. The originally intended design of a lake-focused community can still be viewed on various maps of the area, but the depression of the 1930s altered the grand plan; land ownership became fragmented and development was not strongly controlled. Building pressure in the Town does not appear to have been especially intense until recently, however. The Town incorporated and established rules for property development, but not in time or with enough limitation to moderate intense development. Additionally, much development is occurring outside the boundary of the incorporated Town. These areas require certain services (e.g., police and fire protection) and are plausible targets for annexation at some future date. Just how to deal with these developing areas with regard to lake use is a significant issue.

Lake Lure itself occupies 720 acres with several major arms and numerous smaller coves (Figure 1). Topography is steep, both around most parts of the lake and within the lake itself; water depth is substantial within 50 ft of shore in most areas. Notable exceptions include major inlets, where accumulated sediment has reduced depth considerably, and a few major cove areas, such as the Lake Lure Golf and Beach Resort area in the northernmost part of the lake. In the arm receiving flow from the Rocky Broad River, sand deposition has been great enough to warrant a regular program of sediment removal through hydraulic dredging. Most of the lake is deep enough, however, to avoid motorboats stirring up significant amounts of sediment, a common problem in many shallower lakes.

The dam is designed to control outflow, minimizing flood damage both upstream and downstream and generating electricity. An interesting aspect of dam operation is that the first priority is to maintain full pool elevation in Lake Lure. Electricity generation and maintenance of downstream flows have not been accorded the priority encountered in many other impoundments; this is a function of the origin of Lake Lure as an aesthetic and recreational amenity, as opposed to having energy production as its top priority. Detailed flow records were not encountered during investigations relating to boating management, and are not essential to developing a boating management plan, but an analysis of the system hydrology and anticipated downstream flow needs would be helpful in possible future flow management.

The vast majority of residences around the lake are tied into a sanitary sewer for wastewater management. The treatment facility is slightly downstream of the dam. The actual sewer lines run from nearshore areas into the lake; concrete manholes are visible in many shoreline areas. The sewer mains run fairly deep into the lake, such that leakage into the sewerage system is more of a threat than leakage of sewage out of the system. Given the additional lake water entering the sewer system, the quality of the influent to the wastewater treatment facility tends to be much better than normal domestic wastewater, necessitating some adjustment in the treatment process. Joints have been sealed on several occasions, but Lake Lure wastewater tends to be very low strength sewage. Leaks in the upland portion are possible, as feeder lines are often not even buried and are subject to damage from a variety of actions, including downed trees.



Figure 1. General features of Lake Lure.

The watershed of Lake Lure covers approximately 96 square miles of fairly hilly terrain. Erosion and sediment loading are issues, but many areas are outside of the control of the Town. Steep slopes and erodible soils cause much of this problem naturally, but development with inadequate erosion controls and runoff detention exacerbates the problem. Other sources of contaminants from the watershed are not the subject of this boating evaluation, but protection of Lake Lure warrants careful evaluation of watershed activities that can affect the lake. The Environmental Quality Institute at the University of North Carolina at Asheville has been assisting with this effort for almost a decade, through the Volunteer Water Information Network (VWIN) program.

Water quality in the Rocky Broad River and several other tributaries to Lake Lure has been monitored for nearly a decade by VWIN. The program does not focus on wet weather events, when most loading would be expected to occur, but most median values for the tributaries of Lake Lure are above the average median value for forested watersheds and many values are higher than the regional average median for all monitored watersheds. Loading during storms may be quite high. Phosphorus levels in water entering Lake Lure and in Lake Lure near the dam are high enough to support excessive algae growth, and the visibility in Lake Lure (based on Secchi disk measurements) has ranged from 2 to 14 ft between April and October since 2001. Lake Lure undergoes thermal stratification during the growing season, and waters deeper than about 20 ft are devoid of oxygen during much of the summer. Water quality appears suitable for all designated uses, but swimming and fishing uses may be impaired to some degree. It does not appear that water quality is substantially affected by boating, the subject of this management plan.

Lake Lure hosts minimal aquatic plant growths, owing to steep underwater sediment slopes and limited light penetration. The potential for invasive nuisance species such as Hydrilla or various milfoils to cause shoreline use impairment exists but is limited in Lake Lure. Some level of control of boats being brought in from other potentially infested lakes is always desirable, to minimize the import of invasive species, but the level of threat at Lake Lure is lower than at many other North Carolina impoundments.

Fish and other wildlife abound in and around Lake Lure. The fertility of the lake, while a potential problem for visual aesthetics and some aspects of water quality, does promote higher fish production. A wide variety of species are present in the lake, including trout. Trout may be stressed by higher surface water temperatures and lower deep water oxygen during the summer, but appear to survive. Warmwater fish will be limited primarily by available cover, with the very low amount of aquatic vegetation representing the greatest habitat constraint on many species. The lake is a popular fishing location, but no fishery studies were reviewed in the course of this project. While the use of boats to fish is a major use in Lake Lure, there is no immediate concern about fish or fishing outside of the issue of more boats on the lake, so additional insights into the fish community are not essential to developing a boat management plan.

Recreational facilities on the lake consist of a Town Beach complex, with swimming area, park and boat launch, as well as an accompanying marina. Town boats, including dredges, are stored nearby. There is some Town land abutting the lake, but most is steep and not amenable to major recreational uses. Most land around the lake is privately held. There are a number of additional beaches and several boat ramps, as well as two larger private community marinas (Lake Lure

Golf and Beach Resort, Lake Lure Village) and one smaller one (Pier Point), all of which are under private control. There are camps that use the lake for recreational activities during the summer months. The Dam Marina is privately held but can support public launching and rents mooring slips; however, it is currently operating on a very limited basis. There is interest by some development groups in creating more community marinas to serve private developments.

The majority of boating activity comes from shorefront residences. There are approximately 723 individual lots abutting the lake, about 700 of which have homes. A few larger, undeveloped parcels still exist, but a development is currently planned for one parcel and others are for sale. There could be as many as 850 lakefront lots with dwellings on them eventually. Many lakefront homes have multiple boats; current rules allow mooring spaces for three boats if the lot has at least 100 ft of frontage. Most shorefront homes have seawalls, retaining walls with generally very vertical faces and no rip rap or other materials to dissipate energy from incoming waves. Many have substantial boat houses as well.

In addition to shorefront homes with boat slips, there are over 300 boat slips associated with private developments that abut the lake, but which have very few actual shorefront lots or dwellings. The community marinas represent a means for gaining easy access to the lake without owning shorefront property, and additional development in the area may seek similar arrangements.

Lake Lure and the surrounding area are very scenic, and despite the distance to major amenities or cities, the area has been “discovered”. Building activity is fairly intense, both on and off the lake, and especially on ridges within and beyond the Town of Lake Lure boundary. Pressure on a variety of Town services is increasing, including use of the lake. The Town enacted a number of rules to moderate use of the lake and set boundaries on how some uses impact others, such as no wake rules within 75 ft of shore, or in coves less than 200 ft across, or between the hours of 9 PM and 7 AM. These rules have served the users fairly well, but have not decreased the desire to boat on the lake.

There are approximately 2750 lots in the Town of Lake Lure. Subtracting lakefront homes, this means that over 2000 parcels of land could have owners requesting boat permits. With subdivision of existing parcels, that total could grow. Not all of those parcels have dwellings on them, but the current permit system does not require a dwelling to be eligible for a permit, and some lots near the lake are very tiny (so called “postage stamp” lots with a tax value of \$100, sold mainly to allow owners to get resident status). Additionally, unincorporated land outside the Town of Lake Lure is being developed to a point where annexation will be considered, potentially increasing the number of lots, dwellings and boat permit applications from within the Town. Residents of other towns can still purchase boat permits for Lake Lure, although a rate increase has slowed that trend. However, it is easy to envision increased demand for boat permits, while the area and time available for boating on Lake Lure remains constant.

The boat permit system has been in place for over 40 years, but has evolved to address issues of fairness and limited resource availability over time. Changes in the system over time make any summary of trends in total permits or even just motorized permits somewhat misleading, as engine size categories are not reported in summary tables, new categories have been created over

time, and permits have been issued for annual, seasonal, weekly and daily use (although not consistently over the years). However, given that most motorized watercraft on Lake Lure are large powered pontoon boats permitted for annual use, the overall increase in annual motorboat permits between 1997 and 2003 from 893 to 1290 permits does signal increased overall use of the lake. Several changes over the past few years have curbed this rise, at least temporarily.

Specific elements of the current permit system include:

- Personal watercraft (“jetskis”) are not allowed on the lake.
- Fishing Only permits are issued, with time of use restrictions (early morning and late evening).
- Residents of the Town pay less per year for a boat permit than non-residents.
- Powerboat permits cost more than non-motorized boat permits.
- Daily permits have been eliminated during the peak season, and weekly peak season permits cost more than weekly off-season permits.
- Commercial uses (e.g., real estate and recreational tours, waterski school, rental boats, fishing guides, property maintenance services) are charged more per permit and have limits on the numbers and types of boats used.

The regulation of commercial uses and elimination of daily peak season permits is perceived as having had a substantial impact on peak boat densities. Potential boaters cannot simply come to the lake for the day without purchasing at least a weekly permit. Camps or other groups from out of town cannot come to the lake at will and operate ski schools or other commercial ventures, as commercial entities are allocated a set amount of time and space on the lake by advance permit. Overall, the permit system governs average boat use more effectively than peak use, but these steps have been important peak-limiting measures.

A detailed spreadsheet program has been developed for allocating space and time (acre-hours) for commercial use of boats on the lake, and the total portion of the acre-hours available for use by commercial entities has been set at 30%. As commercial operations have specific goals, routines and hours, and are therefore more predictable than private recreational users, this system works fairly well for maintaining commercial boat densities at levels that ensure both user safety and general enjoyment of the activity. Commercial permits have accounted for 5% of the total number of motorboats >10 hp permitted on Lake Lure over the past four years (2003-2006, Table 1).

Year	2003		2004		2005		2006		4-Yr Avg	
	# Permits	%	# Permits	%						
Annual Motorized Resident	1,148	89	1,052	91	921	85	937	86	1015	88
Annual Motorized Non-Resident	81	6	45	4	53	5	53	5	58	5
Commercial	52	4	56	5	70	6	64	6	61	5
Non-Resident Commercial	9	1	0	0	0	0	0	0	2	0
Complimentary	0	0	0	0	32	3	26	2	15	1
Municipal		0		0	4	0	13	1	4	0
Resident Rate for Non-Resident		0		0	1	0	1	0	1	0
Total	1,290	100	1,153	100	1,081	100	1,094	100	1155	100

Table 1. Summary table of number of permits issued to motorboats >10 hp from 2003-2006 on Lake Lure.

Non-commercial uses by residents of the Town of Lake Lure have not been limited beyond the constraints of permit pricing. An exercise conducted as part of this effort indicates that motorboats with engines >10 hp should be subject to some control to maximize safety on the lake. This has caused some controversy over the amount of resource area and time potentially allocated to commercial and non-commercial uses during public discussions. Interested parties should bear in mind that commercial uses include boats involved in tours, shoreline facility repairs, guided fishing, and ski training, all of which provide important functions to the community, add to the local economy, and offer opportunity to people who might otherwise not be able to enjoy the lake or might increase recreational pressure through the use of more private boats.

But this allocation system does not apply to the other 70% of the acre-hours theoretically allocated to private users; that capacity can be exceeded in the permit process. Private use is more unpredictable than commercial, although private use is to some extent more self-regulating. Since most boats are moored along the shoreline, a shorefront resident can survey the lake visually and decide if it is worth venturing out under the prevailing conditions of boat density and boating activities. The self-regulating aspect of community marinas is less strong, as most boat owners must make a trip to the lakefront to see the conditions; a decision not to go boating then wastes their trip time. There is little self-regulation for boaters coming from off the lake and launching from trailers or car-tops; they have invested in a trip to the lake and are likely to go boating under all but the worst conditions, and possibly even then. How to manage these varied user groups is in large part the problem facing the Town as pressure to boat on Lake Lure increases.

Based on this background, the boat related problems of Lake Lure can be distilled into mainly safety and enjoyment issues. Shoreline erosion and general surface turbulence from wakes may be an issue as well, but can be better addressed by a change in how shoreline development is governed, not a change in boat density. Water quantity regulation (required outflows) that could affect access to and utility of the lake is not a current issue for Lake Lure, although it could become one. Water quality issues exist, but are not strongly tied to boating; neither seems to impact the other to a substantial degree at this time. Interaction of boats with sediment is limited in Lake Lure, although some resuspension of settled sediment occurs in shallow areas. Possible invasion by nuisance species brought in by boats is a threat, but the physical features of Lake Lure greatly limit that threat. Noise may be a problem for some shorefront residents, especially those not involved in motorized boating, but the no wake rules minimize the severity of noise nuisances.

It is mainly the ability to enjoy an activity on the lake, and in extreme cases the presence of significant safety risks, that is currently in question, and then only at fairly predictable times (good weather weekends and holidays) during the peak season (Memorial Day through Labor Day). There is a rational fear that boating safety problems will increase over time, and a sense that a system must be put in place very soon to protect lake users from themselves and preserve desirable lake characteristics.

Boating accidents at Lake Lure have thankfully been rare, with only a few deaths over almost 80 years related to collisions between boats or between boats and people in the water. There have been a lot of near misses, however, and people who have used the lake regularly for multiple decades have recognized certain high risk factors. These include:

- Overall high density of boats, as might be encountered on hot sunny days between July 4th and Labor Day, especially on weekends and holidays
- Boat operation by inexperienced operators
- Towed water activities, especially when boats are abundant and people wind up in the water off a tube or ski rope
- Varied direction of travel by boats, mainly when boats are abundant
- Limited police presence on the lake, especially during peak use periods when police presence is often most in demand off the lake as well

Recollections from the last five years indicate that towed water activities by groups from out of town using the lake on daily permits and operation of high powered boats by inexperienced operators renting properties for vacation have created hazardous conditions that warranted adjustments in the permit system. Overall boat density on hot summer days is perceived as a rising threat, however, and is not implicitly controlled by the permit system. Issuing fewer permits will reduce the total pool of possible boats on the lake, but will not prevent peak densities considered unsafe for the range of activities enjoyed at Lake Lure. Town liability for boating accidents is a very real concern.

Use Patterns

Managing boating on lakes requires estimation of the number of boats that can use the lake without unacceptable impacts, which for Lake Lure are defined in terms of safety. The acceptable maximum density of boats is commonly called the carrying capacity. To generate the most meaningful estimate of carrying capacity, it is necessary to gain an understanding of the use patterns for the mix of boats on the lake. There were no quantitative data available for use patterns prior to 2006, but in our initial effort to evaluate carrying capacity, collective experience provided insights that helped establish estimates for use patterns that were useful in understanding why there are boating problems and how we might begin to address them.

Fishing tends to be an early morning or late evening activity, minimizing the conflict between boat use for this activity and most other boat uses. Non-motorized boats, while they can go out into the main body of the lake, can also operate quite enjoyably within or near the 75 ft no wake limit. An exception is provided by sailboats, but sailboating is not a major use of Lake Lure. Smaller motorboats (<10 hp) are actually fairly rare on Lake Lure, and simply do not account for enough use to be a major factor, other than as obstacles for higher powered boats and therefore as safety concerns. Issues with smaller motorboats can be lumped with those of non-motorized boats for purposes of use pattern analysis. Commercial boats do not represent a large portion of total permits, but they use the lake for disproportionately more time per boat than most non-commercial boats, so they are a factor in use analysis.

The daytime use of motorboats >10 hp (commercial and non-commercial) is the primary factor creating safety risks and diminished enjoyment on Lake Lure. By virtue of the number of permits issued, there is the potential for crowding on any day, even if no towing was occurring; in 2005 there were 966 motorboats >10 hp, each estimated to need about 7 acres of area to operate safely, with permitted access to about 540 acres of boatable lake (excluding nearshore areas and coves where high speed operation is prohibited). The number of permits for boats >10 hp was similar in 2006, at about 978. Yet in reality, crowding occurs only during sunny weekends, holidays, and some particularly ideal (either hot or very scenic) days during the week between Memorial Day weekend and Labor Day. Most weekdays and any rainy days are not reported to exhibit crowded conditions. Non-peak season crowding is undocumented and not reported by anyone involved in boat management discussions to date. Even when crowding does occur, it could be much worse than the reported conditions indicate, suggesting that there are self-regulating mechanisms in place that should not be disregarded.

It should surprise no one that the distribution of boating on Lake Lure is not even; virtually no lake reports an even distribution of lake use, by boaters or any other user group. This signals the primary flaw in the carrying capacity analysis and any boating management system that divides the resource (as acre-hours or any other logical unit) without consideration of temporal variability; it is not the average boating density that is most in need of management, but rather the peak density.

Only with knowledge of that temporal variability can we most effectively and equitably allocate the resource (available lake space over time) for boating uses. As part of the questionnaire survey (Appendix A), seasonal and daily use was investigated. Boat use surveys were also conducted in

the peak season of 2006 to ascertain the use pattern over time within days and among days (Appendix B). Tables 2 and 3 summarize use information from the questionnaire survey, while Figure 2 summarizes the daily pattern of boat use on clear, summer, weekend days.

The assumption has been that it is only larger motorboats that are causing capacity to be exceeded and that the average use level is acceptable. The data provided thus far suggests that this is a reasonable assumption. Motorboats >10 hp represent the dominant type of boat on Lake Lure and the greatest safety risk. Peak use of motorboats >10 hp therefore becomes the primary target of management. Within that group of boats we must address commercial and non-commercial uses, towing and non-towing activities, and features of the users that make them more or less of a safety risk (e.g., training, experience, ability to make go-no go decisions on lake use at a particular time).

A few key aspects of the questionnaire and observation survey data warrant special mention:

1. With over half of large boats accounted for in responses, the average number of motorboats >10 hp per responding household is reliably about 1; many have 0 and only a few grandfathered cases involve more than 3 motorboats >10 hp. As residents can have up to 3 permits at the resident rate, many more permits could be issued under that rule.
2. Non-motorized boat owners may be under-represented in the survey, as only 60 such boats were accounted for. However, actual use data does not indicate extensive use of non-motorized boats on Lake Lure.
3. About a third of respondents live in town year round. About a third are registered voters. About a third have waterfront property. Yet two thirds of respondents bought their homes in town with the intent of using the lake for boating.
4. About 11% of homes are rented to others some of the time, but only 17% of these rentals include a boat as part of the deal; this suggests that 2% of residences are rented and provide a boat to renters.
5. No more than about half of residences in town are occupied at any one time, with the peak in the summer. This will limit the number of boats in use at any time.
6. Of respondents who revealed their level of training for boat operation, about half were trained and half were not.
7. Motorboats >10 hp were used more frequently and for a longer duration per use than motorboats <10 hp or non-motorized boats, resulting in an average of 39 hours per motorboat >10 hp per summer vs. about 5 hours per non-motorized boat and <1 hour per motorboat <10 hp. There are also many more large motorboats permitted for use on the lake, making them highly dominant on the lake.
8. About three quarters of all questionnaire respondents cruise in larger motorboats and create a wake on the lake. Almost half tow people at some time. No other use (fishing, paddling, sailing) is practiced regularly by even half the respondents, and at least a third (and as many as 60%) report that they never participate in those activities. Cruising at higher speeds and towing activities are the main uses of boats on the lake.
9. The pattern of use of motorboats >10 hp on summer days with favorable weather is uneven over the course of the day but is fairly consistent among days (Figures 2A-C, 2E). Use is low until about 11 AM, then climbs during the late morning and afternoon. Use declines after about 5 PM, but remains substantial during the evening until dark.

Table 2. General features of lake users and their boats from a questionnaire survey.

Feature	Total	Average	Median	Maximum	Minimum
Total number of Surveys returned	844				
Years at Lake Lure		12.2	8	65	<1
Motorized Boat Permits > 10 hp	585	0.8	1.0	4.0	0.0
Motorized Boat Permits < 10 hp	60	0.1	0.0	2.0	0.0
Non-motorized Boat Permits	60	0.4	0.0	6.0	0.0
	% Yes	% No	% No Answer		
Year Round Resident	33	65	2		
Registered Voter	30	66	4		
Own a House	77	20	3		
Live on Shorefront	36	61	2		
Live in Defined Community	37	60	3		
Boat Use a Factor in Home Purchase	67	26	7		
Home Rented to Others	11	80	9		
Boat Included in Rental	17	77	5		
Trained Boat Operator	44	43	14		
	Boats >10 hp	Boats < 10 hp	Non-motorized		
Total Weeks of Use (All Boats of Type)	3878	453	1510		
Weeks of Boating per Summer per Boat	6.6	1.2	3.3		
Days of Boating per Week per Boat	2.3	0.5	1.2		
Hours of Boating per Day per Boat	2.5	0.5	1.1		

Table 3. Frequency of activities pursued on Lake Lure.

Activity	% Much	% Little	% Never	% No answer
Motorized Towing	22%	26%	27%	26%
Motorized Pleasure	55%	19%	9%	18%
Motorized Fishing	14%	28%	34%	25%
Non-motorized Paddling	14%	24%	36%	26%
Non-motorized Sailing	2%	5%	60%	33%
Non-motorized Fishing	5%	19%	47%	29%

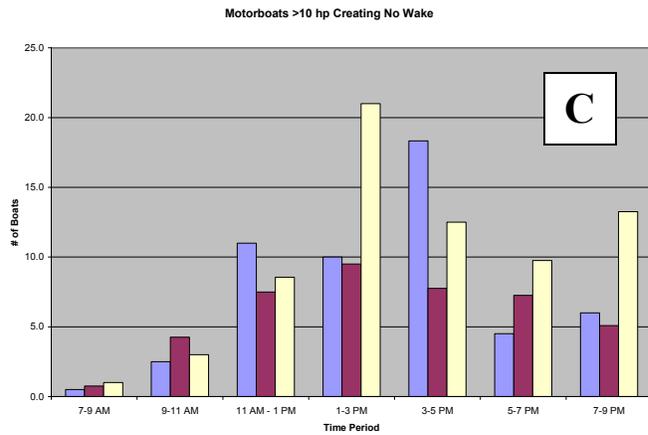
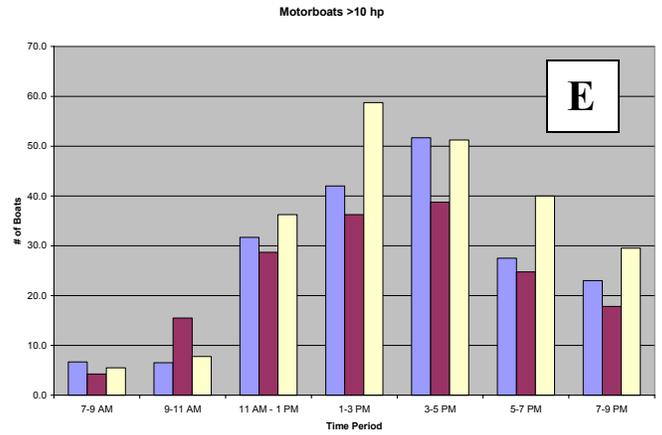
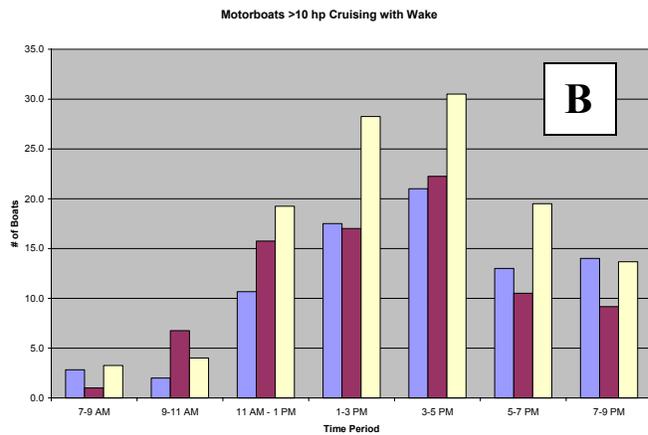
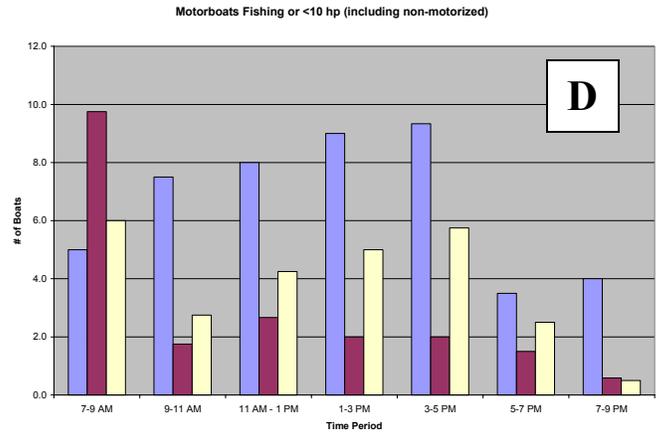
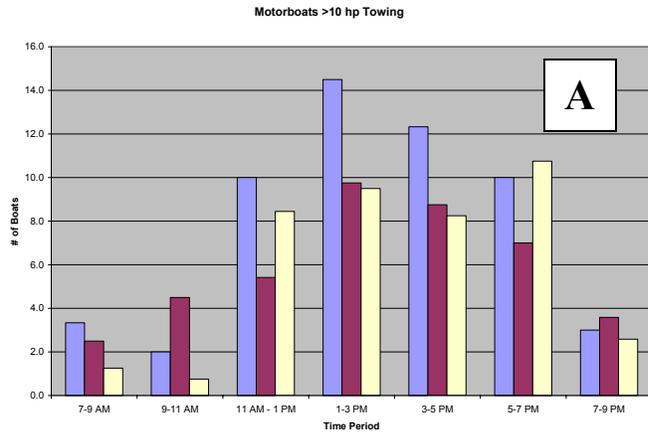


Figure 2. Boat use patterns during clear summer weekend days, for each of five boat types (A-E), based on three days.

10. There are some shifts in specific uses of larger boats, including the relative proportion involved in towing, cruising, and drifting over the course of the day, but the variation is not striking.
11. The temporal pattern of non-motorized boats, motorboats <10 hp or fishing boats >10 hp is more even over the course of nice days than for motorboats >10 hp involved in towing or cruising, but can vary considerably among days (Figure 2D).
12. There are fewer non-motorized boats, motorboats <10 hp or fishing boats >10 hp than there are motorboats >10 hp involved in towing or cruising at all times surveyed except early morning, when fishing uses can be the most common use of the lake. No crowding occurs at that time.
13. No clear pattern is observed on most weekdays or rainy days, and use levels are much lower than for summer weekend days with nice weather (Appendix B). However, fishing use may actually increase during rainy days, and fishing activity is observed over more of the lake's surface area. Fishermen tend to stay near shore when large powerboat activity is high, but fish offshore more commonly in the absence of those boats.

The conclusion that can be drawn from boat ownership and use data is that crowding occurs mainly on summer weekends and holidays with nice weather, and then only from late morning to early evening. This is consistent with opinions expressed by parties familiar with the lake and reflected in user perceptions from the questionnaire survey. Lake use is not even over time, and it is peak use that must be managed if safety is to be maximized.

Carrying Capacity

The concept of carrying capacity relates to the amount of a use that a lake or other resource can support without an unacceptable level of impact. Carrying capacity can be expressed instantaneously, as in the number of boats that can be on the lake at once and still maintain safety and provide an enjoyable experience. Carrying capacity can also be assessed over time, as in the boats using the lake at any one time projected throughout the boating season, factoring in any changes in instantaneous capacity that might occur over time. The impact may be to the resource or other users. In the case of boating carrying capacity, different types of boats have different levels of impact to the resource and require different amounts of space to avoid impact to other users. For Lake Lure, the impact of boats on the resource is not perceived as the major issue to be addressed, although a reduction of wake impacts is desired and could be attained by altering the nature of seawalls constructed as part of shorefront development. The key issue is impact on other users, particularly other boaters.

There are multiple ways to estimate carrying capacity. “How’s the Water” a book on recreational water use and related impacts, conflicts and management approaches, was edited by R. Korth and T. Dudiak in 2002 and published by the University of Wisconsin Press. This book is suggested to readers of this report for a lot of background on carrying capacity and boating issues that cannot be easily covered here. The key factors in estimating carrying capacity for boats include necessary area for safe operation of each type of boat, the use pattern for boats of different types, the feasible hours of operation for each boat type, and the available space.

Volunteers working on commercial boat permitting developed a list of desirable space allocations for use of each of the primary boat types on Lake Lure (Table 4), based on a variety of literature sources, and we concur that these values are reasonable (within the reported ranges from many other studies).

Table 4. Acres of lake area needed to operate types of boats on Lake Lure.

Boat Type	Acres Preferred During Use	Rationale
Towed Water Activities	11	Safety, esp. for downed towee
Motorized Over 10 hp	7	Safety, esp. at high speeds
Motorized Under 10 hp	3	Safety and aesthetics
Non-Motorized	2	Maximized enjoyment
Fishing	5	Maximized enjoyment
Tours (sightseeing, realty)	4	Safety and best enjoyment
Service Boats (prop. maint.)	3	Safety, esp. wake production

One could argue that some of these values could be increased for maximized safety or enjoyment of the experience, and one might also consider that operator experience and group enjoyment could allow these values to be lowered in some cases. Ultimately, these are average values that represent the space needs for conducting the corresponding activity on a regular basis without unacceptable risk of either accidents or a diminished enjoyment of the activity. The range of numbers in available studies comes from a combination of accident statistics, observed densities and behaviors, and exit interviews with boaters after spending time on a study lake.

Again, there is room for debate in all of these numbers. Some towing space estimates are as low as 7.5 acres per boat, while others are in excess of 20 acres per boat. Fishing and non-motorized boating can be “safe” at as little as an acre per boat, but the enjoyment of the experience is reduced for the participants. Many large horsepower (hp) boats are used in Lake Lure to cruise fairly slowly and enjoy the scenery; only an acre or two per boat would probably be acceptable during such use, but what is the safety risk after several hundred boats watch a sunset and then want to motor quickly back to their docks? The above “acre per boat factors” were derived for Lake Lure, mainly focusing on the commercial sector, but they are appropriate for consideration of lake use by everyone.

The second factor, pattern of use, is best based on actual observation. Estimates have been gained by questionnaires and the estimates match the general experience of lake users with years of experience. Key elements in the evaluation of use patterns include how often boats go out, how many of what type are out at a time, how long they stay out on the lake, and what types of activities the users engage in. Towing boats may be used to cruise, fish or just float for some of the time they are on the lake, but will spend the majority of their time towing people on skis, tubes or wake boards. Fishing boats spend most of their time drifting or using an electric motor, but some troll and all want to get to the desired fishing location fast. Because the intricacies of use pattern can get very complicated, it is often ignored in favor of an assumption of even use over the course of a day. This is not the case at Lake Lure for motorboats >10 hp, a situation that should be kept in mind when considering carrying capacities based on even use. Managing for an average carrying capacity estimate will be likely to result in periods of underuse and overuse, as occurs at Lake Lure.

The third factor, feasible hours of operation, is easy to estimate in general, although it can be difficult to estimate precisely without direct observation data. Except for fishing and some low speed cruising or paddling, use is minimal between 9 PM and 7 AM by rule at Lake Lure. Powerboating with wakes can occur from 7 AM to 9 PM, but there is a daily pattern to motorboat use on nice summer weekends, as evidenced in Figure 2. High speed boats are most likely to be on a lake between about 11 AM and 7 PM, while fishing boats are more likely in the exact opposite time pattern. Non-motorized boats will overlap with each, but tend to stay closer to shore when high speed boats are abundant. Estimating the number of people likely to be on the lake based on simple division of available hours by hours that an activity is typically pursued ignores factors such as work schedules, weather pattern, and human nature. This is a major problem in managing peak use. We can bracket the use pattern by assuming even use as one scenario and the peak use as a second scenario, using the values given in Table 2 from the questionnaire survey as interpreted by use pattern shown in Figure 2.

The final factor, but perhaps the most important, is the area available for boating activities. Not all boats can or should use the entire lake surface. Lake Lure is 720 acres in area, with several major arms and many coves. Based on map measurements and on-site observations, about 180 acres are not useable by larger powerboats, simply as a function of the no wake rule for areas within 75 ft of shore or in coves less than 200 ft across. This leaves about 540 acres on which boats with >10 hp motors can operate. The no wake rule is both a safety and shoreline impact protector, and while it is possible for some high powered boats to create minimal wake at high

speeds, the intent is to slow boats down when they are approaching shore. Boats with <10 hp motors (which includes electric boats in this case) and non-motorized boats can use the entire area of the lake, although there are certain logical restrictions (e.g., sailboats should not operate at full sail near docks or other obstructions, and boats should stay out of swimming areas).

Ignoring the amount of time each boat goes out onto the lake and the possible hours of operation, one can get an impression of just how many boats can be safely and enjoyably on the lake at a time under the above constraints. A total of 49 towing boats would fill the available 540 acres if each had the suggested 11 acres in which to operate (think of it as a flexible 11 acre buffer that moves with the boat). A total of 77 non-towing motorboats >10 hp could fill the same space, each with a 7 acre moving buffer zone. There are only a few larger tour boats on the lake, so the capacity for these alone is not a factor. The other four types of boats listed in Table 4 require 2 to 5 acres per boat, but could theoretically use the entire lake surface. This results in estimates of maximum boats of each of those four types on the lake at once that range from 144 to 360.

As use of the lake is not restricted to one type of boat at a time, the actual carrying capacity at any one time is a function of the mix of boat types. There could be 25 towing boats and 39 non-towing boats >10 hp on the 540 acres of lake outside the no wake zone at once, with 30 motorboats <10 hp and 45 non-motorized boats in the 180 acres within the no wake zone at the same time. Alternatively, there could be 15 towing boats, 54 non-towing motorboats >10 hp, 10 motorboats <10 hp and 75 non-motorized boats on the lake at once, each with adequate space. The possible combinations are almost limitless, which is why some sense for the pattern of use and feasible times of operation must be known if an accurate carrying capacity is to be derived for a given lake. Given the shape of the lake, it may also be prudent to consider carrying capacities for each arm of the lake.

But the situation is even more complicated, given that boats go on and off the lake over the course of a day, with a different number and mix of boat types possible every hour or so. Projecting the carrying capacity over time requires some estimate of the total amount of time available for boat use. While the feasible hours of operation are not identical for all boats (e.g., many fishing boats will go out at night, when no towing boats should be on the water), the amount of available time during the peak season has been estimated as 14 hours per day for 7 days each week for 15 weeks, or 1470 hours of time. Multiplying by 720 acres of lake area (even though not all boats can use all this area), 1,058,400 acre-hours exist to be allocated among lake uses.

As swimmers are supposed to stay within 50 ft of shore and motorized boats >10 hp are supposed to stay at least 75 ft from shore, there is only a small safety issue with other boats potentially in the same areas as swimmers. With boat docks and other manmade obstructions, the actual boatable acreage is actually somewhat less than 720 acres, but it is not a major source of error. Consequently, the Marine Commission has adopted the concept of 1,058,400 acre-hours of resource as the basis upon which to calculate commercial allocation of the resource.

For commercial boats, where activities and schedules are more predictable, a reasonably complete estimate of carrying capacity can be developed. Members of the Lake Lure Marine Commission have done this using a proprietary model developed by those members, setting aside

30% of the total acre-hours for commercial uses. The breakdown within commercial uses is set based on experience, and results in an allocation for each commercial use that totals to the 30% of all ac-hr allocated to commercial uses (Table 5). As permit applications come in at Town Hall, allocation is assigned (under a system of seniority and other factors) until no more ac-hr are available. As commercial operations function on a relatively predictable schedule, peaks in use are limited or at least predictable, and the resource allocation is viewed as representative of actual use.

Table 5. Allocation of acre-hours among commercial boat uses at Lake Lure.

Activity	% of All Use	Allocated Ac-hr
Towed Water Activities	20%	44,100
Motorized Rental Under 10hp	8%	25,402
Motorized Rental Over 10hp	56%	123,480
Tours	11%	24,255
Fishing Guide	2%	6,350
Service Boats	1%	3,175
Realty	2%	6,350
	100%	233,113
Non-Motorized (remainder of available commercial)		<u>84,407</u>
30% of the total 1,058,400 ac-hr available for use during peak season	TOTAL	317,520

Non-commercial uses are not restricted to the remaining 70% of the total ac-hr available, and the use pattern by non-commercial users is considerably less predictable. In attempting to evaluate how allocation of the remaining 70% of the available resource might be performed for non-commercial boats, it is evident that properly dividing up the available ac-hr among permit applicants requires knowledge of the relative percent of time that different uses are active and the turnover rate of users over the course of a day. Neither of these factors is precisely known, but data from the questionnaire survey (Table 2 and Appendix A) and observations of boat use on the lake in 2006 (Figure 2 and Appendix B) provide the best available estimates.

An estimate of the relative proportion of uses can be made based on permit sales or from the questionnaire survey results. Motorboats >10 hp represented 66% of the boats permitted for use on the lake in 2005, but are on the lake more often and for longer than other boats, with the questionnaire survey indicating that these larger boats represent at least 89% of the boating hours on the lake. Our initial analysis used the percentages based on permits issued, but with the addition of more specific data for time of use for each type of boat, adjustment to actual usage seems appropriate. Fishing boats, which tend to have engines >10 hp but are used differently than towing or cruising boats, had to be split from those other boats >10 hp, but the assumptions of frequency and duration of use were held constant for this analysis. An analysis similar to that conducted for the commercial sector was then conducted, and results in the allocation presented in Table 6.

Table 6. Estimated allocation of acre-hours among non-commercial boaters on Lake Lure, with corresponding numbers of permits that could be issued.

Types of Boating Activity	Allocation of Ac-hrs Based on Use Pattern	Uses wakeable area	Uses non-wakeable area	Acres/boat needed	Activity hrs/day	Activity Days per Week	Activity Weeks Per Peak Season
Motorized under 10 hp	1%		x	3	0.5	0.5	1.2
Motorized over 10 hp	79%	x		11	2.5	2.3	6.6
Non-motorized	10%		x	2	1.1	1.2	3.3
Fishing	10%		x	5	2.5	2.3	6.6

Types of Boating Activity	Ac-hrs/season/boat	Acre-Hours Available for Activity	Calc. Permits that can be Issued	Actual average permits issued for 2005	Actual average permits issued for 2006
Motorized under 10 hp	1	1,852	2058	50	60
Motorized over 10 hp	417	438,971	1052	966	978
Non-motorized	9	18,522	2126	408	490
Fishing	190	18,522	98	39	47

Note: Permit calculations assume available ac-hrs associated with area of primary operation (wakeable or non-wakeable).

The result is an estimate of permits that could be issued, depending on certain allocation assumptions, to use up the available acre-hours in accordance with the best available estimate of overall use pattern. Note that no distinction is made between towing and cruising in motorboats >10 hp, as many non-commercial boats are used for both activities. The higher ac/boat factor is applied to those boats, since they could be towing people. Allocated permits for motorboats >10 hp could be increased by 36% if there were no towing activities, but towing is assumed and provides a margin of safety in the analysis.

There appears to be no current permit limit issue with motorboats <10 hp, non-motorized boats, or fishing boats under the estimated allocation scenario in Table 6; there is more availability than permits issued. Only motorboats >10 hp represent a threat to overrun the carrying capacity of the lake when the actual permits issued is compared with the projected permits that would result in complete use of the estimated allocation. A previous estimate based on allocation by historic numbers of permits issued to each boat and an assumption of equal use in hours per season resulted in similar estimates, except for motorboats <10 hp (which apparently have lower use rates than other boats). In particular, the estimate of permits that could be issued for motorboats >10 hp ranged from 772 to 1112, bracketing the value of 1052 permits obtained in this refined analysis.

Aside from the margin of safety accorded by assuming a need for 11 acres by all boats >10 hp, an additional margin of safety is built in. Motorboats >10 hp are assumed to operate only in the 540 wakeable acres of Lake Lure, while all other boats are assumed to operate within the 180 non-wakeable acres, yet each use is accorded a percentage of total ac-hrs as though all the resource was available. There will be more space in each area than assumed in the analysis, but as smaller boats can go outside the 75 ft no wake zone, there is a risk of conflict and such a margin of safety is justified for the larger motorboats. Many more small motorboats or non-

motorized boats could be accommodated within the no wake zone, but the actual number of permits issued does not approach the capacity estimate, even with the conservative assumptions applied in this analysis. Fishing boats tend to have a temporal separation from other boats, such that more of these could also be accommodated, but the actual number of permits does not approach the minimum estimate of allowable permits under the constraints of this analysis.

If carrying capacity is expressed as the number of permits that can be given out, then only motorboats >10 hp are using Lake Lure at a level close to the estimated carrying capacity. The number of permits issued in recent years has been higher than in 2005 or 2006 based on Town records, but changes in the permit system make direct comparison difficult. For example, boats attached to rental properties have been moved to the commercial category and daily permits during the peak season have been discontinued. The apparent highest permit year was 2001, which when translated to match the approach used in assessing the 2005 permits, would have yielded about 1290 full time, peak season equivalents for motorboats >10 hp. Most people agree that safety on the lake was compromised in 2001 at a greater frequency than observed in more recent years.

Values for 2002-2004 were intermediate, with estimates of 1097 to 1233 full time, peak season equivalents for motorboats >10 hp. As peak season daily permits were eliminated in 2005, these values would be somewhat lower, but adjustments for rental home boats and combining weekly permits to make full season equivalents have been made in these estimates. The key point is that based on a carrying capacity analysis, the number of permits given out for non-commercial motorboats >10 hp has fluctuated around the perceived appropriate limit, if that limit is the only factor keeping the capacity from being overrun.

The perception that safety was compromised in 2001, when the highest number of permits was issued, is taken as an indication that the carrying capacity range for larger non-commercial motorboats (1052 from Table 6, but probably more appropriately represented as a value between 1000 and 1100) is a reasonable representation of reality for this system. It should be kept in mind, however, that carrying capacity is a bit of a moving target, given the changing mix of boat types and uses during any period on any given day and from year to year. If boats cease towing people when boat density gets high, the immediate carrying capacity increases, as it is assumed that a towing boat requires 11 acres to operate safely, while a non-towing, cruising boat requires only 7 acres. If inexperienced operators are involved, each of these acre per boat estimates might logically be increased (values as high as 20 acres per boat are applied in many boating analyses). Where safety must be accorded the highest priority, it makes sense to err on the low side of estimated carrying capacity.

The carrying capacity analysis and related permit allocations in Table 6 assume an even use of the lake resource over 14 hours per day and the 15 week peak season. We know from Figure 2, however, that boat use is not even. A more conservative estimate of carrying capacity can therefore be calculated by taking the daily use pattern into consideration. Working with just the motorboats >10 hp, the dominant and potentially most dangerous watercraft on the lake, the use pattern for 3 nice weather weekend days in summer of 2006 is shown in Figure 3. This is the same as Figure 2E, except that thresholds have been added to indicate safety levels of 27

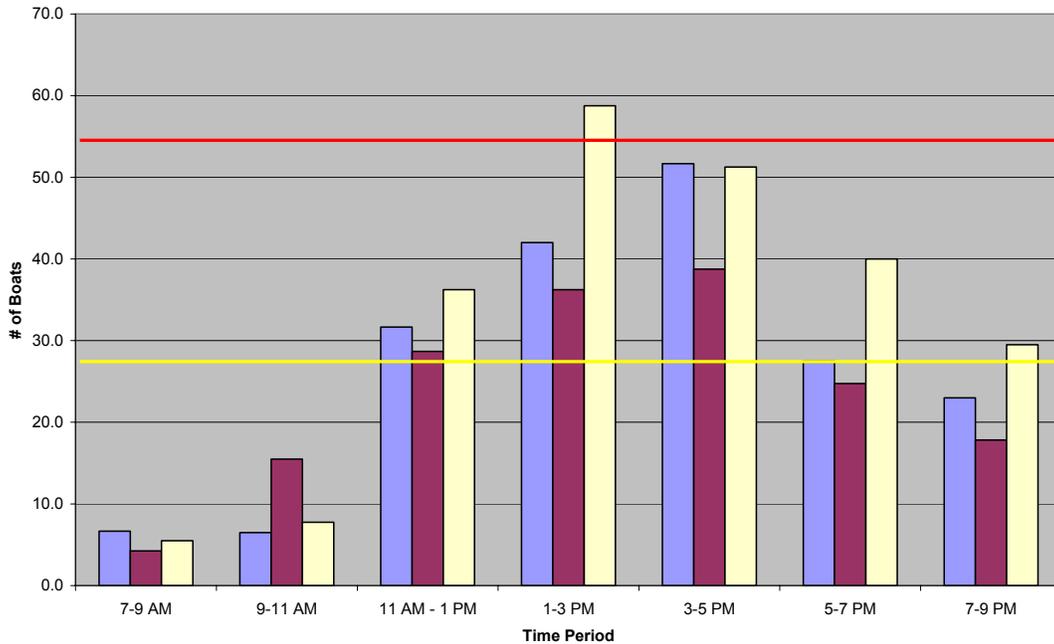


Figure 3. Pattern of use of motorboats >10 hp on three summer weekend days with nice weather. Safety and enjoyment thresholds of 20 acres per boat (yellow) and 10 acres per boat (red) are shown for comparison.

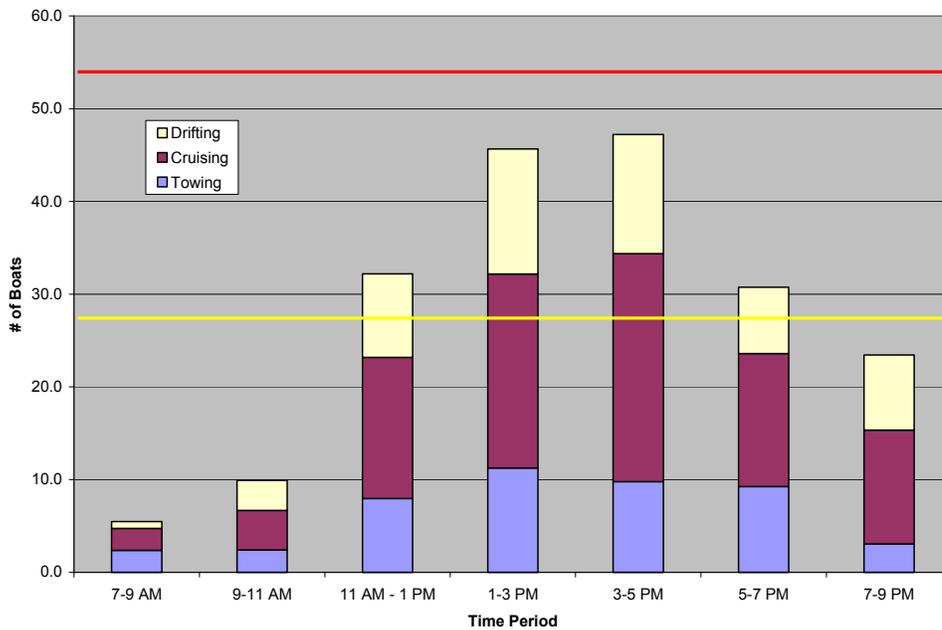


Figure 4. Breakdown of motorboats >10 hp by activity for the average of three summer weekend days with nice weather. Safety and enjoyment thresholds of 20 acres per boat (yellow) and 10 acres per boat (red) are shown for comparison.

(yellow) and 54 (red) motorboats >10 hp on the lake. These correspond to 20 acres per motorboat and 10 acres per motorboat, the generally accepted range over which safety and user enjoyment diminish. The permit system at Lake Lure assumes that 7 to 11 acres are needed per non-commercial motorboat >10 hp, bracketing the 10 acre/boat threshold.

As is evident in Figure 3, the density of motorboats >10 hp on Lake Lure is higher than the 20 acre/boat threshold between 11 AM and 5 PM on all three surveyed days. This does not indicate an imminent safety hazard, but the potential for safety to be compromised if operators are not skilled or disobey the rules. Density is near the 20 acre/boat threshold from 5 PM to 9 PM on average, but exceeded it on one of the three days. Density exceeded the 10 acre/boat threshold on only one day, and then only during one period (1-3 PM), but the potential to move into the zone of distinct safety hazard and diminished user enjoyment is apparent.

Other days not surveyed in 2006 or earlier may have been busier, and gas prices and flooding just before the fourth of July holiday weekend may have depressed boat use slightly in 2006. However, the three days depicted in Figure 3 are believed to be reasonably representative of typical busy periods on Lake Lure. As such, it can be seen that there is a potential for safety hazards from 11 AM to 5 PM, and sometimes from 5 PM to 9 PM, but that densities are rarely in the distinct danger zone (less than 10 acres/boat, above the red line threshold). However, the bars in Figure 3 represent the average density in each two hour period, and instantaneous densities can and do exceed the red line danger threshold at times. This is particularly true in the North Arm of Lake Lure, which is popular for towing activities. Yet providing <10 acres per motorboat >10 hp represents a distinct danger only if the boats are moving fast, and many of the observed boats were drifting, so observed density alone does not signal an imminently hazardous condition. The carrying capacity for boats capable of moving fast is approached or exceeded at times in Lake Lure, but self-regulating mechanisms appear to limit the use of those boats in fast moving activities, keeping effective densities well below the redline threshold (10 acre/boat) (Figure 4).

Examining the breakdown of boat use on a specific busy day (Sunday, July 23, 2006), the general pattern exhibited in Figure 4 is again observed in Figures 5 and 6. The yellowline threshold (at least 20 acres/boat) was exceeded in multiple arms during multiple 2-hour periods, but the redline threshold (10 acres/boat) is only occasionally exceeded by the combination of all boats, and only once by the combination of towing and cruising boats >10 hp. During non-peak days, however, boat use is well below any threshold for potential danger (Figures 7 and 8).

If the permit system was to be used to minimize peak densities, the only mechanism would be to limit permits to a level that would shrink the number of boats on the lake, leaving the distribution of boats over time as it is. If we set a limit of 10 acres per boat >10 hp, no reduction in the number of permits recently issued would be necessary, based on average summer, nice weather conditions as depicted in Figure 4 (all values are below the redline threshold equating to 10 acre/boat). The data for specific arms of the lake on one busy day (Figures 5 and 6) support this assessment. If a safer threshold of 20 acre/boat >10 hp (the yellowline threshold) is applied, or if the 10 acre/boat threshold is applied to all boats, the number of permits issued for motorboats >10 hp would have to be reduced by about 40% to reduce the peak densities adequately. This would result in a lot of unused resource time during non-peak periods and create considerable

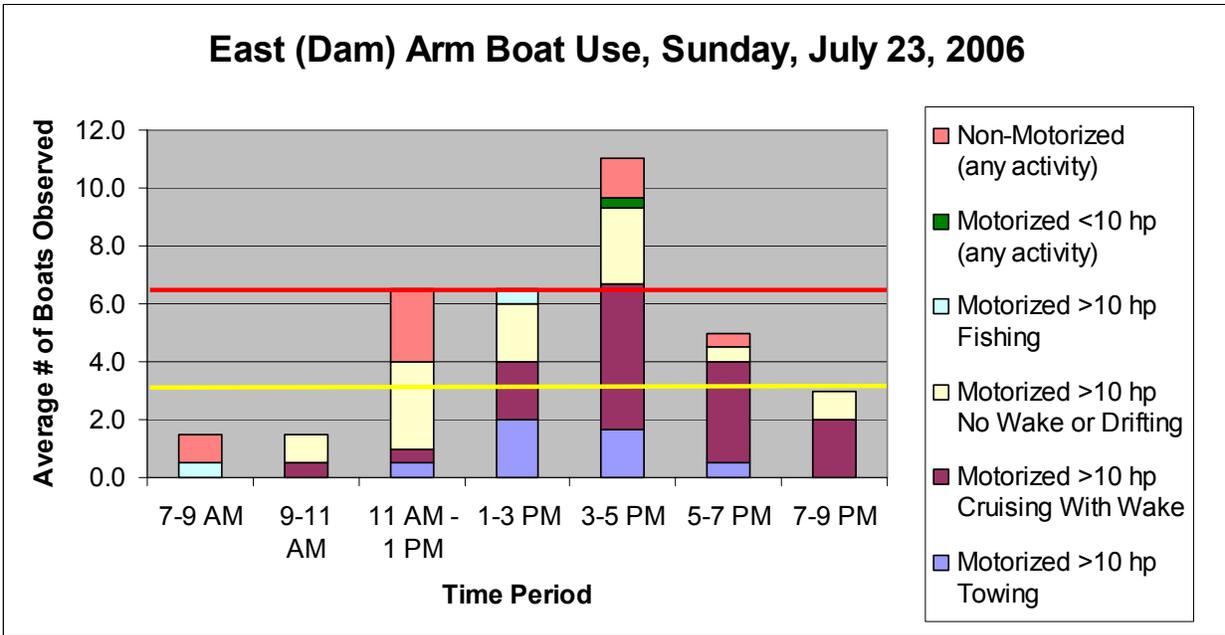
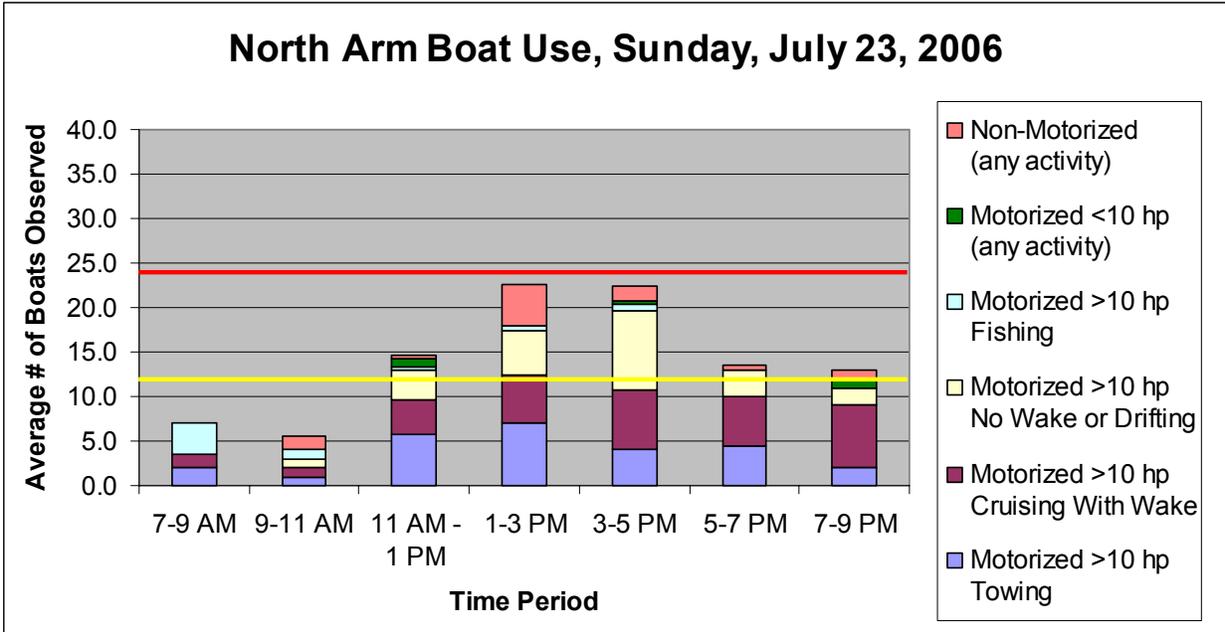


Figure 5. Boating use pattern for the North and East Arms of Lake Lure on July 23, 2006, a nice weather weekend day. The yellow line represents the 20 acre/boat threshold and the red line represents the 10 acre/boat threshold, each for the respective area of the associated arm of the lake.

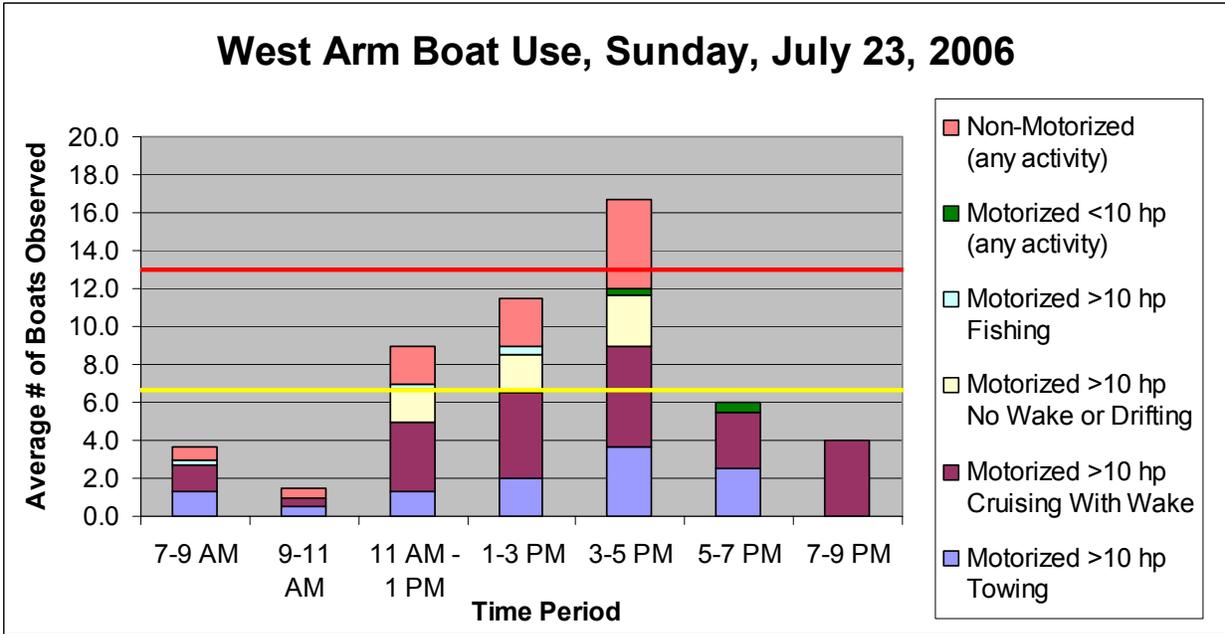
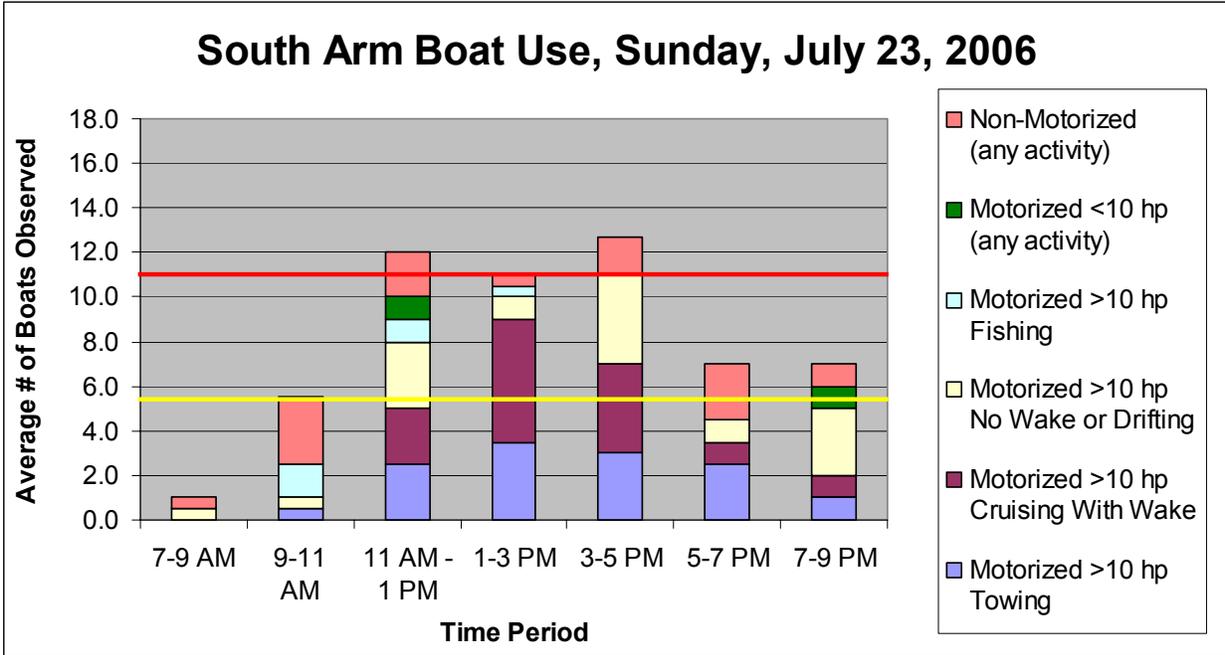


Figure 6. Boating use pattern for the South and West Arms of Lake Lure on July 23, 2006, a nice weather weekend day. The yellow line represents the 20 acre/boat threshold and the red line represents the 10 acre/boat threshold, each for the respective area of the associated arm of the lake.

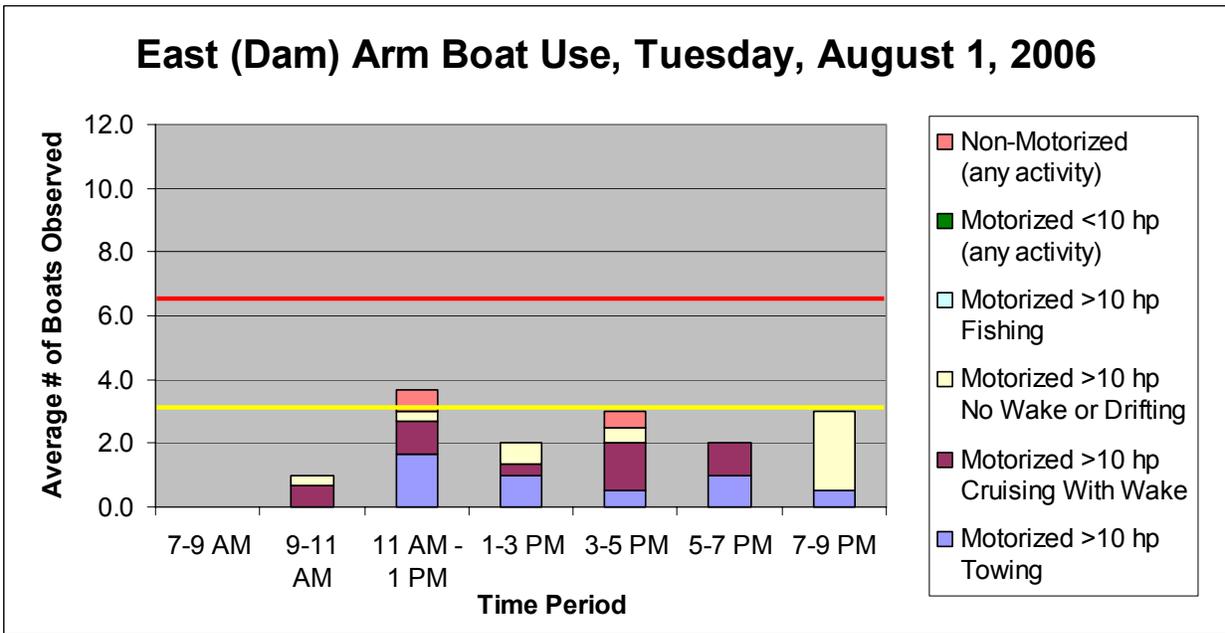
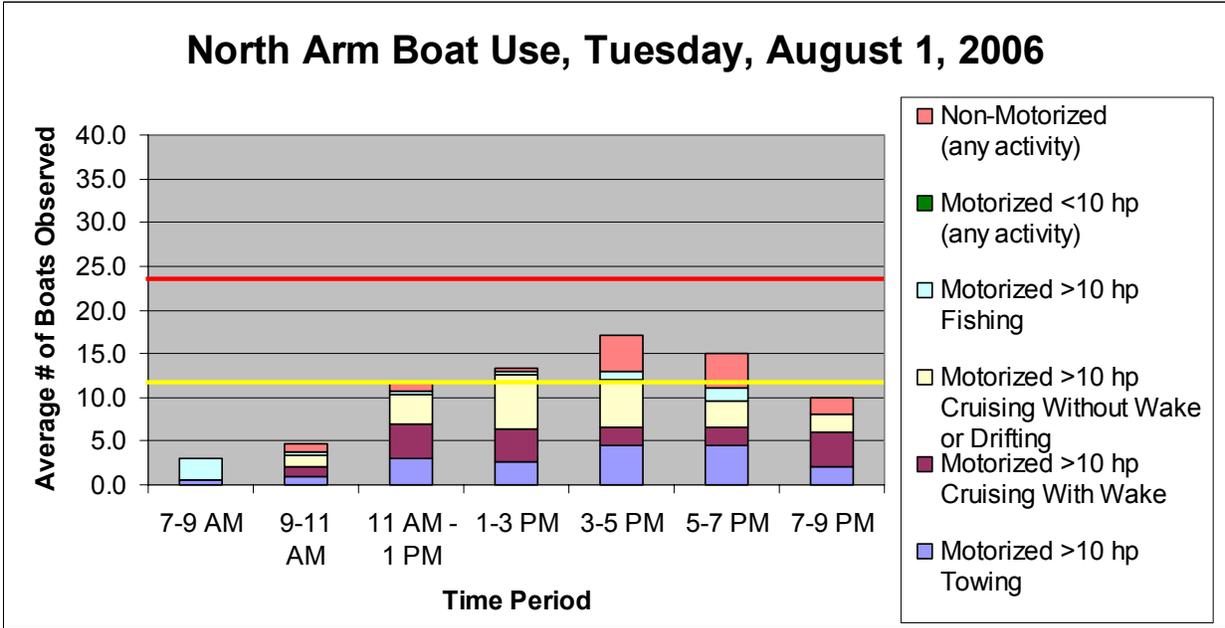


Figure 7. Boating use pattern for the North and East Arms of Lake Lure on August 11, 2006, a nice weather weekday. The yellow line represents the 20 acre/boat threshold and the red line represents the 10 acre/boat threshold, each for the respective area of the associated arm of the lake.

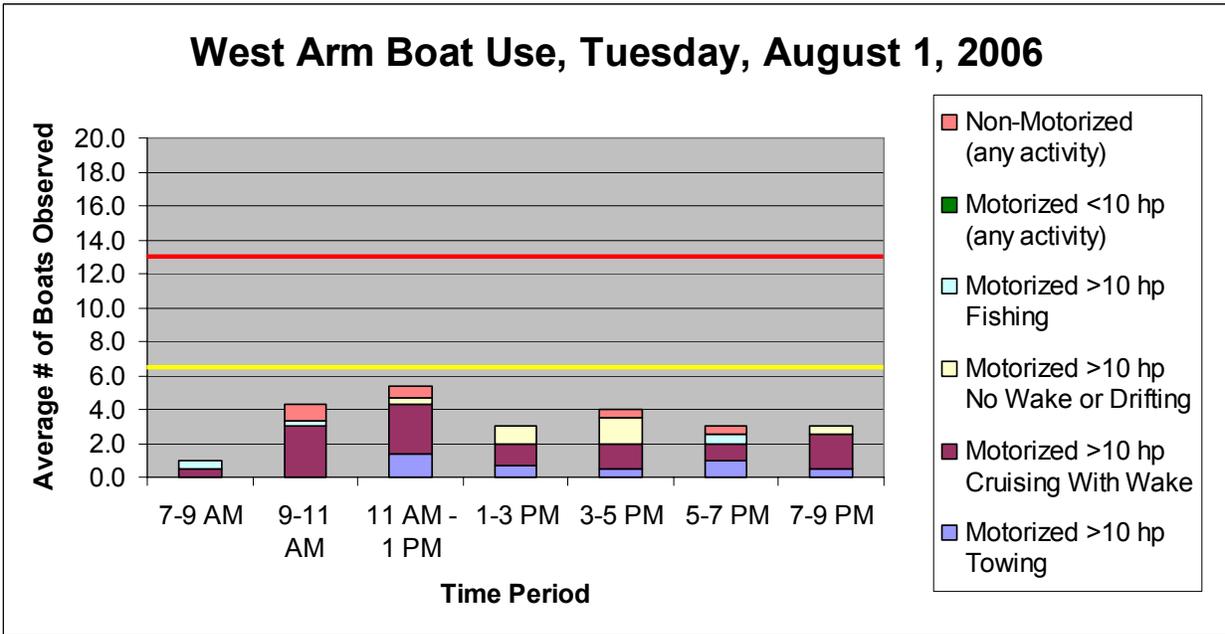
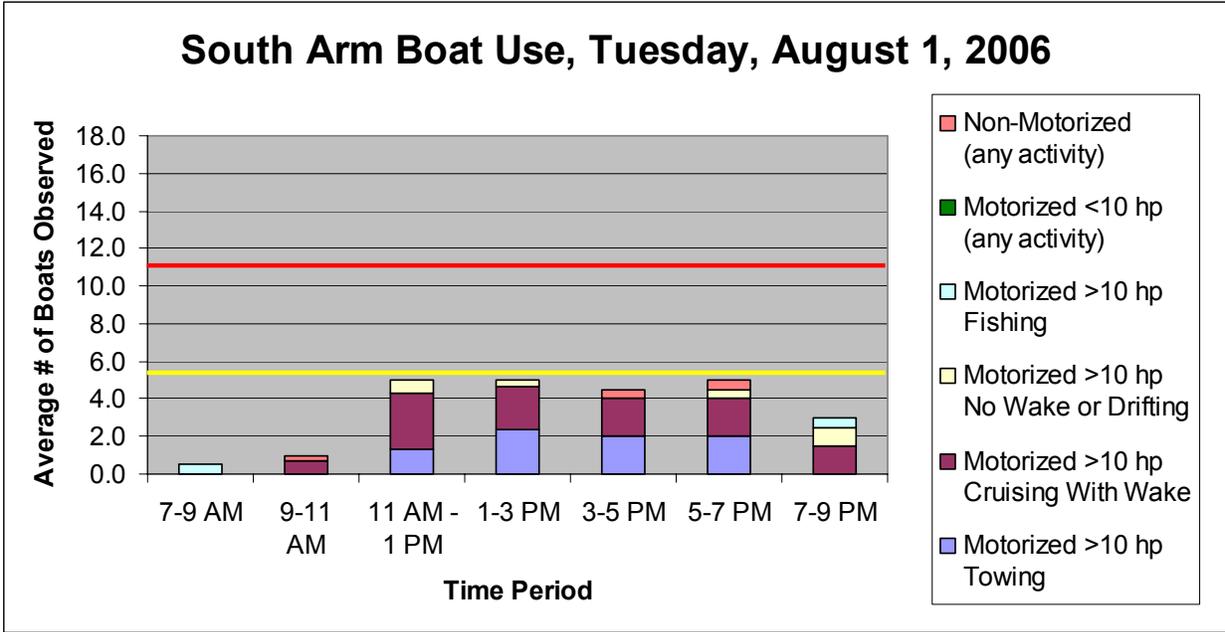


Figure 8. Boating use pattern for the South and West Arms of Lake Lure on August 11, 2006, a nice weather weekday. The yellow line represents the 20 acre/boat threshold and the red line represents the 10 acre/boat threshold, each for the respective area of the associated arm of the lake.

unrest among boating enthusiasts. It would seem more appropriate to look for ways to reduce peak densities without lowering use at all times.

Based on the preceding analysis, we conclude the following regarding boating carrying capacity in Lake Lure:

1. The key factors in estimating carrying capacity for boats include necessary area for safe operation of each type of boat, the use pattern for boats of different types, the feasible hours of operation for each boat type, and the available space.
2. Working from 1,058,400 acre-hours of peak season resource time to be allocated among lake uses is reasonable, and the application within the model used to control commercial uses of the lake seems appropriate. Application to non-commercial uses is less reliable, given a number of more variable factors, and the Marine Commission recognizes this.
3. Developing a carrying capacity estimate for non-commercial uses involves a number of assumptions, and the questionnaire and boating observation surveys were used to derive the most dependable values available. Based on areas of use, frequency of use, duration of use, and the ratio of use times for each boat type, approximate numbers of permits that could be issued to use up 70% of the allocated resource hours were derived.
4. Use by non-motorized boats, motorboats <10 hp, and any boats designated for fishing under the rules of Lake Lure does not approach the allocation provided in the analysis. Only use of motorboats >10 hp approaches the theoretically allocated resource time, such that permit limits might be needed with any expansion of boating pressure in the future. Under the current use assumptions, including an even pattern of use, between 1000 and 1100 permits can be issued for motorboats >10 hp.
5. The use pattern of boats is not even, however, and peak use of motorboats >10 hp does exceed the carrying capacity at times, based on a range of 10 to 20 acres per boat for maintenance of safety and user enjoyment. Having <10 acres/boat >10 hp is rare. Having <10 acres/boat for all boat types combined is more common, however. Having <20 acres per boat >10 hp is common on nice weather summer weekend days (and holidays) between the hours of 11 AM and 5 PM, and occurs sometimes between the hours of 5 PM and 9 PM.
6. Many motorboats >10 hp are used for drifting or low speed cruising, especially during peak use periods. Consequently, while carrying capacity is exceeded by the actual number of boats on the water, it is much less commonly exceeded by boats engaged in high speed activities upon which the carrying capacity estimate is based. There may be a self-regulating mechanism in place that provides a margin of safety during peak use periods, although not everyone subjects themselves to that mechanism, creating potential safety hazards.
7. In order to use the permit system to reduce peak densities below the generally regarded potential hazard limit (at least 20 acres/boat >10 hp or 10 acres/boat for all boat types), an approximate 40% reduction in permits for boats >10 hp would be needed. This would lower the peaks, but assuming a continuation of the current daily pattern of boating, much resource time would be unused on weekdays and in the morning of weekend days. This would be a very inefficient way to control peak boat density and is likely to be socially unacceptable. Alternatives that hold permits issued to 1000 to 1100 and provide additional controls for peak density control appear preferable.
8. Given available capacity during the week, it may be possible to offer peak season weekday only permits that would allow use of the resource during that timeframe without adding to weekend peaks. Permits for the non-peak season appear to require no restriction at this time.

Potential Management Options

There is a very wide range of potential management options that could be applied at Lake Lure. The key is to select options that represent the least intrusive and most equitable means to ensure safety to the greatest feasible degree. An exception to equitability may be the desire by many lake users to preserve lake conditions and user rights as they are today for the future; this may not be fair to all possible future users, but avoids ruining the resource for the temporary enjoyment of the maximum number of possible users (known commonly as the “tragedy of the commons”). The primary objective is to maximize safety and enjoyment of the lake. Those goals may seem antagonistic at times, as some of the enjoyment comes from inherently risky activities, but the overall enjoyment of the lake by a large number of people does depend on facilitating a safe experience.

Some management approaches are focused on specific problems, such as minimizing pollutant inputs, preventing invasions of exotic species, or reducing noise, many of which are not central issues at Lake Lure, although each is relevant. We focus here on methods specifically intended to maintain boating safety while maximizing boating use. A listing of potential management options is provided in Table 7. Most are fairly self evident, while a few may require some additional explanation to place them in the context of Lake Lure. Management options are divided into four major categories (Access Control, Time Zoning, Space Zoning, and Training and Behavioral Modification) plus an enforcement category that applies to all of the others.

Permit Systems

The current permit system allocates available space and time (in acre-hours) among commercial permit holders, with 30% of the total acre-hours available during peak season allocated for commercial uses. Non-commercial permits were initially unlimited, but have undergone some adjustments to address out of town users (greater cost, since no contribution to the tax base is provided), daily users (eliminated during peak season), and rental property boats (moved to commercial system). Consideration of the 70% of total acre-hours implicitly (although not by regulation) allocated to non-commercial uses (Table 6) indicates that permits for motorboats >10 hp approach the capacity that might be allocated to them based on the carrying capacity analysis. However, no such allocation has been formally made, as non-commercial use is much less predictable than commercial uses, and there appear to be density dependent self regulating mechanisms at work on Lake Lure. Consequently, no firm limit has been placed on the total number of residential peak season permits issued for non-commercial motorboats >10 hp in the past.

Density dependent mechanisms warrant some explanation. When responsible boaters observe that boats are becoming too abundant to enjoy their chosen activity safely, they tend to modify their behavior. Towing may cease, speeds may be reduced, new areas with fewer boats may be sought out, boaters may choose to drift along the shoreline, or boaters may simply leave the lake. For those who live at the edge of the lake, they can easily come and go as conditions warrant, and can often assess the situation without even leaving their homes. Those with less time at the lake, including vacationers and those who trailered a boat from elsewhere, are less likely to leave the lake, but if they are responsible boaters, they will maintain safe behavior. At 11 acres per towing boat, Lake Lure can only support about 49 such boats operating at once, while about 966

Table 7. Potential boating management options for Lake Lure.

Technique	Advantages	Drawbacks	Applicability Issues for Lake Lure
<i>Access Control</i>			
<i>Permit Systems</i>			
Unlimited	Simple	Lack of control	Limits exist; alternative methods of density control could allow more permits to be issued, albeit with time restrictions
Limited total	Sets maximum, allows prediction of average, can be used with experience to limit problems	Will not prevent peaks unless low number applied; will shut some out of lake use as demand increases	Maximum on >10 hp could minimize peak problems, but will not prevent them by itself; issues of equitable distribution of permits; could eliminate weekly peak season permits or permits for lots without dwellings; weekday only permits might facilitate more use without peak increase
Unlimited first motor permit, others by availability	Maximizes opportunity	Limits permits for some who have had more in past, ultimately will not provide long term control	By distributing the same number of permits among more people, peak use may rise; not adequate by itself
Transferable permit, but limited number per lot	Allows multiple boat options, but only one at a time on lake	Limits past freedom, restricts use of second boat by guests	Will limit peak use, but as demand for permits rises, may not be adequate by itself; shorefront owners tend to have implicit version of this system already
Limited by type of boat or motor	Controls problem sectors	Not everyone can get all they want	Current practice: PWCs prohibited. Extension to other boat types or motor sizes on lake may be socially unacceptable, and only a minority have more than one boat >10 hp
Limited by season of use	Addresses seasonal variation	Will limit summer users	Current practice: Off-season permits offered at lower rate. Might get more off-season demand if peak season permits limited, spreading out use over time
Limited by weeks of use	Allows breakdown within busy season	Will restrict users in peak weeks	Currently issue weekly permits, but without limit on number per week; could reduce peaks by such a limit, or by specifying weekday use only
Limited by days of use	Alternating days limits peaks on weekends/holidays; weekday only permits can provide increased use without higher weekend peaks	Limits freedom of use during potentially favorable periods, requires substantial enforcement	Partitioning of days (odd-even) likely to create social upheaval; may be too difficult to enforce; ignores current self-regulating mechanisms. However, offering weekday only permits could allow use of unused capacity without making weekend conditions worse

Technique	Advantages	Drawbacks	Applicability Issues for Lake Lure
<i>Access Limits</i>			
Parking spaces at boat ramps	Passively limits ability to launch boats	Does not control shoreline owners or marinas	May create on-lake/off-lake conflicts, but works with anti-drydock ordinance to limit launchings
Boats available commercially	Limits boats that are likely to be used the most	May increase demand for individual boats	Commercial boats represent least and greatest hazards (commercial operators vs. rental property boats); uses are varied and serve a variety of useful purposes (tours, seawall repair, learning to ski); detailed system of allocation already in place; may need more commercial operations to satisfy future demand safely, especially rental boats
Boats moored at docks or in lake	Limits maximum boating density by sector with greatest access to lake	Does not control peaks, effective limit may be lower than what users are used to	Have 3 slip/property (>100 ft frontage) limit now, but most owners use only one boat at a time; self-regulating mechanism appears to be in effect; group pays higher taxes and may resent greater limitation
Check in/check out system	Allows rational allocation of available space, especially from controlled access points, does not require a limit on the number of permits that can be issued	More difficult to control shoreline owners, requires allocation system and enforcement, does not guarantee access for all permit holders whenever desired	Could work in concert with commercial allocation to maximize overall use while controlling peak use; could involve flags that are issued, reserved or otherwise provided with limit that corresponds to capacity; mainly applicable to motorboats >10 hp, but strongly opposed by current users
<i>Time Zoning</i>			
<i>Quiet Times</i>			
Quiet days	Provides peaceful aspect on predictable basis, opens area for safe non-motorized use	Greatly limits available time for motor use, may get same effect with bad weather days	Noise is apparently not a big issue at Lake Lure; limits available acre-hours when demand is high
Quiet hours	Minimizes disturbance during key times, provides some opportunity for expanded non-motor activity	Can impact early morning or night fishermen (common time for quiet hours), may restrict motor use during best time for some users (after work)	Have 9 PM to 7 AM no wake period, which effectively creates quiet time overnight; appears to be adequate for now and does not affect use during peak periods

Technique	Advantages	Drawbacks	Applicability Issues for Lake Lure
<i>Time Slots for Uses</i>			
Banned uses	Removes primary safety risks, limits conflicts caused by competing uses	Infringes on perceived user rights, may have legal ramifications; puts Marine Commission in large regulatory role	Have ban on PWCs and boats >20 ft long, may consider other watercraft that represent problems (hovercraft?) or regulation of motor use by property renters, but generally contrary to spirit of openness for Lake Lure
Fishing hours	Maximizes experience for this activity, which tends to occur on the fringes of the daily use period	May limit other largely non-competing uses unnecessarily	Seems to occur on its own, but would overly limit other non-competing uses if formalized; current mix of fishing only permits with night no wake restriction appears to create desired situation
Skiing hours	Sets limit on one of the more area intensive uses, opens up time for competing uses (sailing, cruising)	May create severe congestion and safety risk in small time period, impacts commercial operations with fixed time schedules	Appears too limiting for demand on Lake Lure, compresses allocation such that demand will not be met or safety will be compromised
Sailing/windsurfing hours	Allows safer use of more area for this activity	May overly restrict other uses if demand for sailing is low	Sailing is not a primary use, can provide space by other means
Multi-use hours	Creates groupings of activities that can co-occur, maximizing safe use	Gets complicated and may still create conflicts	Too many uses and users to apply effectively at Lake Lure, will compress demand into less time, potentially compromising safety
No wake hours	Limits high speed uses, increases safety and reduces noise at key times	Removes time periods from available total for some high demand activities	Have 9 PM to 7 AM no wake period, could consider another period during day to provide safe opportunity to other low speed users, or system that allows declaration of "no wake allowed" when crowding occurs (requires notification and enforcement)
No towing hours	Limits activity perceived to create greatest risk	Removes time periods from available total for one high demand activity	Could be applied for peak weekends and holidays where known problems occur, or could be applied as warranted as with no wake declaration, with proper notification and enforcement

Technique	Advantages	Drawbacks	Applicability Issues for Lake Lure
<i>Space Zoning</i>			
<i>Area Restrictions</i>			
Complete exclusion zones	Keeps activity out of sensitive areas, maximizes safety	Eliminates area for activities in demand	Only applicable near dam, for safety reasons (a minor loss of area); other sensitive areas unknown for Lake Lure
Motor exclusion zones	Keeps motorized activity out of sensitive areas, maximizes safety	Eliminates area for motorized activities in demand	Would be applicable in the absence of no wake zones; would require boats to row or use electric motors to move motorized watercraft 75 ft out from shore or out of small coves
No wake zones	Protects sensitive areas (usually shoreline, but sometimes shoals)	Eliminates area for motorized activities in demand	Have no wake zones <75 ft from shore and coves of <200 ft width; appropriate in Lake Lure but expansion not warranted
Use limited areas	Excludes activities with highest risk of impact from areas where impact is intolerable	Removes area potentially useable for certain high demand activities based on risk, not actual impact	Primary area where applicable is near shore; need effectively met by no wake zones
Designated use areas	Divides lake into sections most appropriate for desired uses, limits inappropriate uses of some areas	Removes potential space for high demand activities, makes some users travel long distances for desired use, creates conflict over use zoning	Might encourage use of some areas over others, but local resistance to extreme space zoning; no wake zone effectively sets bounds for larger motorboat activity, other exclusionary approaches probably more applicable for protecting sensitive (swimming areas) or high risk (dam) areas
<i>Training and Behavior Modification</i>			
<i>Voluntary Measures</i>			
Education through mail	Informs people of responsibilities and expected procedures, provides warning, lays ground rules, solicits cooperation	May not reach all users, may not be read, does not require compliance	Materials can be provided with permit, informs permit holders of rights, rules and responsibilities; essential communication step moving forward where increased regulation is likely to be needed

Technique	Advantages	Drawbacks	Applicability Issues for Lake Lure
Posted signs at access points	Informs users of rules or issues at point of entry	Will not reach shoreline property owners	Important to remind off-lake residents of rules and issues not facing them every day
Live education at access points	Allows direct interaction, answers questions, puts a face on requirements, facilitates enforcement in advance of on-lake violations	May create conflict, may slow down launching, may unfairly focus anti-rule sentiment	Interactions at boat launches, with safety as focus, would limit on-lake problems; could be accomplished in association with boat surveys
Buoys with possible signage	Posts key areas with any special rules or warnings	May not be seen by all users, especially at high speeds	Appropriate as a back-up for other educational programs, but insufficient by itself
<i>Operator Education Requirements</i>			
Operator licensing	Ensures knowledge by operators, provides tracking of past offenders	Does not guarantee safe behavior, limited effect on boating density	May decrease acres per boat needed for safe operation or may increase operator awareness of unsafe conditions; may be able to get the same effect with mandatory education, but actual licensing by Lake Lure Marine Commission increases control
Operator education mandate	Ensures knowledge by operators	Does not guarantee safe behavior, limited effect on boating density	Consistent with many laws, justified when safety risks are apparent; requires proof of training to get permit, may include age restrictions
Safety acknowledgment forms	Assigns safety risk minimization to users	Does not guarantee safe behavior, limited effect on boating density	Easily handled with permit process, makes users aware of responsibility, may ease town risk to small extent; forms turned in with permit applications
<i>Behavioral Controls</i>			
Speed limit	Increases safety, eliminates some uses during periods of high risk	May eliminate desired uses at times, requires monitoring and notification system	Potentially useful as a peak use safety measure, implemented when needed, as long as a notification and enforcement system is in place
Direction of motorized traffic	Minimizes safety risk from other boats	Restricts use, may diminish enjoyment	Lake layout not conducive to uniform pattern of motor use, but common practice of keeping closest shoreline on the right seems to minimize problems

Technique	Advantages	Drawbacks	Applicability Issues for Lake Lure
Distance from shore use limits	Separates uses to some degree, minimizes safety risk	Measurement of distance can be difficult	In place already with no wake zone, marker buoys, swimming restriction; important to maintain this separation in Lake Lure
Distance from other watercraft limits	Maximizes safety, creates density dependent use limitation	Requires judgment of distance to nearest boat, possible enforcement complications, may not protect downed waterskiers or people overboard	Would limit some activities (especially towing and high speed cruising), with enforcement, if density got too high; potential peak limiting step instead of speed or access limits
Alcohol consumption statutes	Minimizes safety risks and liability	May limit enjoyment of the lake experience by some	Essential safety step - designated driver rule
Flotation device use requirements	Maximizes safety	Considered an infringement of rights by some, may not prevent boating accidents	For some uses (waterskiing, sailing) this is a standard requirement, for others it is likely to remain optional; very brightly colored vests may help make people in the water more visible
Enforcement			
<i>Off-lake Enforcement</i>			
Access point inspections	Prevents problems before they occur on the lake	May slow launching, does not control shoreline owners	Would allow permit checking and support other management applications above
Access point observation	Allows evaluation of density and use issues by inspectors	Can't see much of Lake Lure from any one access point	Not likely to be very effective at Lake Lure; need boat patrol
General shoreline observation	Allows inexpensive assessment from multiple points	Cannot react quickly to problems	Helpful if problems can be reported to boat patrol or central contact; need dedicated phone line and rapid response
<i>On-lake enforcement</i>			
Police boat patrols	Makes users aware of need to act responsibly, provides fast reaction to problems	Can be expensive on a regular basis, may force less responsible users into other areas of the lake with even greater risks	Essential to have some enforcement of any regulations, at least during peak use periods; police presence on the lake is the most effective enforcement method, but requires some training to shift focus toward education and facilitation of safety

Technique	Advantages	Drawbacks	Applicability Issues for Lake Lure
Designated citizen boat patrols	Can provide same benefits as police presence	May not be respected to the degree that a police detail will be, may also carry expense or stretch volunteer resources	Not as desirable as official police presence, but has advantage of being less threatening; may not have same compliance effect; trained person or small group authorized by Town could provide key coverage during peaks, when police presence elsewhere may be essential
Citizen reporting process	Facilitates notification of authorities if there is a problem	Police or other official group has to respond to potentially frequent calls	Needs clear guidelines on how to apply, but ability for on-lake boaters to report violations is important
Peer pressure	Works behind the scenes to bring unsafe users into compliance, carries no clear cost	May get out of hand, issues with lack of authority or uneven application	Better to have responsible users report unsafe conduct to designated authority

permits were issued in 2005 for boats that could engage in towing, without even considering the commercial permits for towing boats or any other use of the wakeable 540 acres of Lake Lure. Self regulation may be a key factor here.

In addition to density dependent self regulating mechanisms, many people cannot get to the lake on a daily or even weekly basis, so the number of permits that can be issued is obviously much greater than the instantaneous carrying capacity of the lake. Table 6 makes a number of assumptions about use frequency that seem to represent reality, based on the questionnaire and observation surveys. If conditions change in the future, as with vacation homes being converted to year round use, the analysis may no longer be valid.

One other large factor in the ability to issue many more permits than the lake can support at one time is the tendency of shorefront residents to have more than one boat. Up to three mooring slips are allowed, and a few grandfathered lots have four or even five slips. However, except where multiple people from a dwelling go out on the lake at once in separate boats, only one boat is used at a time. It seems likely that this cuts the actual portion of permits likely to be used at any one time about in half, a supposition generally supported by the questionnaire data.

Despite factors that limit actual use of permitted boats, the permit system does not control when permit holders can use the lake. Peaks in use can occur that exceed the carrying capacity of the lake for boats, especially larger motorboats. If there is no limit on non-commercial peak season permits, the capacity of the lake to safely host larger motorboats may eventually be exceeded on an average basis, but that has not happened so far. Safety was believed to have been compromised more often in 2001, the year of maximum permit issuance, extending beyond just nice weekends and holidays during the peak season. Therefore, the limit for permits as a control device for average boating density is just slightly higher than the current annual average, or somewhere between 1000 and 1100 permits.

Different approaches to permit limitations include limiting the number of permits per dwelling or lot, per type of boat (engine size), or per season, week or day of use. Any number of scenarios would be possible, but ultimately any limit on permits will create issues of equitability. One simple approach is to “grandfather” current permit holders, which under the current analysis would leave some small number (<100) of additional permits to be offered in the future. Receipt of a permit after the limit has been reached would depend on someone relinquishing a permit. Those wishing to obtain permits would be placed on a waiting list, and the system would run much like the commercial permit system operates now. Current equitability is upheld, but future issues with new town residents can be anticipated, and with only about a third of current permit holders being registered voters, the democratic process could get contentious.

As an interim measure, experience and 2006 data for Lake Lure suggest that permit limits will be effective for average conditions, but not for generally predictable days of peak use (like weekends, holidays, and perhaps hot, sunny mid-summer weekdays). And the number of permits issued in 2005 and 2006 are within acceptable limits from the carrying capacity analysis conducted as part of this program, so no cut back in permit issuance is needed at this point. In the long run, however, some additional method of controlling boat density is needed if peaks are

to be controlled, self regulating mechanisms are to be supported, and equitable opportunity is to be provided.

One such approach is included in the Permit Systems category. Check in/check out systems would modify the permit system to function more like a private golf club; purchasing a permit (analogous to membership) entitles one to access, but does not guarantee a tee time. Some form of reservation system would be needed to allocate the lake space during peak use periods, or permit holders could be issued a flag or other identifier that would be in shorter supply than permits. Such a system need only be invoked during peak use periods, and then only for motorboats >10 hp, to keep the density at a safe level. Equitable distribution and minimum infringement on historic freedoms at the lake are the key issues here, each of which presents serious challenges.

A secondary permit system, which is what a reservation or flag system would constitute, requires a lot of thought and general public buy-in before application. If a single flag was issued to each shorefront lot owner, that would limit use of multiple boats from a lot at once, but we are not sure that there is much use of second or third boats now. For those not living on the lake but mooring a boat in a communal marina, some limited number of flags could be available through the marina for expected peak days. For those who must trailer a boat to the lake, ramps could be managed with a limited number of flags, much like marinas. Alternatively, flags could be available from one or more sources in a limited supply, with reservations placed ahead of time.

The primary benefits of a secondary permit system are that it can be applied flexibly as conditions warrant and it opens up the possibility of issuing more permits while still maintaining control over the density of larger motorboats as needed. The primary drawbacks are creating equitable time on the lake for would-be users, the need to physically distribute flags or other identifying markers, finding a way to notify potential users in advance that the secondary permit system is in effect, and the need for enforcement. As the demand for permits increases over time, as it is expected to do as the area becomes more developed, the adoption of a private golf course model is viable, but represents a major departure from past management and will be perceived as an infringement on the rights of property owners and long-time boaters.

Time Zoning

Time zoning options in Table 7 are fairly straightforward, and many are already in place to some degree at Lake Lure. The no wake rule applied between 9 PM and 7 AM is particularly important in achieving multi-use goals. Banning certain uses altogether is an extreme act only applied to personal watercraft to date at Lake Lure. What has not been applied are specific times for skiing (or other forms of towing), sailing sports, or combinations of uses that require more space than others. These approaches generally limit acre-hours for those activities, and at Lake Lure it makes more sense to maximize those acre-hours, sharing the resource with other uses to the extent possible.

Space Zoning

Space zoning options in Table 7 are also readily comprehensible, and the use of a no wake zone within 75 ft of shore and in coves <200 ft across, plus swimming being restricted to within 50 ft of shore, are key aspects of the current management plan that maximize safety. Aside from these

limits and exclusion of activities from the immediate area of the dam, other space limitations do not appear warranted at this time. There may be some consideration of removing certain erosion prone or narrow areas from the wakeable area, even though these areas are more than 75 ft from shore, but any such changes represent a minor adjustment to wakeable area.

Training and Behavior Modification

The set of options lumped under this category of management actions include educational efforts intended to increase boater safety awareness, sense of responsibility, and general competency, and rules that would improve safety. Educational efforts range from simply providing information to permittees to requiring training for boat operators. Required training could range from simple acknowledgement of having read the Lake Lure rules through boater safety courses to actual licensing by the Marine Commission after successfully completing an on-line or other approved course. One possible overlay on the training requirements could be an age limit for unsupervised operation of a motorboat >10 hp. An age limit of 16 has been suggested, with operation at younger ages possible only under the onboard supervision of an older operator with approved training.

Lake Lure already applies distance from shore rules, alcohol consumption statutes, and flotation device requirements. Additional rules that might be established for operation of motorboats >10 hp on Lake Lure include a number of practices that could be invoked only as needed, if a system of notification and enforcement can be developed. Speed limits, direction of boat traffic, and distance from other watercraft are controls that could be applied as needed, especially when boating density is perceived as high. In order to apply many of these rules only as needed to preserve safety on the lake, a system would be needed to notify boaters of the need to modify behavior. Posting flags of a set color (e.g., green for normal operations, red for reduced speed) around the lake at key sites visible to boaters would be one feasible approach. Instead of speed limits, it may be possible to eliminate towing sports when boating density gets too high, as people in the water in the wakeable zone appear to be most at risk. Requiring that a safe distance be maintained between boats moving at more than headway speed may be the simplest approach, requires not advance warning, and would be density dependent (more likely to have an effect as boat density increases); it does require active education and enforcement, however.

From the observation of boats in summer of 2006, it is apparent that in busy areas there is already a de facto boat direction rule in effect. The vast majority of boaters keep closer to the shoreline on their right than to their left, such that a generally counterclockwise pattern of use is maintained. Boats need not follow each other exactly; this might even be considered dangerous when towing people. Rather it works more like a multi-lane highway, with multiple lanes in each direction, but everyone staying out of the oncoming lanes and no one randomly cutting across lanes at right angles. Exceptions will occur when a towed person is lost and the boat must circle around to retrieve that person, and there may be issues when multiple people are being towed or operators put a higher priority on their enjoyment than on safety. A few buoys in the center of the channel might help with defining those lanes, but most users appear to recognize the proper zone for high speed operation. Perhaps if this informal arrangement is noted in the literature provided to permit holders and gentle reminders are issued by enforcement officers, no more formal action will be needed; directional controls are not necessary much of the time on the lake.

Maintenance of a safe distance between boats when traveling at more than headway (no wake) speed is an especially attractive approach at Lake Lure. It is a density dependent mechanism that any competent boater should accept and can apply under average lake conditions, and will limit activities as boating density increases. Towing or high speed cruising, activities that require more space to be safe and represent the greatest risk for injury, may actually be curtailed at the highest possible densities; there simply may not be enough space to allow high speed operation at the proper distance from other boats. Boats wishing to go faster must seek out areas of lower density or wait for boats to leave the lake. This may reduce enjoyment for some boaters during busy days at the lake, but will not affect most users most of the time, promotes a more even use of resource hours, and maximizes safety. The safe distance between boats could be anywhere from 50 to 100 ft, with 75 ft (the length of most tow ropes) suggested as a logical limit. Enforcement will be a key aspect of any such strategy, but can be eased into place over time as part of an education program and extended period of adjustment.

Enforcement

Any increased regulation of boating on Lake Lure will require some measure of enforcement. This does not have to mean an overbearing regulation of the lake to the point where enjoyment is suppressed. Rather, a focus on education and promotion of safe boating techniques should be maintained, especially early in the process. There will be some need for penalties for non-compliance, but exercise of such penalties should be reserved for extreme cases and repeat offenses. It is best to work with the boating community to promote safety, rather than attempt stringent control too quickly. Additional controls are not intended for blanket application, but rather just to keep safety foremost when boat density increases to a potentially dangerous level.

Enforcement can occur off the lake to the extent that permits can be checked at launch sites and observation of boating safety violations from shore should be reportable to the police or other central contact that will take prompt action. Yet effective enforcement will necessitate on-lake action, and a police boat patrol would be the most desirable form of on-lake enforcement presence. A trained, authorized, citizen patrol may also be possible, and might be very helpful during peak days where police resources will be taxed by on-shore needs. Enforcement on more than peak days would be advisable, just to further the educational component of such enforcement, but the most critical times will be those hot summer days, especially on weekends and holidays, when boat density is expected to be high.

Selection of Viable Options

The current permitting system, with adjustment over time, has served the Town well, but does not control peak boating activity at a safe level. Reducing the number of permits is not a rational solution, as average boat density is acceptable and the demand for boating on the lake is expected to increase. It would be desirable to find a way to increase the number of permits issued, as the average level of boating could be safely increased and more boaters are likely to want the opportunity to use Lake Lure as development of the area proceeds. However, the number of permits issued for motorboats >10 hp is approaching the estimated limit above which crowding and safety risks may become intolerable, unless the currently uneven distribution of lake use over the course of a day can be altered. Peak density of boats engaged in high speed activities must be controlled if safety is to be maximized and Town liability is to be minimized. This will require at least one additional level of control.

A considerable amount of public discussion has occurred, and a questionnaire survey has been conducted to gauge the response of lake users to possible management actions. More input and deliberation is needed before any major adjustment of boating control can be implemented, but the results of input to date can be summarized as follows:

1. Lake users show a distinct increase in feeling unsafe on the lake as boat density rises (Appendix A). Only 1% feel threatened in the off season, 7% are uneasy during summer weekdays, and 22% feel unsafe on summer weekends and holidays. A majority agree that improved safety on the lake warrants a high priority.
2. No specified category of peak density management was favored by a majority of respondents (Figures 9, 10 and 11), except for reducing the number of new boat slips for new development, which received a slim majority and is only an aid to controlling future increases in boating pressure. Reducing or eliminating permits for non-residents and commercial renters received considerable support at meetings. These options were the most favored of various controls in the more widely circulated questionnaire, but did not receive a majority of favorable responses.
3. Reducing the allocation of resource time for commercial uses overall was raised at several meetings, but was not favored in the more widely circulated questionnaire. There is a lack of understanding about the variety of commercial operations, how they work, what they mean to the community, and how they may operate to relieve boating pressure from other sources (most notably tourists). When expressed as collective “commercial” enterprises, many people are willing to limit them further, under the pretense that money is being made from a public resource. Split into individual entities with specific known values (like tour boats, real estate boats, work boats, ski schools, etc.), the value of each was recognized and no majority was attained for any reduction in permit allocation (Figure 10).
4. Reducing the number of permits for motorboats >10 hp overall was strongly disfavored in the questionnaire (Figure 10), but in meetings there was favorable response to not increasing permits much beyond current levels. How to allocate a limited number of permits for boats >10 hp was somewhat controversial, but there was strong sentiment that current permit holders could be grandfathered at their current levels, with permits given out to new permittees as they became available, drawing applicants from a waiting list. The political

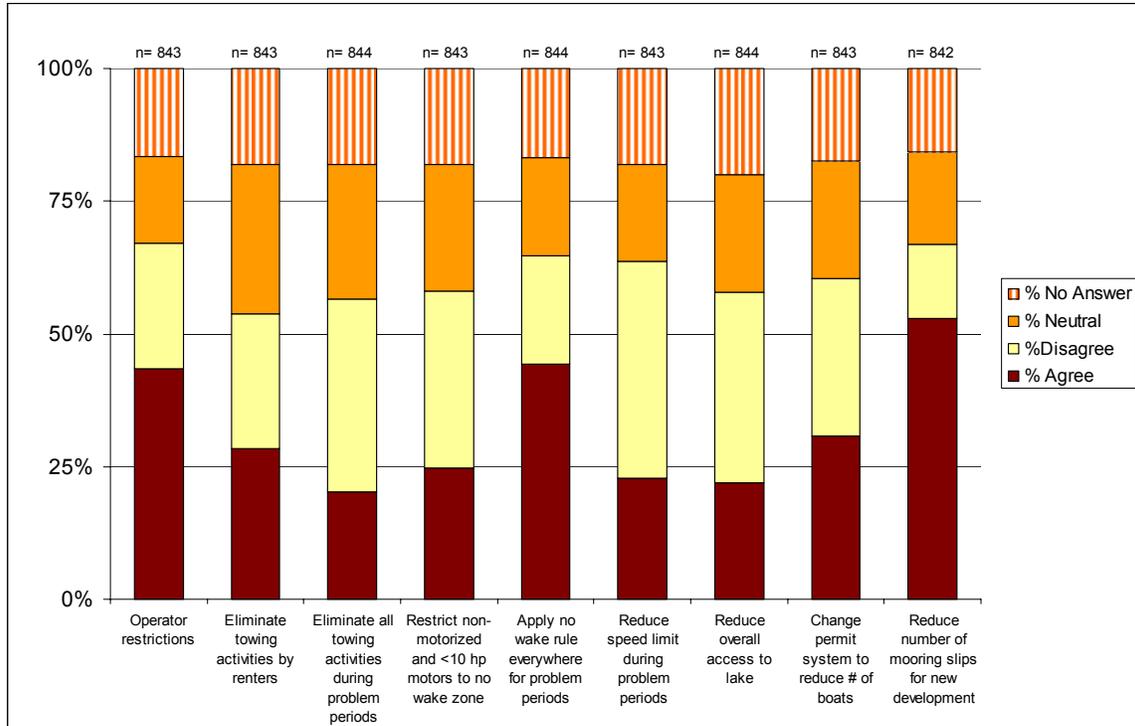


Figure 9. Response to various boating controls

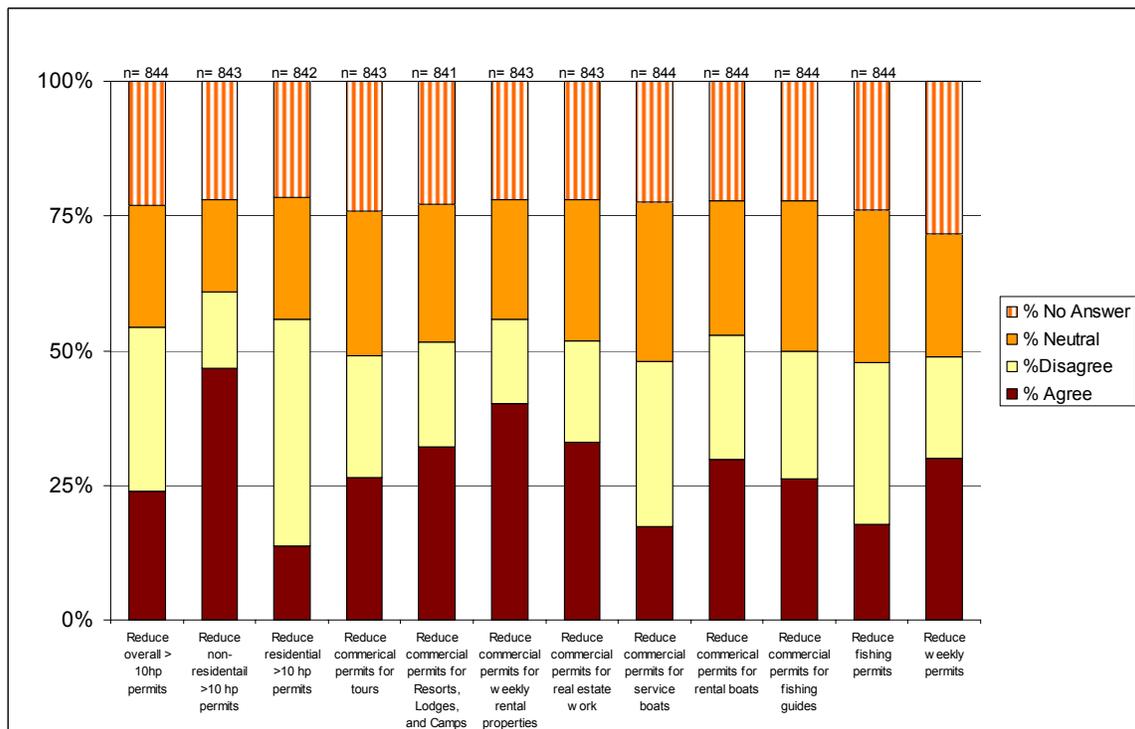


Figure 10. Response to possible permit system changes.

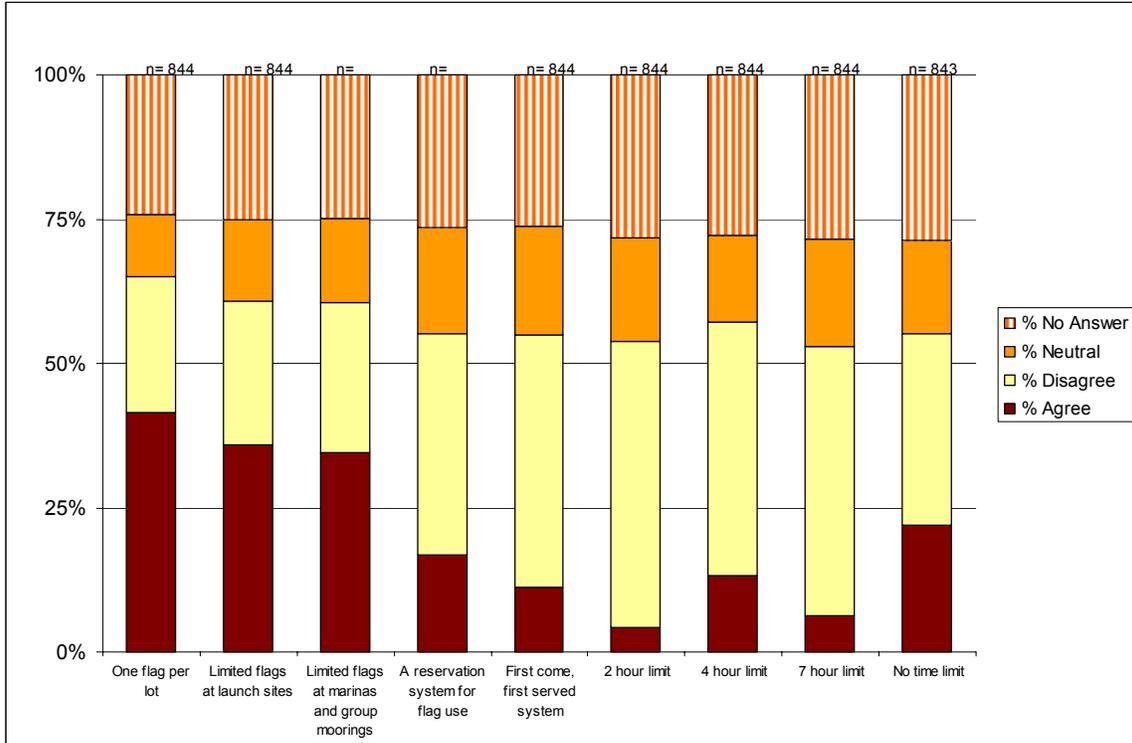


Figure 11. Response to secondary permit ("flag") options

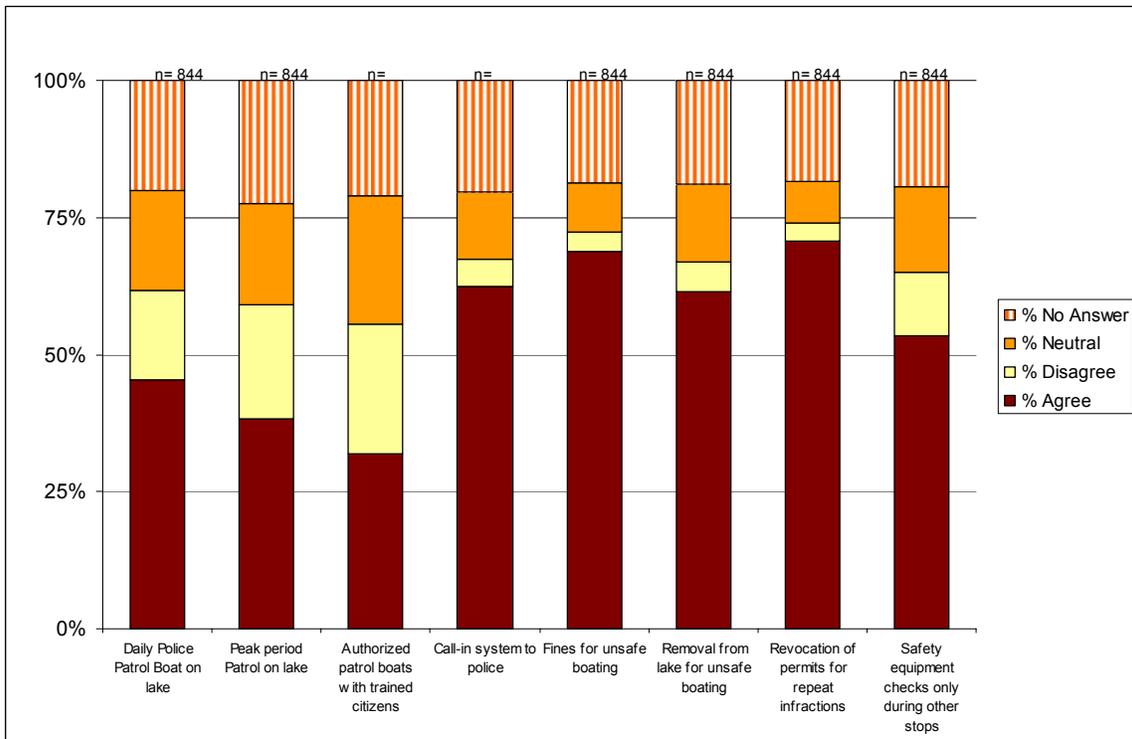


Figure 12. Response to enforcement options.

ramifications of new homeowners not being able to get a motorboat permit need to be explored, but this approach does preserve the privilege of those now using the lake. Linking the permit to the dwelling seems to be the most favored approach to grandfathering existing permits.

5. An alternative that frees up more permits would be to give only one permit per household or lot, but have it be transferable among boats. In general, this was favorably received at meetings, but it is not clear that acceptable average conditions would be maintained under such a system, or that peak densities would be reduced in any way. In 2006, 175 individuals held permits for at least two boats, and most could only use one at a time. Freeing up “extra” permits could increase congestion.
6. The idea of a secondary permit system, one in which access may be denied on busy days unless the user has one of a limited supply of “flags” (or other agreed identifier) that work like a tee time at a golf country club, was generally not supported (Figure 11). Giving all property owners one flag per lot received the most support, as this provides all property owners with the means to use the lake in some manner at all times. Yet the complications of limiting the supply of flags and enforcing associated regulations were viewed as problematic, and long-time lake users viewed this approach as a major infringement of privilege, especially for lakefront property owners.
7. Operator restrictions (age or training limits) and imposing a no wake rule during times of high boat density did not receive majority approval as a general category of controls, but were more favored than most other options (Figure 9). In separate questions (Appendix A), a majority believed that mandatory boat operator training is an appropriate requirement, and that restricting boat operation to people at least 16 years of age, unless a qualified operator is supervising onboard, is a reasonable restriction.
8. Invoking a safe distance between boats was not specifically presented for a reaction in the questionnaire, and received relatively little attention at meetings despite being described as a density-dependent option, and should be discussed further within the community.
9. In the questionnaire, it is apparent that a strong majority believes that enforcement is necessary, but there is not majority approval of any of the enforcement approaches suggested (Figure 12). In the meetings, it became clear that the issue revolves around the history of police enforcement on the lake. Patrol officers assigned to boat duty have tended to take a confrontational approach with an emphasis on safety equipment and boat features, not an educational approach to boat operation and consideration for safety in that operation. Lake users do not feel that police on the lake have the right focus in their enforcement approach.
10. While on the lake, consultants to the Town observed the police boat traveling at high speed between locations, but never engaged in any conversation with boaters. Despite numerous observed issues with boat operation (e.g., improper towing, high speed in coves or near shore, people in the water hundreds of feet from shore and nowhere near a boat), the police boat was never observed addressing such issues. The observations of people at meetings and the comments received with the questionnaires appear justified.

It cannot be stated that there is consensus among the user population about how to manage boat density on Lake Lure, but there is general agreement that the threat is real and that actions must be taken. A protracted process of discussion and iterative steps is possible, and may be desirable, but some interim actions are essential to protecting the Town and lake users in the immediate

future. Meeting attendees voiced a strong opinion that a plan should be developed that includes adaptive elements, to be invoked as needed going forward to provide the desired level of protection. However, this is a difficult task in the absence of clear direction on which controls are acceptable.

The Town Council, the Marine Commission and the Lake Advisory Committee are all urged to continue the dialogue on boat management options and to seek consensus on density control approaches. Any of the options discussed in this report and perhaps some that are not known to us could be revisited and considered further. Management of Lake Lure, for boating safety and other goals, should be a continuing and adaptive process.

However, as consultants to the Town, we have been charged with recommending plan elements that can be applied both immediately and into the indefinite future, and we will not shrink from this task. You are under no obligation to accept these recommendations, and should adopt them only if you are in agreement with their substance and intent. We stand ready to provide any additional support needed to develop a final plan, but in the long run, the people of Lake Lure will hold Town officials accountable for the decisions made.

A number of adjustments are feasible and appear appropriate based on the work done in 2006. The following relatively simple, albeit possibly controversial, adjustments are recommended for implementation in preparation for the 2007 boating season:

- Maintain all existing rules with regard to permitting and safety controls for boats on Lake Lure, most notably the no wake zone restrictions (areas and time).
- Maintain the commercial boat permitting system as it is now administered, with minor adjustments as warranted. If future pressure for boating increases as expected, consider allocating some portion of the commercial acre-hour allotment to a yacht club or public marina, where trained operators could rent or sign out “community” boats for use. Limiting the number of boats will restrict the impact on the lake and potentially spread use over a wider daily timeframe. Also, if problems persist or training requirements are not upheld, consider limiting rental property permits for boats >10 hp to weekday use only, limiting impact on weekends (when peak densities occur).
- Limit the number of permits issued for non-commercial motorboats >10 hp to be used during the peak season to a number not less than 1000 and not more than 1100. We suggest starting at 1000 and increasing the number only as it becomes evident that safety risks have been minimized. Recognize that it will be hard to reduce the number of permits once a higher number has been issued. Consider granting permits on a priority system based on permit holders from 2006, followed by date of application by new permit holders. This will require setting a deadline by which previous permit holders must apply in 2007, suggested as May 15th, to allow new permittees to get their permits by Memorial Day weekend. Grant only one permit for a boat >10 hp to all new applicants.
- The peak season permit allocation for boats >10 hp should include weekly permits, such that 15 weekly permits equals one complete peak season permit for purposes of total permit count. If problems persist, consider setting a limit on the number of weekly permits that can be issued for a given week of the peak season, with 10 per week suggested as the maximum. If density issues still continue, consider offering weekly peak season permits only for weekday use, as high densities are mainly associated with weekends.

- When all permits for boats >10 hp have been assigned, consider providing “weekday only” permits for this class of boats. There is enough unused capacity during weekdays during the peak season to allow at least 25% more boats >10 hp without exceeding the lower threshold for possible safety issues and as much as 100% more boats (a doubling) without exceeding the upper threshold (above which safety problems are very likely). Based on 1000 permits yielding the current pattern, between 250 and 1000 additional permits for weekday use only could be allocated. It is suggested that 250 permits be offered initially, with annual program evaluation.
- There does not appear to be a need for any limitation of boats <10 hp or fishing boats of any motor size during peak season for any boats during the non-peak season. If limitations are needed in the future due to capacity exceedances, apply the principles used above in setting permit limits. This would involve collecting data on use pattern and adjusting permit totals to alter peak densities as described earlier in this report.
- Promote education of boaters. Include information on the lake, its uses, and generally accepted procedures for maximizing safety (such as having the righthand shoreline closer than the lefthand shoreline when traveling at wake speeds). Require all permit holders to sign an acknowledgement form indicating that they understand the Lake Lure rules and will be responsible for the operation of their permitted boat(s).
- Require operators of motorboats >10 hp to complete a safety course, and require operators under the age of 16 to be supervised by an onboard person competent (by training) in boating safety. A grace period could be offered in 2007, as this would be a new requirement, but by 2008 all operators could be trained. This is the most equitable way to eliminate unsafe operators. It may eliminate many rental arrangements, which are considered among the more hazardous operators on the lake, but would do so without prejudice toward rental status.
- Provide a police boat patrol on the lake to enforce the rules, focusing on education and cooperation by boaters first, followed by penalties for violations as warranted. It is essential that the police assigned to this duty be trained for boating safety education and enforcement, and that they develop both a knowledge of lake users and the trust of the lake community.
- At a minimum, the patrol boat should be on the lake between 11 AM and 7 PM on all weekend days and holidays with suitable weather between Memorial Day weekend and Labor Day weekend, and on anticipated busy weekdays during summer. Wider coverage would be desirable, if affordable, but these represent the critical enforcement days and hours based on boat density. Operating from a starting location in the central basin of the lake and using binoculars, the patrol boat should be able to determine where its presence is most needed and move from arm to arm as warranted. On especially busy days, it may be necessary to have two patrol boats on the lake, but one should be adequate on most days.
- The Town should consider hiring a boating education and enforcement officer dedicated to Lake Lure during the peak season, as there will be time conflicts with use of the regular police force during this period. Ideally, a full-time lake operations director would be hired to oversee all areas of lake management including permit applications, education, training sessions, and coordination of on-lake activities. This person might be the primary on-lake enforcement officer, or may just coordinate police assignments and fill in as needed.

- A call number should be established for reporting boating safety problems or related issues to a dispatcher who can reach the patrol boat or send a patrol boat out, if it is not already on the lake. Callers must provide their own contact information and records of calls should be kept and assessed for valid call history over time. Responses should be made within 30 minutes if at all possible.
- Enforce a safe operating distance of 75 ft among boats (and among boats and people) when either boat is moving faster than no wake speed. This provides a density dependent mechanism to minimize safety risks as boat density increases. It may eliminate high speed activities during some peak use periods, at least in parts of the lake. Activity should focus on education in 2007, with violators cited only upon repeat offense when it is apparent that they are not cooperating. The exact distance between boats is less important than the apparent disregard for safety when boating density is high, and the police must strike a balance between education and enforcement. This should serve to spread out high speed uses over space and time to the maximum extent possible, and will curtail high risk activities when there are too many boats on the lake to safely pursue those activities.

More major adjustments may not be necessary, but would warrant considerably more public input if implementation was pursued. The primary option left out of any recommendation to this point is a secondary access control system, possibly involving flags on permitted boats, with the number of flags available being considerably less than the number of permits. The requirement for displaying flags or other highly visible markers on motorboats >10 hp would be invoked on specified days during the peak season, with advance notice, based on experience with peak boating periods. Key factors to be discussed include the number of flags that could be made available and equitable distribution of flags, recognizing that during peak periods not everyone can use a motorboat >10 hp on Lake Lure safely.

To implement a secondary access control system with user acceptance, the public has to understand the safety issues and be involved in the development of the system. This will be a somewhat protracted process, involving extensive two-way communication. The lake-using public does not support such a system now, and it is not clear that an acceptable version of this system would actually provide the desired peak density control. Additionally, the institution of a permit limit for boats >10 hp will tend to freeze the use pattern as it is now, leaving relatively few days during the peak season where additional density controls would be needed. Education and enforcement relating to maintenance of a 75 ft distance between boats when either is going faster than headway (no wake) speed is expected to minimize safety issues on such days without restricting access (although high speed uses may be effectively restricted). A system of secondary access control would therefore be unnecessary and is not recommended at this time, although it could be revisited in the future if safety problems related to crowding are perceived to persist.

An alternative system to the 75 ft distance between fast moving boats would be a speed limit to be invoked during busy periods. This may involve less judgment on the part of enforcement agents, but still involves judgment or considerable technology and rapid response. Additionally, to implement a rapid, on-demand rule to control boating behavior when capacity limits are exceeded, a system to inform boaters that the rule has gone into effect would be needed. While advance notice may be possible in some cases, the intent of such a control system is to invoke

restrictions only when absolutely necessary. Announcing that there will be a speed limit for the 4th of July weekend ahead of time when there is uncertainty over the need for such limits is unnecessarily disruptive. A more immediate system of notification is needed, with advance notification that such rules might be implemented as warranted by boat density at any time. The simplest system would appear to be a set of flags at key points around the lake, with green indicating normal, less restricted operation and red indicating that additional restrictions (e.g., a speed limit) are in effect. Operation of such a system is more complex and requires greater preparation and expense. It is not justified at this time, but may be revisited in the future if warranted.

The recommendation to cap non-commercial permits for motorboats >10 hp represents a departure from the initial thinking that more opportunity should be provided for boating on Lake Lure, and that secondary access methods would be adequate to control peak density. While there is unused capacity even during the peak period (mainly during mornings), it is not an especially large amount of available resource, and the lower use by high speed boats at times represents an opportunity for other uses to increase, including non-motorized boating and fishing. It was not particularly surprising that fishing increased on rainy days when high speed boats were less abundant, but the change in distribution to greater offshore fishing was striking. Likewise, kayaks, canoes, and other non-motorized boats are observed further from shore when larger powerboats are less abundant. Getting more big boats on the lake represents a diminishment of utility and quality for other uses as well as a safety risk. However, given that the focus of recreational boat use on Lake Lure involves boats >10 hp, recommendations for permit system changes emphasize greater use of off-peak resource hours by larger boats. This may warrant further discussion going forward.

While a cap on boats >10 hp will create some controversy, and may aggravate a currently low level battle over how much commercial allocation is appropriate, it does limit the need for secondary access controls. Peak density controls are still needed, but the 75 ft minimum distance between boats (or between boats and people) when one is moving faster than headway speed is sufficient protection if properly obeyed and enforced. High speed uses may be limited during busy periods, but these will be infrequent and there will be room for high speed boat users to relocate to other areas or times to satisfy their needs. This requires alteration of some use patterns, but does not prohibit reasonable use of the resource.

We believe that the suggested plan elements are sufficient to manage boat density and safety indefinitely, if implemented properly and monitored for any needed adjustments periodically. Those elements are:

1. Maintaining existing rules of operation.
2. Maintaining the commercial permitting system with possible adjustments.
3. Capping the non-commercial permits for boats >10 hp at 1000 with a system for issuing permits to new applicants when available.
4. Including weekly peak season permits in the total permit allocation for boats >10 hp.
5. Offering 250 weekday only permits for peak season use.
6. Avoiding any permit limits for the non-peak season now, but preparing to adopt the peak season permitting approach as needed to maintain safety.
7. Fostering education and requiring training of boat operators.

8. Providing a trained and responsive police patrol.
9. Adding dedicated education and enforcement officer to the town staff.
10. Providing a call in number for reporting unsafe activities on the lake and ensuring rapid response to valid complaints.
11. Enforcement of a 75 ft distance between boats when one is moving fast.

The primary benefits of these rules include:

- Promotes physical and temporal separation of some uses to maximize safety.
- Encourages the distribution of lake use in its current pattern, known to present limited and predictable safety risks.
- Protects the privilege of those now holding permits.
- Allows only educated and trained boat operators.
- Provides an appropriate level and focus of enforcement.
- Provides a density-dependent mechanism for controlling higher risk activities.

The negative aspects of these rules include:

- As the Town grows, not everyone can hold a permit for a boat >10 hp on Lake Lure.
- Requires capable boaters to take official training.
- Requires a different approach and more effort by the police force.
- May curtail high speed activities that many enjoy during busy periods.

Projecting out many years and assuming continued growth of the Town and interest in the lake, the primary problem with this plan will be the mounting pressure to get more boats on the lake. There is room for more boats in the off season, and permits can be issued accordingly under the current system. There is also available resource time during certain days and times in the peak period, and methods have been suggested to facilitate such use to some degree (weekday only permits, controlled rental marina). Ultimately, however, not everyone who wants to have a permit for a boat >10 hp will be able to get one, if use pressure continues to increase.

In order to gain appropriate information, the Town should conduct periodic assessments of boat use patterns, much as performed in this analysis. Response to selected survey questions from the questionnaire, dealing with use frequency, duration and related demographic data, should be solicited every 3-5 years to determine if use assumptions remain valid. Boat use observation surveys like those conducted in this study should be performed at roughly the same frequency, or perhaps slightly more often (3 nice weather days every 2-3 years) to detect any changes in use pattern. The questionnaire and observation surveys proved critical in getting the data necessary to evaluate carrying capacity and possible management options in this study, and any changes in use pattern may be equally important to adaptive boat management.

Recommendations for the Lake Lure 2006 Comprehensive Plan

The Town of Lake Lure began the planning process during 2006 for a long-term Comprehensive Plan. As part of the Comprehensive Plan, the Boating Use Management Plan (this report) was included in the overall planning document for the town. As part of the full document, WES and ENSR were asked to create a list of objectives, goals and timetables for the town in order to incorporate the results of the study into the comprehensive planning document.

A decision document was created for consideration and incorporation of recommendations into the Comprehensive Plan and is included in this report (Appendix C). Based on the proposed five objectives, the following goals and timetables were proposed for consideration by Lake Lure.

Goals and objectives for 2007

Recommendation A: Maintain 1000 permit limit in 2007 for residential boats >10 hp.

Recommendation B: Enhance education package that goes out with permits (let folks know what is planned, the issues, and how they can help).

Recommendation C: Have patrol boat at least during hours of 11 AM to 7 PM on weekends and holidays in peak season; other times as budget and manpower allow - focus on educating boaters, not fining or other sanctions.

Recommendation D: Implement 75 ft rule for distance between a boat going more than headway speed and any other boat or person.

Recommendation E: Hire a lake operations director to oversee all lake management issues and coordination.

Goals and objectives for 2008

Recommendation A: Keep the recommendations B through D for 2007.

Recommendation B: Operator licensing/mandatory training. If Lake Lure can have its own boat license course by then, great. Otherwise Coast Guard courses will do.

Recommendation C: Have dedicated boating compliance officer in place and increase patrol time beyond peak season weekends and holidays if not done already.

Recommendation C: Repeat boating observation survey if 1000 permit limit has been reached, and determine if there has been any noticeable change in density or peaks.

Recommendation D: Be ready to offer weekday only permits if that helps with boating pressures.

Recommendation E: Determine permit limit for 2009 from boat observation survey. Increase at 25 to 50 permit increments if density is not an issue.

Goals and objectives for years beyond 2008

Recommendation A: Keep all of the past recommendations as appropriate.

Recommendation B: Repeat boating observation survey and determine if there are noticeable changes in density or peaks.

Recommendation C: Determine permit limit for following year from boat observation survey. Increase at 25 – 50 permit increments if appropriate. Set limit when density becomes an issue.

Recommendation D: If density is an issue, consider the following options: Offer Weekday permits, give multiple permit holders a transferable permit, limit certain applicant categories to weekday only.

Recommendation E: If density is an issue, enforce strictly the 75 ft safety buffer rule for boats moving at more than headway speed.

Recommendation F: Determine if additional use management techniques will be required (permit system, time management, space zoning, training and behavior modification, or enforcement). These options and associated issues have been laid out in the 2006 Lake Lure Boating Management Plan.

APPENDIX A

**QUESTIONNAIRE FOR EVALUATION OF USER FEATURES
AND PREFERENCES AT LAKE LURE**

RESULTS

Lake Lure 2006 Boating Use Survey

This Survey was developed by the town's lake management consultants after several days of information review, an on-site assessment, and an all-day workshop with the Town Council / Marine Commission, and the Lake Advisory Committee. This survey was refined by subsequent review and input from those groups, and represents the second opportunity for public input into this process (an earlier survey was done in 2001). We seek your honest reaction to a range of questions, dealing with your use of the lake, perception of boating conditions and issues, and assessment of possible management methods that might be employed to minimize safety risks while maximizing lake use and enjoyment. While the questionnaire is not a "vote" on the possible options, it may help us narrow down the possible approaches. More comments will be welcomed at public forums to be held later this year. The time and thought you put into your answers will be greatly appreciated.

Are you a year round resident of Lake Lure?	Y	N
Are you a Registered Voter in the Town of Lake Lure?	Y	N
How many months per year do you live in Lake Lure? (Check one) <ul style="list-style-type: none"> <input type="checkbox"/> None <input type="checkbox"/> 1 to 2 months <input type="checkbox"/> 3 to 5 months <input type="checkbox"/> 6 to 9 months <input type="checkbox"/> 10 to 12 months Which months? Circle months on the right.	Jan Feb March April May June July August Sept Oct Nov Dec	
Do you own a house in the Town of Lake Lure?	Y	N
Do you live on shorefront property on Lake Lure? If yes, answer next three questions.	Y	N
Is noise from boating activities a problem?	Y	N
Have you noticed an increase (I), decrease (D) or no change (NC) in noise levels coming from boating activities on the lake over the past 5 years?	I	D NC Uncertain
What is the source of the problem noise? (check all that apply) <ul style="list-style-type: none"> <input type="checkbox"/> Boat motors <input type="checkbox"/> Music <input type="checkbox"/> Voices (yelling, talking) <input type="checkbox"/> Other _____ 		
Do you live in one of the communities (e.g., Lake Lure Village, Lake Lure Golf and Beach Resort, Pierpoint) with communal boat moorings on Lake Lure?	Y	N
How many years have you lived in the Town of Lake Lure?	_____ years	

Was part of your decision to purchase a home in Lake Lure based on your desire to enjoy boating activities on the lake aboard your own boat?	Y	N
If you rent out your Lake Lure house, is the use of your boat included?	Y	N
How many motorized boats (greater than) > 10 hp do you hold permits for?	____ boats	
How many motorized boats (less than) < 10 hp do you hold permits for?	____ boats	
How many non-motorized boats do you hold permits for?	____ boats	
Have you had boat operator training?	Y	N
Which boat-related activities do you enjoy at the lake? Motorized towing (ski, tube, wakeboard, etc.)? Motorized pleasure cruising? Motorized fishing? Non-motorized paddling? Non-motorized sailing? Non-motorized fishing?	Much Much Much Much Much Much	Little Little Little Little Little Little Never Never Never Never Never Never
For motorboats (greater than) > 10 hp (circle answer): Average # of weeks of the summer you use a motorboat >10 hp? Average # of days/week you use a motorboat >10 hp? Average # of hours/day you use a motorboat > 10 hp?	0 1-2 3-6 4-8 8-12 >12 0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 8 >8	

<p>For motorboats (less than) < 10 hp (circle answer):</p> <p>Average # of weeks of the summer you use a motorboat <10 hp?</p> <p>Average # of days/week you use a motorboat <10 hp?</p> <p>Average # of hours/day you use a motorboat <10 hp?</p>	<p>0 1-2 3-6 4-8 8-12 >12</p> <p>0 1 2 3 4 5 6 7</p> <p>0 1 2 3 4 5 6 7 8 >8</p>
<p>For non-motorized boats (circle answer):</p> <p>Average # of weeks of the summer you use a non-motorized boat?</p> <p>Average # of days/week you use a non-motorized boat?</p> <p>Average # of hours/day you use a non-motorized boat?</p>	<p>0 1-2 3-6 4-8 8-12 >12</p> <p>0 1 2 3 4 5 6 7</p> <p>0 1 2 3 4 5 6 7 8 >8</p>
<p>Have you noticed an increase (I), decrease (D) or no change (NC) in boat traffic over the last 5 years?</p> <p>In general?</p> <p>On summer weekdays?</p> <p>On summer weekends and holidays?</p> <p>In the spring season?</p> <p>In the fall season?</p>	<p>I D NC Uncertain</p>
<p>Do you feel there are times when there are too many boats on the lake?</p> <p>If Yes, when are these times in general? _____ (fill in)</p>	<p>Y N</p>
<p>Do you feel safe on the lake:</p> <p>During spring and fall (off-peak season)?</p> <p>During peak season weekdays (late May to early September)?</p> <p>During summer weekends and holidays?</p>	<p>Y N</p> <p>Y N</p> <p>Y N</p>
<p>What makes you feel unsafe on Lake Lure?</p> <p>Non-towing boats going fast?</p> <p>Boats towing people?</p> <p>Overall high boat density?</p> <p>Other? _____ (fill in)</p>	<p>Y N</p> <p>Y N</p> <p>Y N</p> <p>Y N</p>
<p>Should improved safety on the lake be a high priority for the town?</p>	<p>Y N</p>

<p>To address safety concerns on the Lake, the following options are being considered or proposed to the Town. Please give your opinion on the boating management options:</p>				
<p>Should the town require operator training to use a motorboat on Lake Lure? (Training would be available both locally in town and through the internet)</p>	Y	N		
<p>Should the town restrict independent motorboat operation to those over age 16, with adult supervision of anyone younger?</p>	Y	N		
<p>If it is determined that controls on boat density are needed to improve safety on the lake, how do you feel about the following controls (Approve - A, Neutral - N, Disapprove - D):</p> <p>Restrict use to operators with licenses/approved training</p> <p>Eliminate towing activities by lakefront home weekly renters</p> <p>Eliminate all towing activities (for problem periods)</p> <p>Restrict non-motorized and <10 hp motors to no wake area</p> <p>Reduce speed limit (for problem periods)</p> <p>Apply no wake rule everywhere (for problem periods)</p> <p>Reduce overall access to the lake (limit on # of boats that can be on the lake at one time – possible flag system option covered below)</p> <p>Change the permit system to reduce maximum number of boats allowed on the lake</p> <p>Reduced number of mooring slips permitted for new development from 3 to 2 or 1 slips</p>	A	N	D	

<p>If a change in the permit system for motorboats > 10 hp is used to address safety, what do you think would be the best options? Indicate your opinion for each of the options.</p> <p>Background information: In 2005, >10 hp permits included 921 annual residential, 53 annual non-residential, 59 commercial (28 of which were rental boats – 16 associated with house rentals, 5 for ski schools, 8 for tours, 3 for fishing guides and 15 for realty and service boats), and 39 non-residential fishing permits, plus 115 non-residential weekly permits for the summer months.</p> <p>How do you feel about the following controls for motorized watercraft >10 hp: (Approve - A, Neutral - N, Disapprove - D):</p> <p>Reduced overall >10 hp permit availability? Reduced non-residential >10 hp permits? Reduced residential >10 hp permits? Reduced commercial permits for tours? Reduced commercial permits for Resorts, Lodges, and Camps? Reduced commercial permits for weekly rental properties? Reduced commercial permits for real estate work? Reduced commercial permits for service boats (e.g., repairs)? Reduced commercial permits for rental boats/towing/fishing? Reduced commercial permits for fishing guides? Reduced fishing permits? Reduced weekly permits?</p>	<p>A N D</p>
<p>How would you feel about reduced motorboat permits if a > 10 hp permit can be transferred to additional boats (one boat on the lake at a time) (Approve - A, Neutral - N, Disapprove - D)</p>	<p>A N D</p>
<p>In order to allow future new residents of the Town of Lake Lure (new development and annexation) boating use of the lake, would you want:</p> <p>Commercial access to be expanded to provide for this use Continued permitting of all residential boats Restrictions on current permit owners to open up more permits The elimination of all boats over 10 HP to allow a higher boating density Other (Please specify)_____</p>	<p>Y N</p> <p>Y N</p> <p>Y N</p> <p>Y N</p> <p>Y N</p>

<p>It may be possible to devise a system of flag use, whereby on days where a safe density of boats is expected to be exceeded, only boats with flags could go on the lake. This would be a special measure beyond the normal permit, only for motorboats >10 hp and only for peak days like the 4th of July. With a flag system, how would you feel about (Approve - A, Neutral - N, Disapprove - D):</p> <p>One flag per lot on the lake</p> <p>Limited flags at launch sites</p> <p>Limited flags at marinas and group moorings</p> <p>A reservation system for flag use</p> <p>A first come, first served system for flag use</p> <p>A 2 hour limit for flag use</p> <p>A 4 hour limit for flag use</p> <p>A 7 hour limit for flag use</p> <p>No time limit for flag use</p>	<table> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> </table>	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D
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<p>How do you feel about the following enforcement options (Approve - A, Neutral - N, Disapprove - D):</p> <p>Daily police patrol boat on the lake</p> <p>Police patrol boat on the lake only during expected peak days</p> <p>Authorized patrol boats with trained residents for boating assistance, information and referral of problems to town police (no law enforcement)</p> <p>Call-in system for rapid response to observed problems</p> <p>Fines for unsafe boating</p> <p>Removal from the lake for unsafe boating</p> <p>Revocation of permits for repeated infractions</p> <p>Safety equipment checks only performed when a stop is made for unsafe boating or violation of an ordinance</p>	<table> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> <tr><td>A</td><td>N</td><td>D</td></tr> </table>	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D	A	N	D			
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Please fold the completed survey and put it and the Comprehensive Plan Survey into the postage-paid envelope and return by March 24th, 2006.

THANK YOU FOR YOUR SUPPORT!

ENSR

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Memorandum

Date: May 8, 2006
To: Lake Lure Community
From: Ken Wagner, ENSR
Subject: Lake Questionnaire Results

Distribution: Barbara Wiggins Bob Washburn

Barbara has arranged for the 844 questionnaires received in response to the Town request to be tallied and for a variety of calculations to be performed. I have furthered those calculations and would like to provide a review of the results for consideration in relation to our upcoming meetings.

General Information:

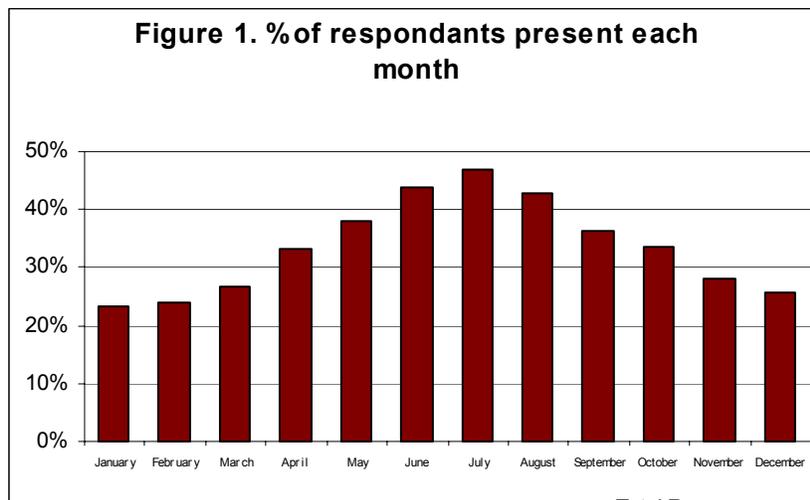
A total of 844 questionnaires were received prior to our completion of the tally addressed in this memo. Over 2100 questionnaires were sent out, but the responses represent a relatively high rate of return (40%). The breakdown among user groups appears inclusive and representative, as evidenced by the information in Table 1 and summarized by the following:

- About a third of respondents were year-round residents, while two thirds are not.
- About a third are registered voters, while two thirds are not.
- About three quarters own a house, less than one quarter do not.
- Slightly more than a third live on the water, slightly less than two thirds do not.
- Over a third live in one of the defined communities around the lake, 60% do not.
- Respondents have lived in Lake Lure (full or part time) for 12 yr on average with a median of 8 yr.
- Just over 10% of residents rent their homes, 80% do not, and just under 10% did not say.
- Two thirds claim boating on the lake as a factor in home purchase, a quarter say it was not a factor.
- Slightly less than half of respondents have boat operator training, slightly less than half do not, with the remainder not saying.
- The complete range of boat types and activities are represented; although engines >10 hp are the dominant type of boat used by respondents, it is also the dominant type of permit issued.

The distribution of respondents present in Lake Lure over the course of the year is shown in Figure 1, and is generally what was expected. The distribution of boats among households are also about what was expected, although questionnaire values were slightly lower than expected for non-motorized boats and boats >10 hp, and higher than expected for motorboats <10 hp, based on permits issued. Total summer hours of use of boats >10 hp, applied in the boating assessment in the Lake Lure report from February 2006, are a very close match for the projection from the questionnaire. Estimates for total summer hours of use for boats <10 hp and non-motorized boats used in the boating assessment are higher than suggested by the questionnaire, but since no major crowding issue was identified for smaller boats, this is not a problem. Among the 11% of respondents who said they rented their homes, slightly more than half rent for as little as a day, slightly less rent for no less than a week, and very few rent for a month or more.

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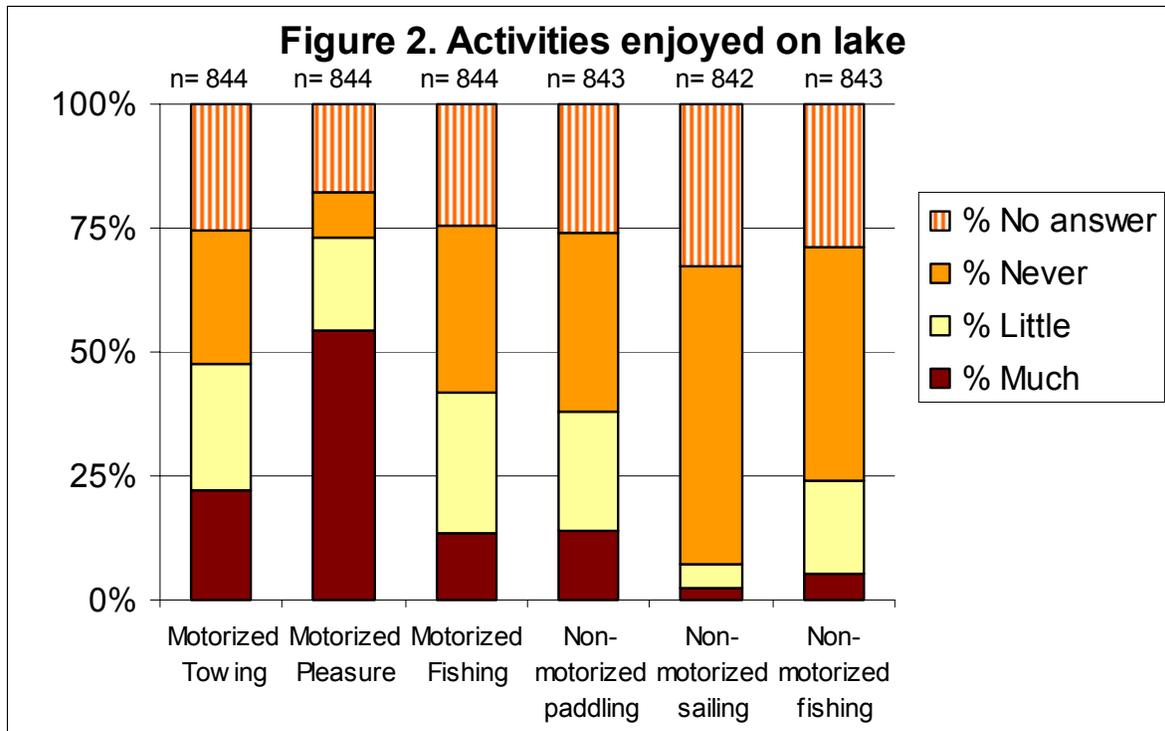
Table 1. General Features of Questionnaire Respondents					
Feature	Total	Average	Median	Maximum	Minimum
Total number of Surveys returned	844				
Years at Lake Lure		12.2	8	65	<1
Motorized Boat Permits > 10 hp	585	0.8	1.0	4.0	0.0
Motorized Boat Permits < 10 hp	60	0.1	0.0	2.0	0.0
Non-motorized Boat Permits	60	0.4	0.0	6.0	0.0
	% Yes	% No	% No Answer		
Year Round Resident	33	65	2		
Registered Voter	30	66	4		
Own a House	77	20	3		
Live on Shorefront	36	61	2		
Live in Defined Community	37	60	3		
Boat Use a Factor in Home Purchase	67	26	7		
Home Rented to Others	11	80	9		
Boat Included in Rental	17	77	5		
Trained Boat Operator	44	43	14		
	Boats >10 hp	Boats < 10 hp	Non-motorized		
Total Weeks of Use (All Boats of Type)	3878	453	1510		
Weeks of Boating per Summer per Boat	6.6	1.2	3.3		
Days of Boating per Week per Boat	2.3	0.5	1.2		
Hours of Boating per Day per Boat	2.5	0.5	1.1		



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A breakdown of activities is provided in Figure 2. Almost three quarters of respondents enjoy pleasure cruising in their motorboats, and almost half enjoy towing people. More than a third use their motorboats to fish, and another third enjoy paddling non-motorized boats. Sailing and non-motorized fishing are of interest to a limited number of lake users. The ratio of these activities matches the impressions provided by the January workshop, although about a quarter of respondents did not provide any indication of which activities they enjoyed.



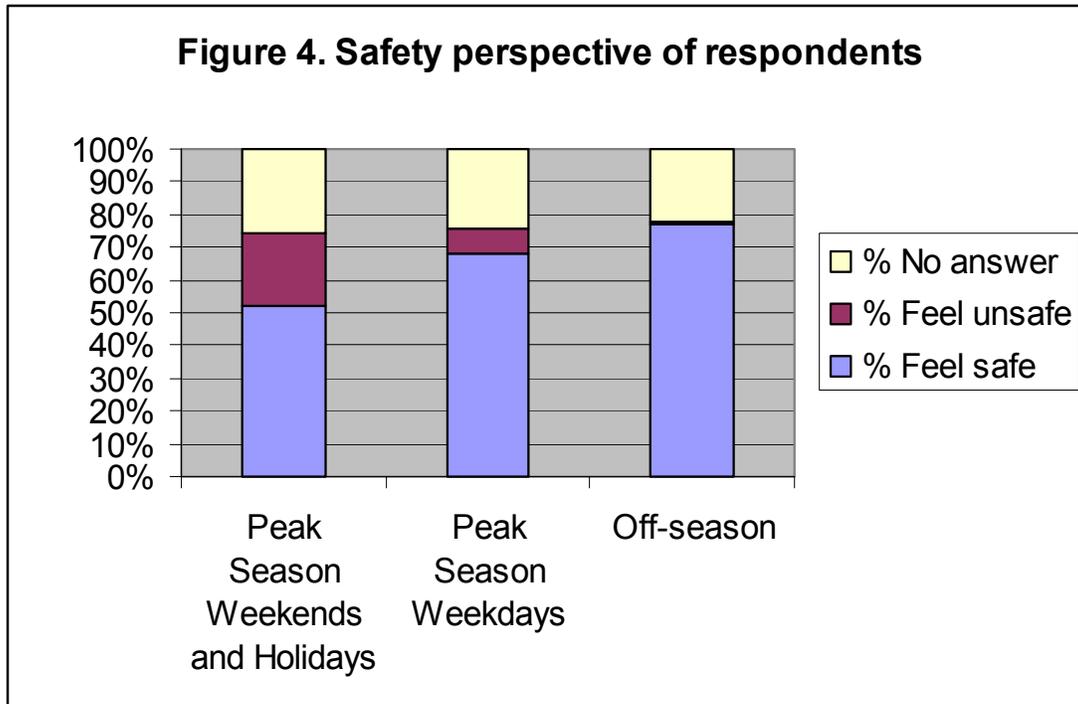
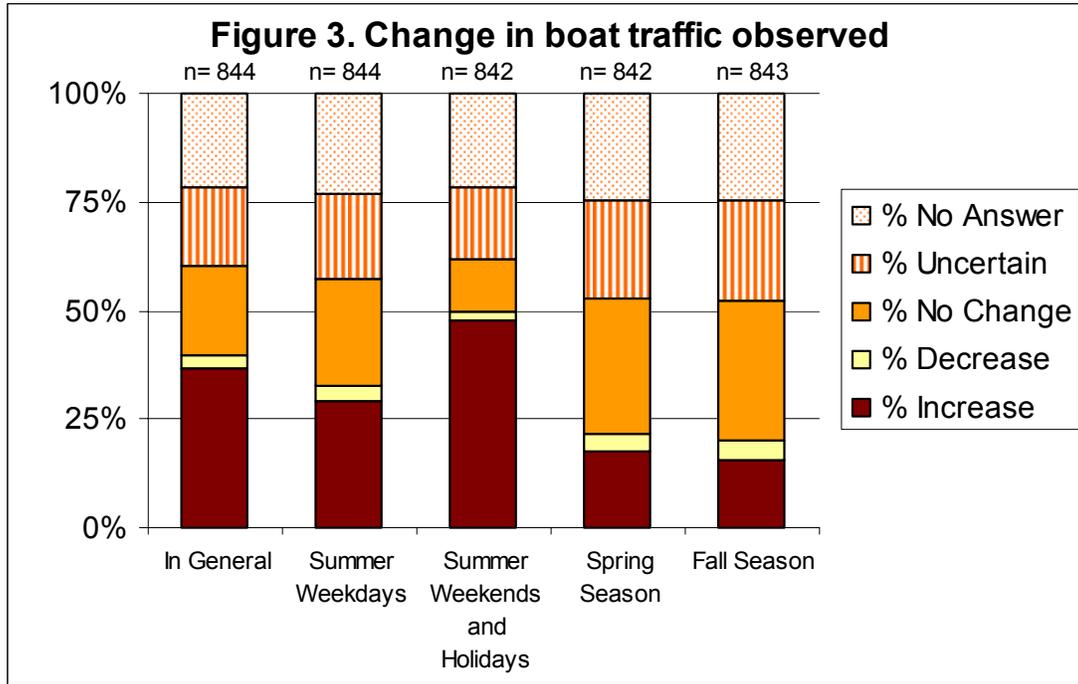
Perception of the Problem:

The public perception of the problem appears to match the general indications provided during the January workshop, as suggested by the following:

- Only 18% of respondents reported noticing any increase in noise in recent years, and less than 10% of the respondents felt that noise was a problem, and while boats topped the list of itemized sources of noise for those that thought noise was a problem, sources varied substantially.
- There is no true consensus about increasing boat traffic, but more people perceive an increase for summer weekends and holidays than for summer weekdays, and least for spring and fall periods. However, a majority does not perceive any traffic increase (Figure 3).
- There is no clear consensus that conditions are unsafe as a consequence of boating; a majority of people feel safe on the lake at all times. However, people feel less safe on summer weekends and holidays than during summer weekdays than spring or fall, in that order (Figure 4). Feeling safe is not clearly linked to boat ownership or type of boat.
- About half of respondents did not answer questions about what made them feel unsafe, but those that did were split fairly evenly over boat speed, towing and overall boat density as factors.
- Of those who feel there are too many boats on the lake, there is no strong link to types of boats owned by respondents; many households own both large motorboats and non-motorized boats.

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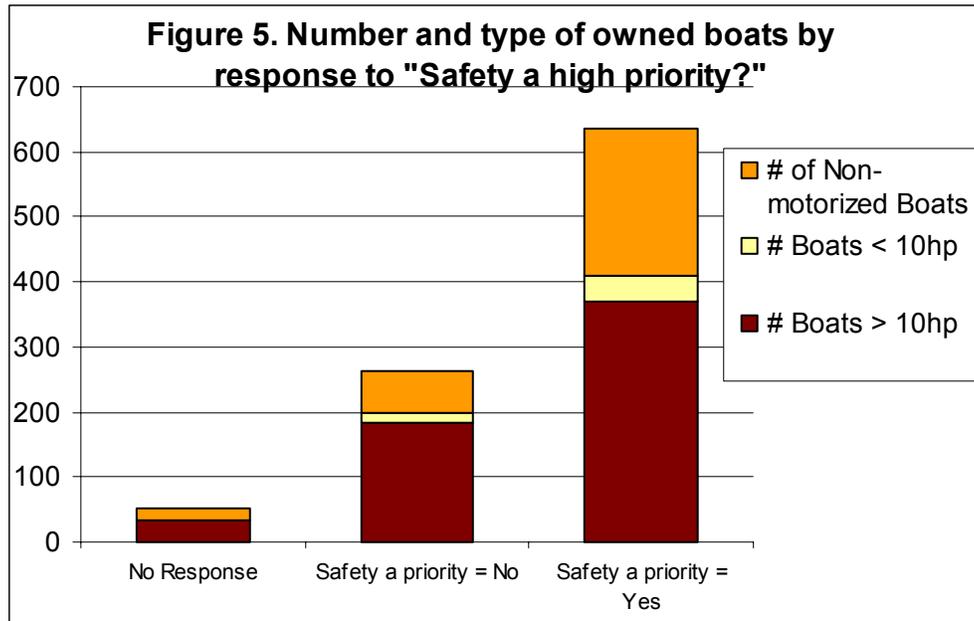
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- A small majority of respondents did feel that improved safety on the lake should have a high priority; this perception was positively linked to ownership of boats, but is most strongly related to the ownership of a non-motorized boat (Figure 5).

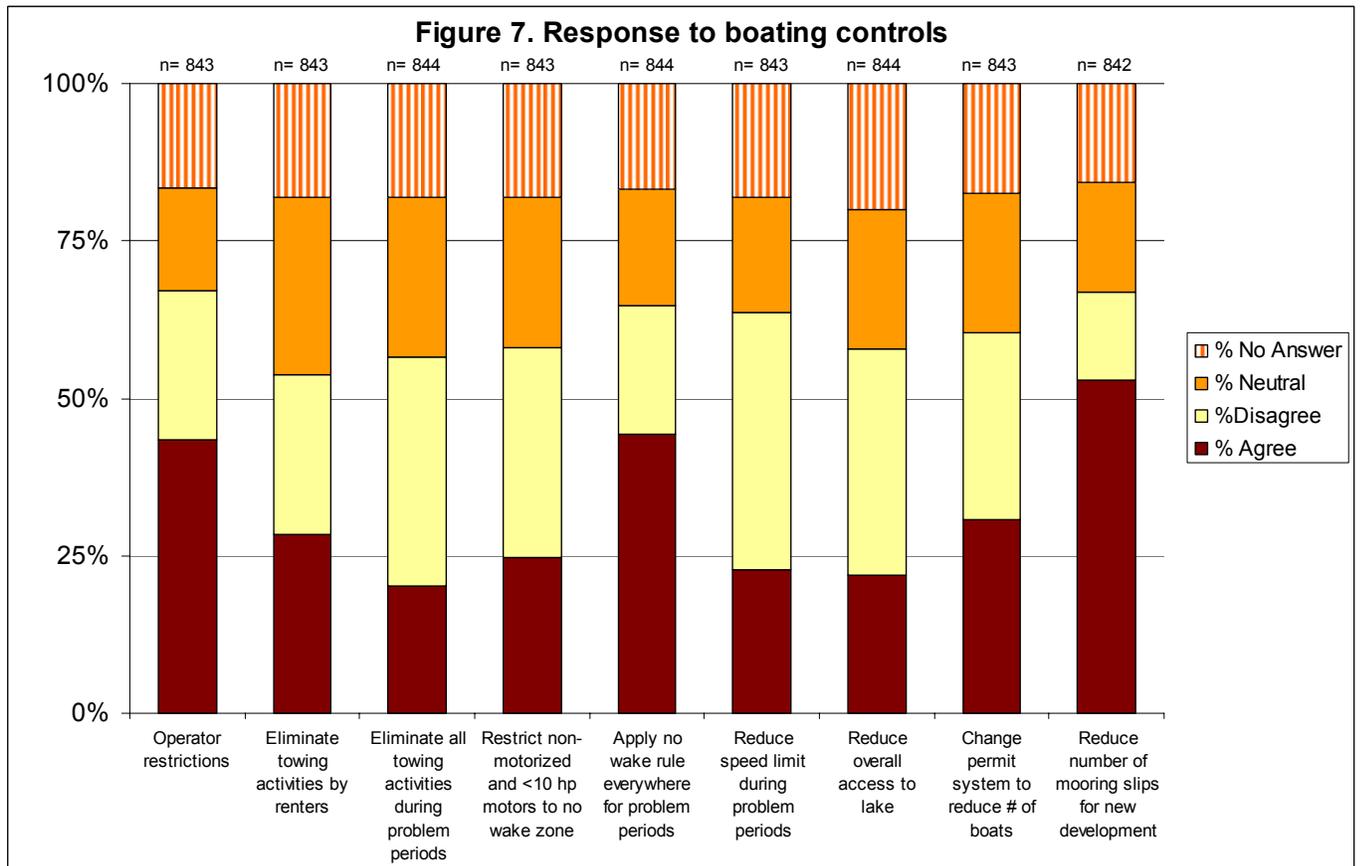
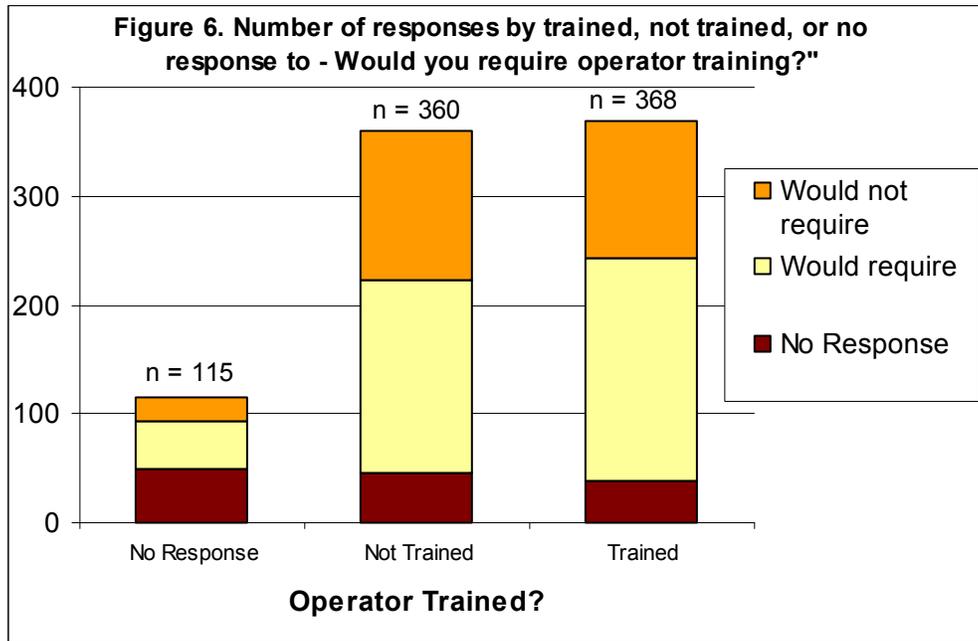


Perception of Problem Resolution Options:

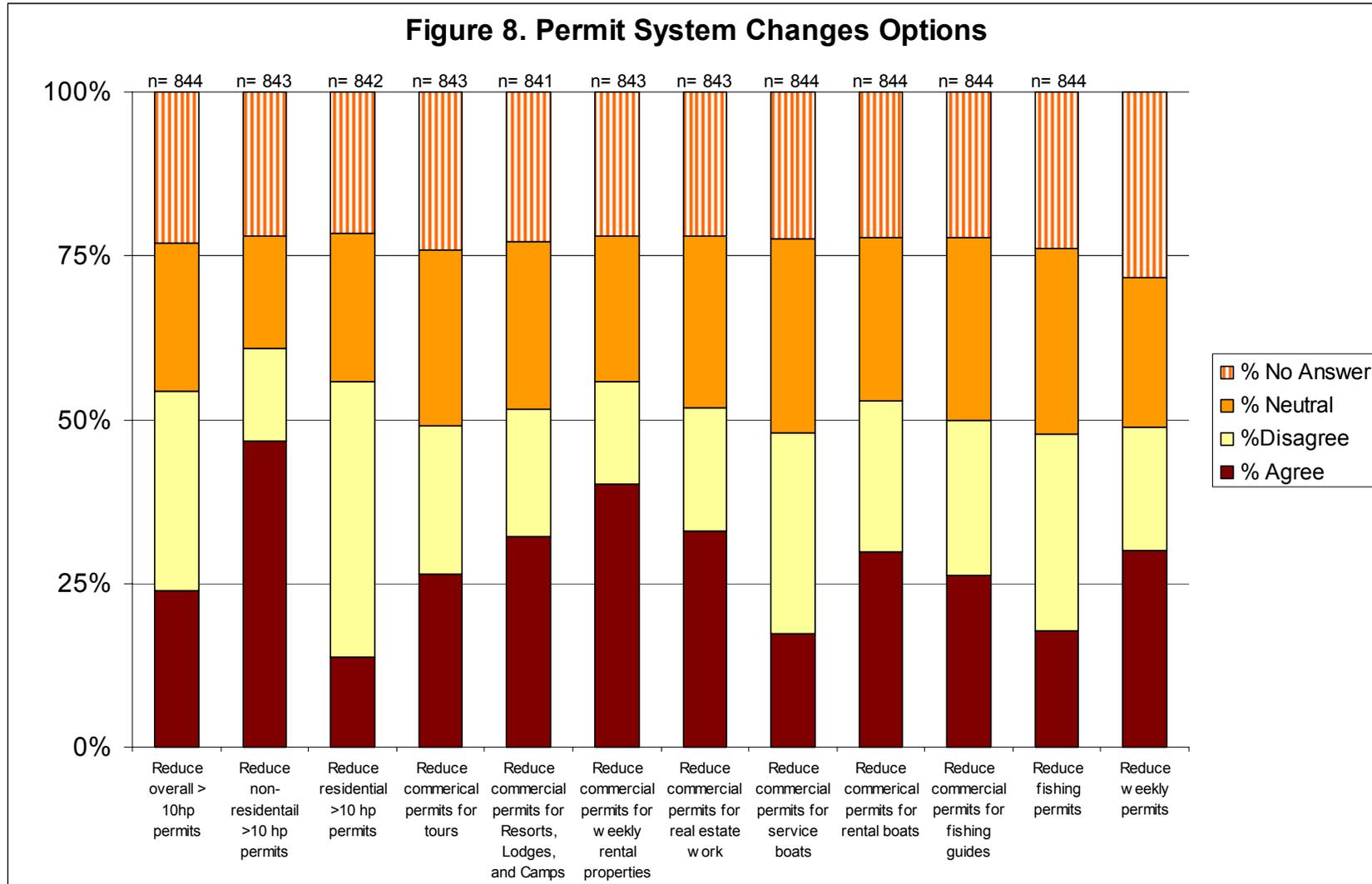
- Half of respondents agreed that motorboat operator training should be required, with a third not agreeing and the rest not responding. While about half of respondents are trained, those believing that operator training should be required were not necessarily those who were trained already (Figure 6).
- Over three quarters of respondents believe that unsupervised motorboat operation should be restricted to those 16 years of age or older; 10% do not agree and 13% did not respond.
- There is no clear consensus on preferred boating controls (Figure 7); only limiting the number of boat slips for new development garnered agreement by a majority with limited opposition. Even though a majority favored training and operator age restrictions in specific questions, the overall topic of operator controls did not get majority support.
- Oddly, institution of a no wake rule during problem periods was supported by 44% of respondents, while the nearly identical question about lowering the speed limit for problem periods received only 23% support (Figure 7).
- The sum of favorable support and neutral responses achieves a majority for several more possible management options, but there is still strong disagreement for many of these. Only the relatively easy choice of restricting boat slips for new development garnered clear support, although the no wake approach was generally received favorably as well. Further discussion is needed to understand the responses and get the respondents to think about options more proactively.
- Reducing access to the lake and changing the permit system to lower eligible boats received less than one third favorable response, and response to a variety of specific permit modification options tends to bear out that indication (Figure 8); exceptions include reducing non-residential and rental property permits for boats >10 hp, but even these did not get a majority of favorable responses.
- Use of a flag system or other density control device to limit access to the lake during expected periods of crowding was generally not favored, and options within a flag system received well under 50% support, most <25% support (Figure 9). Further discussion is warranted with lake users.

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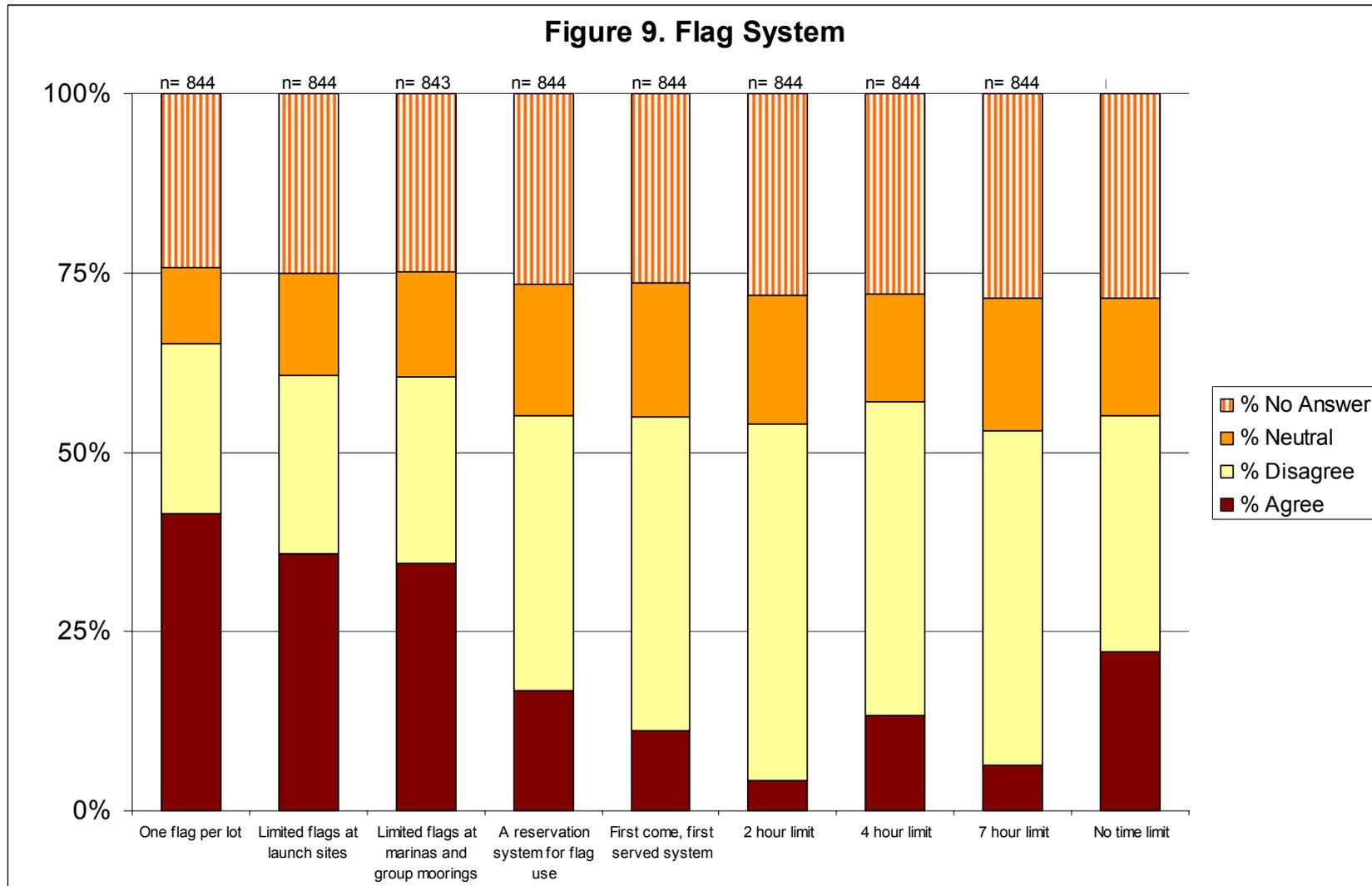
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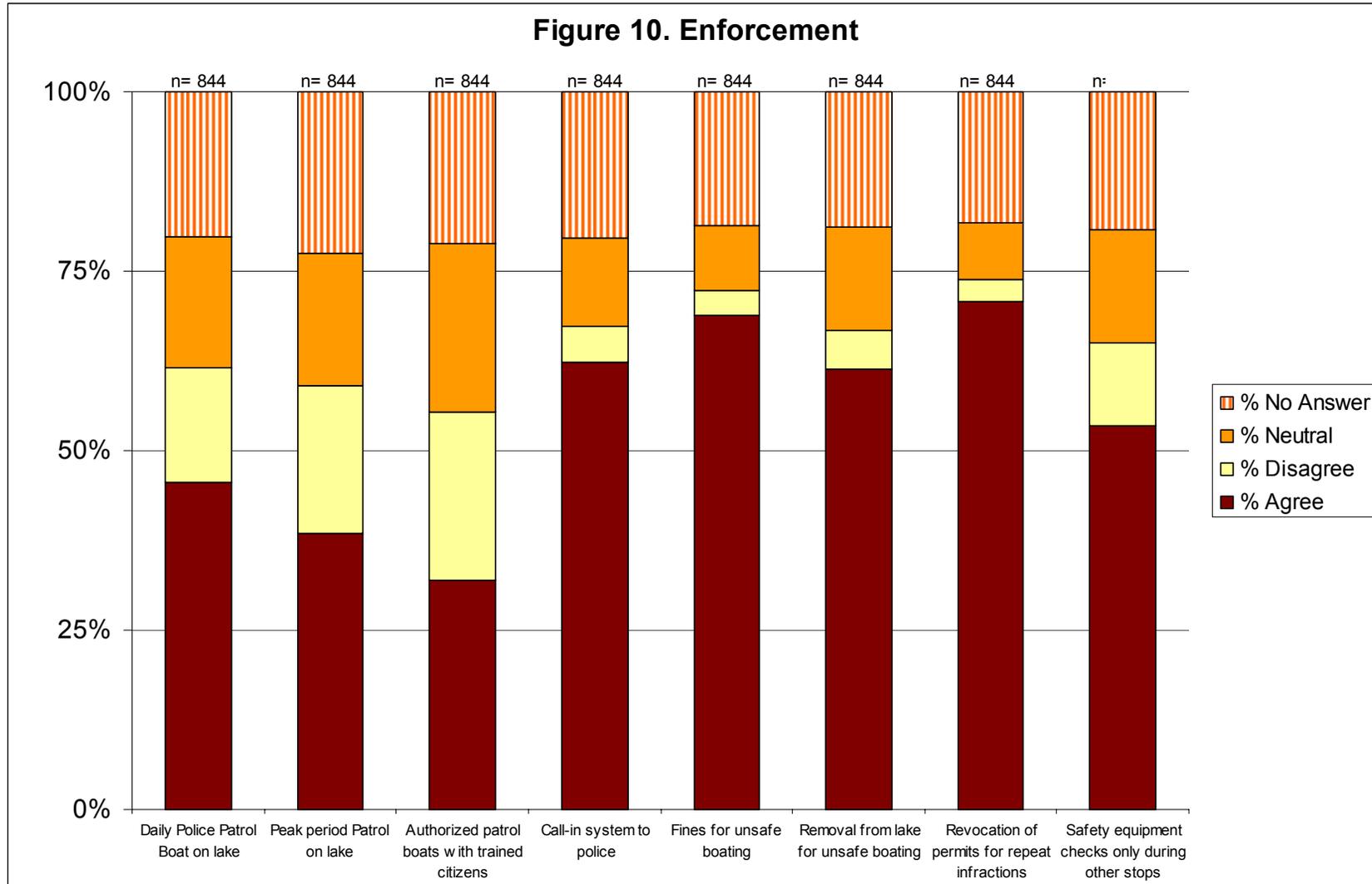
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- Enforcement options were much more favorably received, but the least acceptable approaches involved boat patrols; this is confusing, as patrols are the most effective means to get compliance (Figure 10). Further discussion is warranted with lake users.

Summary and Action Items:

- 844 questionnaire responses were received, a 40% return. Responses appear to sufficiently represent the range of lake users and general demographics of the Lake Lure community.
- Values used in estimating current boating use and carrying capacity of the lake appear appropriate; we may have overestimated the use of non-motorized and small hp motorboats, but these were not considered a problem. Large motorboat use appears to have been very accurately estimated.
- Motorized pleasure cruising is the favorite activity of the community overall. Towing people is a distant second, and none of the other boat uses are practiced by even half the respondents, although interest in fishing and paddling are substantial. Protecting all uses is worthwhile, but priorities are apparent.
- Noise does not appear to be a major issue for users of Lake Lure. Those citing noise as a concern note a range of noise sources including boats, but also including land-based sources. There may be specific cases that warrant attention, but there is no impetus for any major noise initiative at this time.
- There is not a consensus that motorized traffic is increasing or that conditions are unsafe on the lake, but users do perceive that there is more traffic and less safety on peak season weekends and holidays than on peak season weekdays, which in turn has more traffic than off-season periods. Some education of users about trends in boating and the need for control is warranted.
- Those feeling unsafe cite boat speed, towing, and overall boat density as issues, but this is a small fraction of the lake users.
- Increased safety is a priority for just over half the respondents, seemingly contrary to the lack of perception of unsafe conditions, but possibly showing that lake users are thinking of the future. The desire for increased safety is shared by owners of all boat types on the lake; this is not a simple case of paddlers wanting more control on motorboats.
- Half of respondents agreed that motorboat operator training should be required, but this is not the same half that is already trained; apparently many untrained operators recognize the need for training.
- There is strong support for restricting unsupervised operation of motorboats by those <16 years of age.
- There is no clear consensus on preferred boating controls; controls that affect non-residents, rental units, and future development have the most support, but still not a majority, and there is strong sentiment against restrictions of existing freedoms. Respondents were not asked to rank the options to get a most preferred approach, and many did not like any of the choices. Discussion is warranted.
- There are a number of seemingly contradictory answers to similar questions that need exploration in upcoming meetings. For example, there was a much more favorable response to expanding the no wake zone during peak use periods than for a speed limit during those periods, while these are functionally equivalent. User perceptions of effectiveness and level of restriction may be involved.
- Reducing access to the lake and changing the permit system to lower eligible boats is generally not favored. More feedback is desired.
- Use of a flag system or other density control device to limit access to the lake during expected periods of crowding was generally not favored. More feedback is desired.
- Enforcement of existing regulations is strongly favored, but there is hesitancy to provide the boat patrols necessary to facilitate effective enforcement. Some discussion of the appropriate level and mode of enforcement is needed.
- Many interesting, sometimes conflicting, sometimes uninformed, and sometimes very insightful comments were provided; it would be helpful to hear them voiced and explained in many cases.
- No comparison with past surveys has yet been conducted.

APPENDIX B

BOAT OBSERVATION SURVEYS
SUMMER 2006

Lake Lure Boat Survey

Area of Survey: _____ Date of Survey (mm/dd/yy): _____
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny Overcast Drizzle Rain	Sunny Overcast Drizzle Rain	Sunny Overcast Drizzle Rain	Sunny Overcast Drizzle Rain	Sunny Overcast Drizzle Rain	Sunny Overcast Drizzle Rain	Sunny Overcast Drizzle Rain
Boats Observed							
Motorized >10 hp Towing							
Motorized >10 hp Cruising With Wake							
Motorized >10 hp Cruising Without Wake or Drifting							
Motorized >10 hp Fishing							
Motorized <10 hp (any activity)							
Non-Motorized (any activity)							
Notes:							

Lake Lure Boat Survey

Area of Survey: _____ North Arm Date of Survey (mm/dd/yy): 5/27/2006 Observer: Braund
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday **Saturday** Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	1	0	2	4	4	5	3
Motorized >10 hp Cruising With Wake	1	0	0	2	5	1	3
Motorized >10 hp Cruising Without Wake or Drifting	0	0	2	1	2	4	0
Motorized >10 hp Fishing	5	0	0	0	0	0	0
Motorized <10 hp (any activity)	0	0	0	0	0	0	0
Non-Motorized (any activity)	1	0	0	0	0	0	0
Notes:							

Lake Lure Boat Survey

Area of Survey: North Arm Date of Survey (mm/dd/yy): 5/28/2006 OBSERVER: Braund
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday Saturday **Sunday**

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	1			1	3	5	
Motorized >10 hp Cruising With Wake	1			2	4	2	
Motorized >10 hp Cruising Without Wake or Drifting	0			6	5	1	
Motorized >10 hp Fishing	2			0	0	0	
Motorized <10 hp (any activity)	0			0	0	0	
Non-Motorized (any activity)	0			0	0	0	
Notes:							

Lake Lure Boat Survey

Area of Survey: Dam Cove Date of Survey (mm/dd/yy): 5/27/2006 OBSERVER: Hasenfus
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday **Saturday** Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny				
Boats Observed							
Motorized >10 hp Towing	1	2	0				
Motorized >10 hp Cruising With Wake	0	2	5				
Motorized >10 hp Cruising Without Wake or Drifting	0	2	2				
Motorized >10 hp Fishing	2	0	0				
Motorized <10 hp (any activity)	0	0	0				
Non-Motorized (any activity)	0	0	0				
Notes:							

Lake Lure Boat Survey

Area of Survey: Tryon Bay Date of Survey (mm/dd/yy): 5/25/2006 OBSERVER: Keith

Day of Week: (circle day of week) Monday Tuesday Wednesday **Thursday** Friday Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)				Drizzle	Overcast	Overcast	Overcast
Boats Observed							
Motorized >10 hp Towing				0	0	0	0
Motorized >10 hp Cruising With Wake				0	0	0	0
Motorized >10 hp Cruising Without Wake or Drifting				0	1	0	0
Motorized >10 hp Fishing				0	0	1	0
Motorized <10 hp (any activity)				0	0	0	0
Non-Motorized (any activity)				0	0	0	0
Notes:							

Lake Lure Boat Survey

Area of Survey: Tryon Bay Date of Survey (mm/dd/yy): 5/26/2006 OBSERVER: Keith

Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday **Friday** Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny		Sunny	Sunny	Sunny	
Boats Observed							
Motorized >10 hp Towing	0	0		0	0	0	
Motorized >10 hp Cruising With Wake	0	0		0	0	1	
Motorized >10 hp Cruising Without Wake or Drifting	0	0		1	0	0	
Motorized >10 hp Fishing	0	0		0	0	0	
Motorized <10 hp (any activity)	0	0		0	0	0	
Non-Motorized (any activity)	0	0		0	0	0	
Notes:							

Lake Lure Boat Survey

Area of Survey: Tryon Bay Date of Survey (mm/dd/yy): 5/27/2006 OBSERVER: Dittmer

Day of Week: (circle day of week)	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing		1.3	1.3	1.8	1.8	0.8	0.3
Motorized >10 hp Cruising With Wake		2.3	3.8	4.0	5.3	2.3	1.7
Motorized >10 hp Cruising Without Wake or Drifting		0.3	1.0	1.3	1.0	1.0	2.3
Motorized >10 hp Fishing		0.8	0.0	0.0	0.0	0.5	0.0
Motorized <10 hp (any activity)		0.3	0.0	0.0	0.0	0.0	0.0
Non-Motorized (any activity)	1.0	0.3	0.5	0.5	0.3	0.3	0.3
Notes:							

Lake Lure Boat Survey

Area of Survey: Tryon Bay Date of Survey (mm/dd/yy): 5/28/2006 OBSERVER: Dittmer

Day of Week: (circle day of week)	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	0.0	0.8	2.3	1.0	0.8	1.3	0.8
Motorized >10 hp Cruising With Wake	0.8	1.3	3.0	4.0	3.3	3.0	2.5
Motorized >10 hp Cruising Without Wake or Drifting	0.0	0.8	1.3	1.5	1.5	3.3	3.3
Motorized >10 hp Fishing	0.3	0.8	0.3	0.0	0.0	0.5	0.0
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.3	0.0	0.0
Non-Motorized (any activity)	0.0	1.3	1.0	1.0	0.5	0.0	0.5
Notes:							

Lake Lure Boat Survey

Area of Survey: Tryon Bay Date of Survey (mm/dd/yy): 5/29/2006 OBSERVER: Dittmer
 Day of Week: (circle day of week) **Monday** Tuesday Wednesday Thursday Friday Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	0.3	1.8	1.3	1.3	0.5	1.0	0.5
Motorized >10 hp Cruising With Wake	0.0	1.0	1.8	2.3	3.0	2.3	1.8
Motorized >10 hp Cruising Without Wake or Drifting	0.0	1.0	1.5	2.3	2.0	2.8	4.3
Motorized >10 hp Fishing	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Non-Motorized (any activity)	0.0	0.5	0.8	0.3	1.0	1.3	0.0
Notes:							

Lake Lure Boat Survey

Area of Survey: Main Body Date of Survey (mm/dd/yy): 5/25/2006 OBSERVER: Keith
 Day of Week: (circle day of week) Monday Tuesday Wednesday **Thursday** Friday Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)				Drizzle	Overcast	Sunny Overcast	Overcast
Boats Observed							
Motorized >10 hp Towing				0	0	0	0
Motorized >10 hp Cruising With Wake				0	0	2	1
Motorized >10 hp Cruising Without Wake or Drifting				1	2	0	2
Motorized >10 hp Fishing				0	0	0	0
Motorized <10 hp (any activity)				0	0	0	0
Non-Motorized (any activity)				0	0	0	0
Notes:							

Lake Lure Boat Survey

Area of Survey: Main Body Date of Survey (mm/dd/yy): 5/26/2006 OBSERVER: Keith

Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday **Friday** Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny		Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	1	0		0	1	0	
Motorized >10 hp Cruising With Wake	0	0		0	3	0	
Motorized >10 hp Cruising Without Wake or Drifting	0	0		1	1	2	8
Motorized >10 hp Fishing	1	0		0	0	0	
Motorized <10 hp (any activity)	0	0		0	0	0	
Non-Motorized (any activity)	0	0		0	1	0	
Notes:	The 8 boats at dusk were observed by a neighbor; all pontoons						

Lake Lure Boat Survey

Area of Survey: Main Body Date of Survey (mm/dd/yy): 5/27/2006 OBSERVER: Keith

Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday **Saturday** Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	0.5	0.5	1.7	3.3	2.5	1.3	0.3
Motorized >10 hp Cruising With Wake	0.0	1.3	4.0	7.5	7.8	4.0	2.5
Motorized >10 hp Cruising Without Wake or Drifting	0.8	2.0	2.5	6.8	4.8	2.3	2.8
Motorized >10 hp Fishing	0.3	0.5	0.2	0.0	0.0	0.0	0.0
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Motorized (any activity)	0.5	0.0	0.5	1.3	1.0	0.8	0.0
Notes:	Several counts were taken by a neighbor in his absence.						

Lake Lure Boat Survey

Area of Survey: Main Body Date of Survey (mm/dd/yy): 5/28/2006 OBSERVER: Keith

Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday Saturday **Sunday**

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	0.3	0.0	3.2	1.8	3.0	1.8	0.0
Motorized >10 hp Cruising With Wake	0.5	0.0	6.0	3.5	11.0	6.5	1.0
Motorized >10 hp Cruising Without Wake or Drifting	0.0	2.0	5.8	9.0	3.0	2.5	7.0
Motorized >10 hp Fishing	0.5	0.0	0.0	0.0	0.3	0.0	0.0
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.3	0.3	0.0
Non-Motorized (any activity)	0.3	0.0	0.0	1.5	0.8	0.0	0.0
Notes:							

Lake Lure Boat Survey

Area of Survey: Main Channel Date of Survey (mm/dd/yy): 5/28/2006 OBSERVER: Hasenfus

Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday Saturday **Sunday**

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)			Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing			2.5	3.0	0.8	1.3	1.5
Motorized >10 hp Cruising With Wake			4.5	7.0	7.8	4.0	6.5
Motorized >10 hp Cruising Without Wake or Drifting			1.5	1.5	3.0	3.0	3.0
Motorized >10 hp Fishing			0.0	0.3	0.3	0.3	0.0
Motorized <10 hp (any activity)			0.0	0.3	0.3	0.0	0.0
Non-Motorized (any activity)			1.5	2.0	2.0	1.0	0.0
Notes:							

Lake Lure Boat Survey

Area of Survey: Main Channel Date of Survey (mm/dd/yy): 5/29/2006 OBSERVER: Hasenfus

Day of Week: (circle day of week) **Monday** Tuesday Wednesday Thursday Friday Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)		Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing		0.0	0.5	1.5	1.5	0.7	1.0
Motorized >10 hp Cruising With Wake		3.0	2.5	3.8	3.5	2.7	1.5
Motorized >10 hp Cruising Without Wake or Drifting		1.0	0.8	0.8	0.5	1.0	0.5
Motorized >10 hp Fishing		0.0	0.0	0.0	0.3	0.0	0.0
Motorized <10 hp (any activity)		0.0	0.0	0.0	0.0	0.0	0.0
Non-Motorized (any activity)		0.0	0.5	2.3	2.8	0.3	0.5
Notes:							

Lake Lure Boat Survey

Area of Survey: West Arm Date of Survey (mm/dd/yy): 5/27/2006 Observer: Video/Pitts

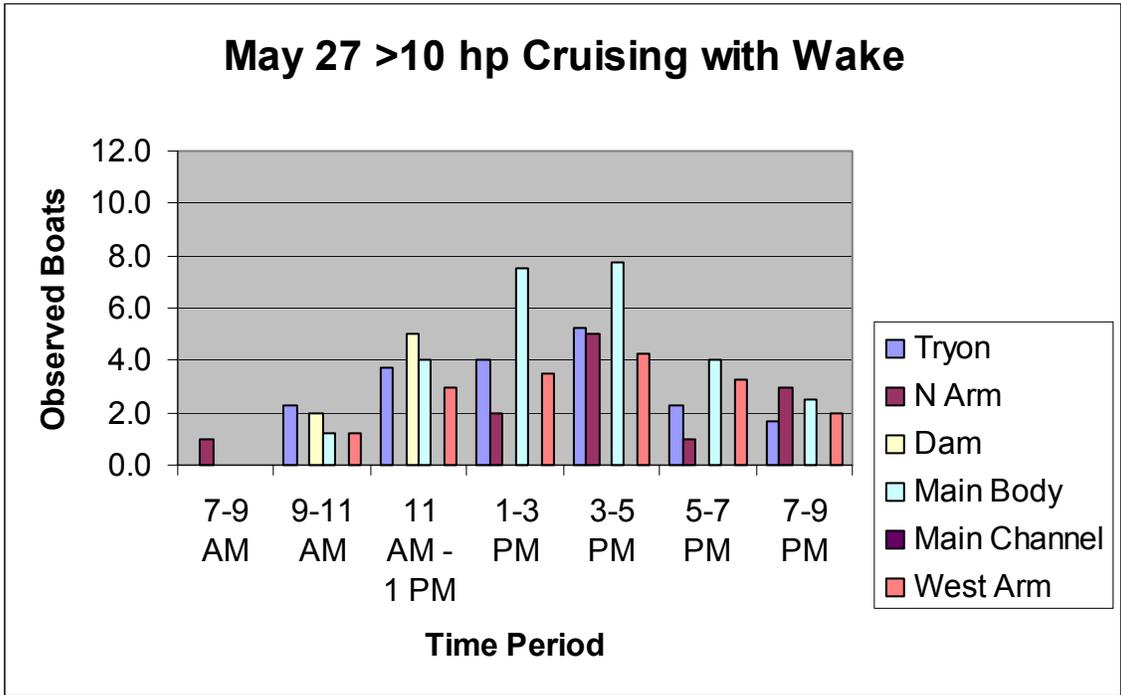
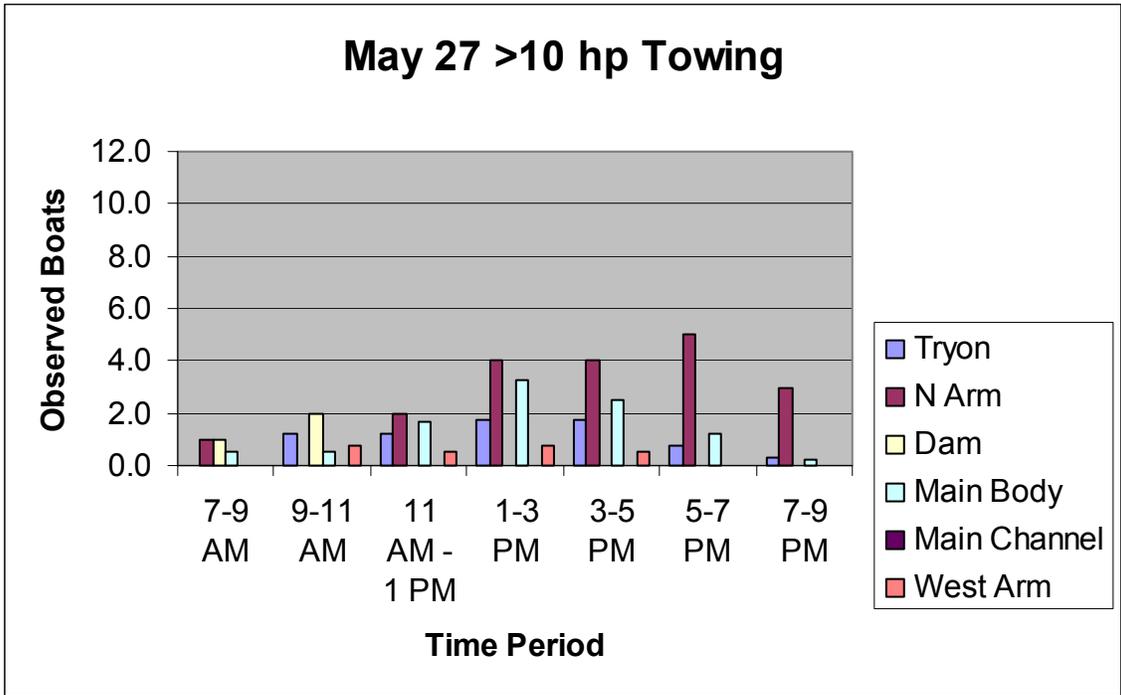
Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday **Saturday** Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing		0.8	0.5	0.8	0.5	0.0	0.0
Motorized >10 hp Cruising With Wake		1.3	3.0	3.5	4.3	3.3	2.0
Motorized >10 hp Cruising Without Wake or Drifting		0.0	0.0	0.5	0.0	0.0	0.0
Motorized >10 hp Fishing		0.0	0.0	0.0	0.3	0.0	0.0
Motorized <10 hp (any activity)		0.0	0.0	0.0	0.0	0.0	0.0
Non-Motorized (any activity)		0.0	1.5	0.3	0.5	0.0	0.3
Notes:							

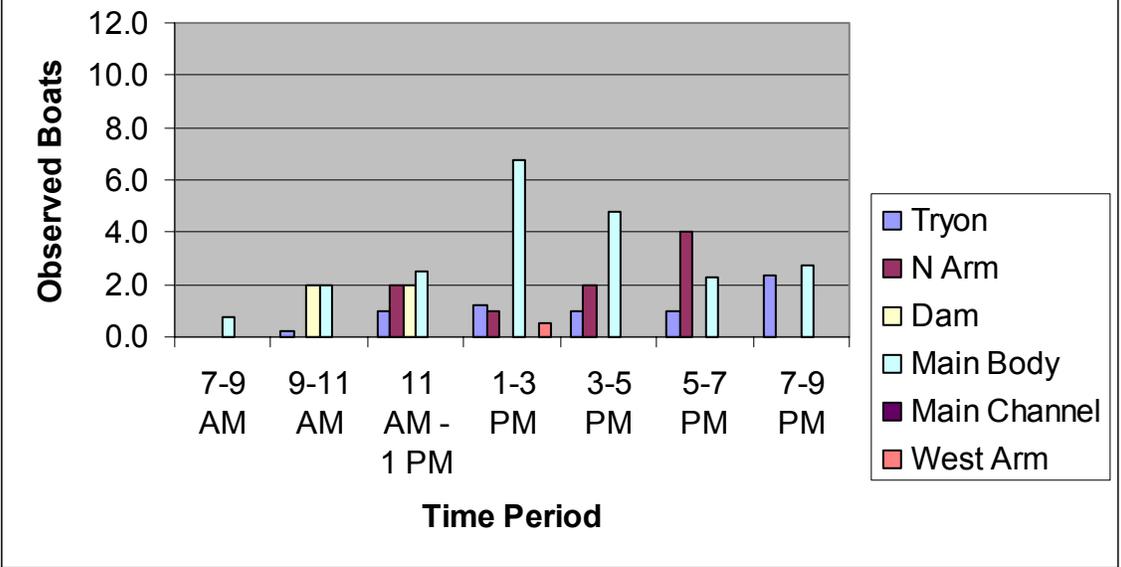
Lake Lure Boat Survey

Area of Survey: _____ West Arm Date of Survey (mm/dd/yy): 5/28/2006 Observer: Video/Pitts
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday Saturday **Sunday**

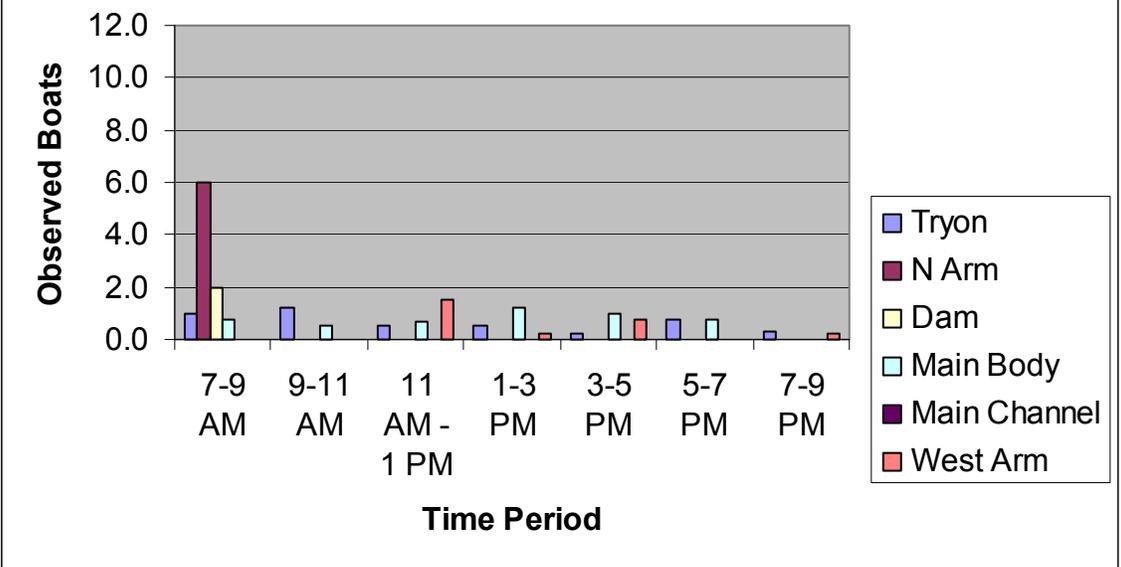
Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	0.0	0.0	0.5	0.8	0.8	1.5	0.3
Motorized >10 hp Cruising With Wake	1.0	2.8	5.8	4.8	4.5	4.0	3.7
Motorized >10 hp Cruising Without Wake or Drifting	0.0	0.3	0.0	0.0	0.0	0.0	0.0
Motorized >10 hp Fishing	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.3	0.0	0.0
Non-Motorized (any activity)	0.0	0.8	1.5	0.0	1.0	0.5	0.0
Notes:							



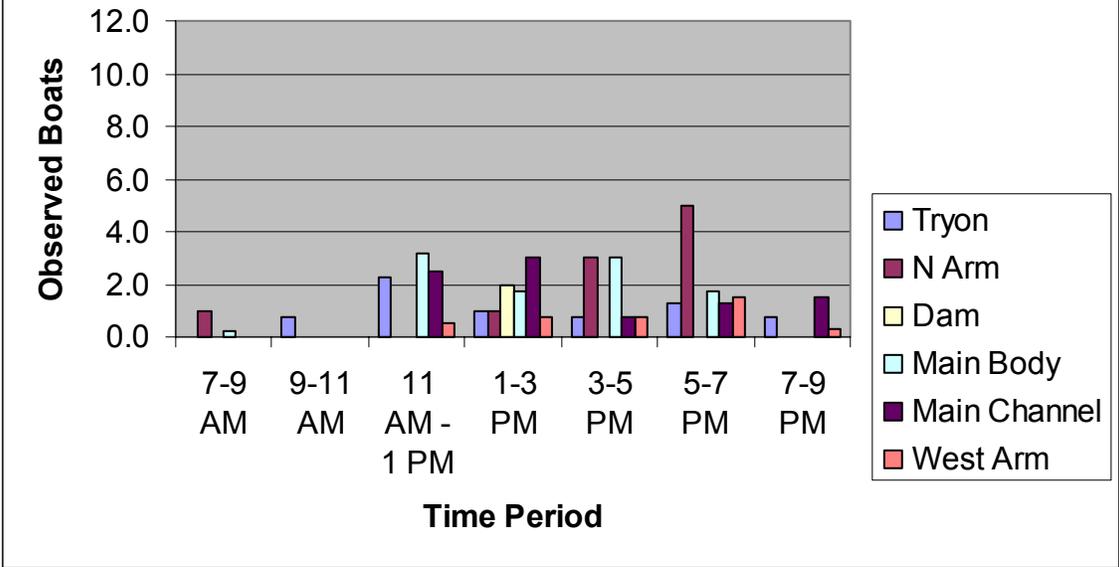
May 27 >10 hp No Wake



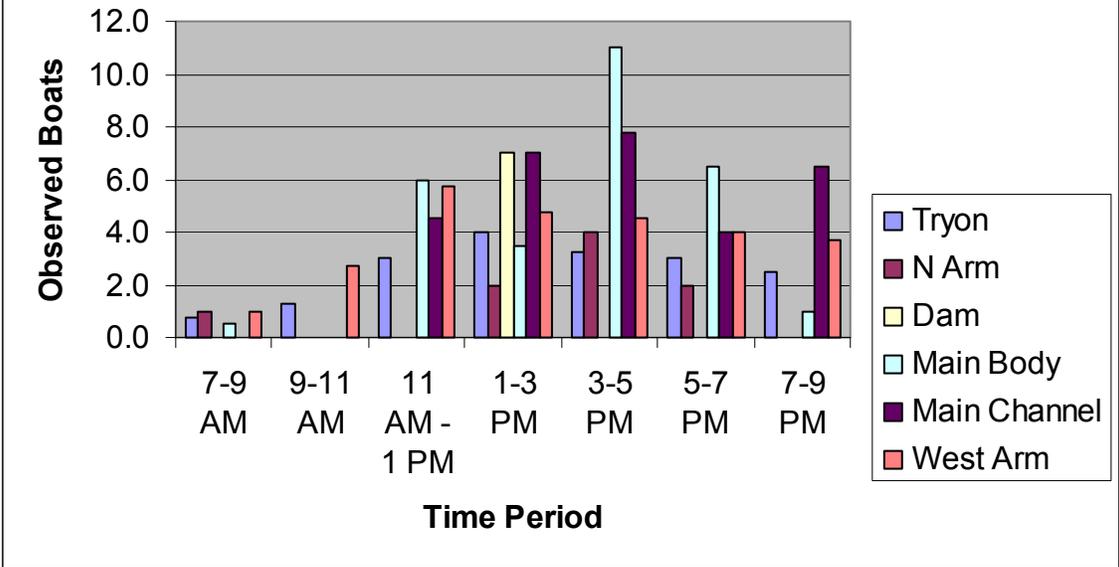
May 27 Other Boating Uses



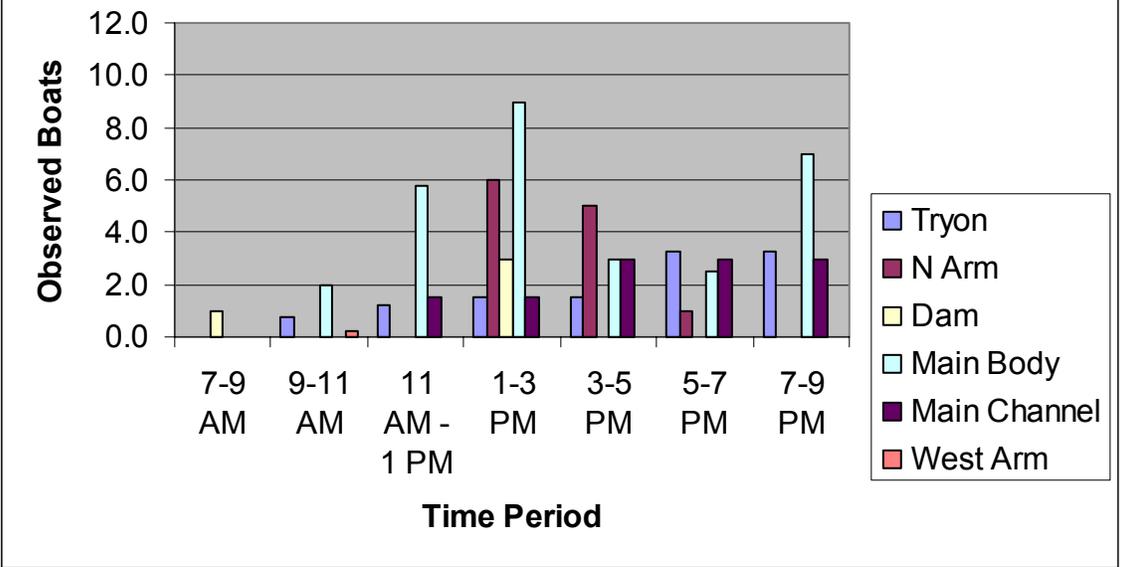
May 28 >10 hp Towing



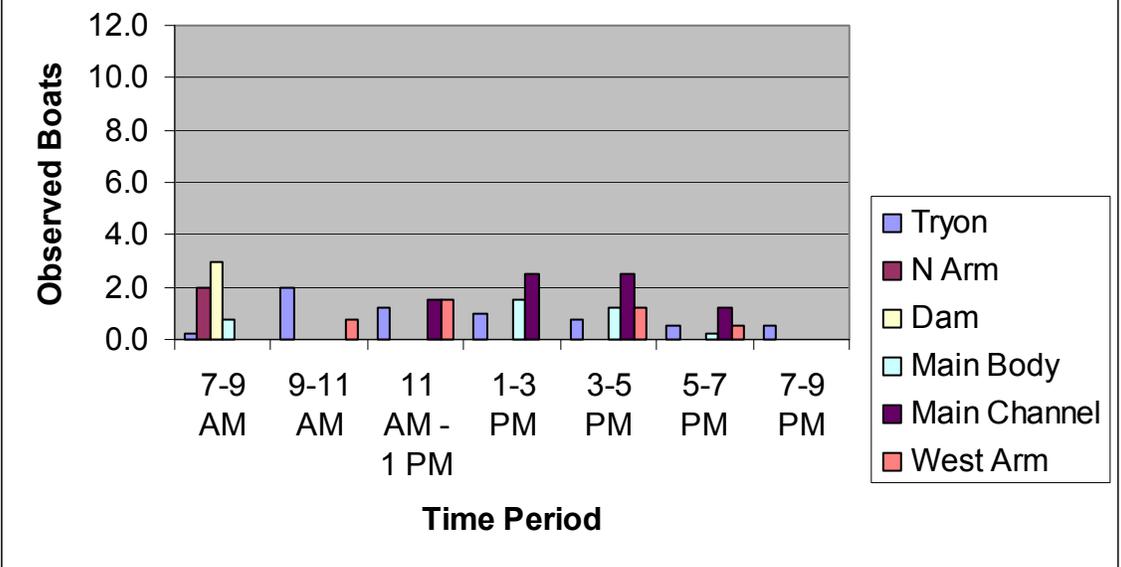
May 28 >10 hp Cruising with Wake



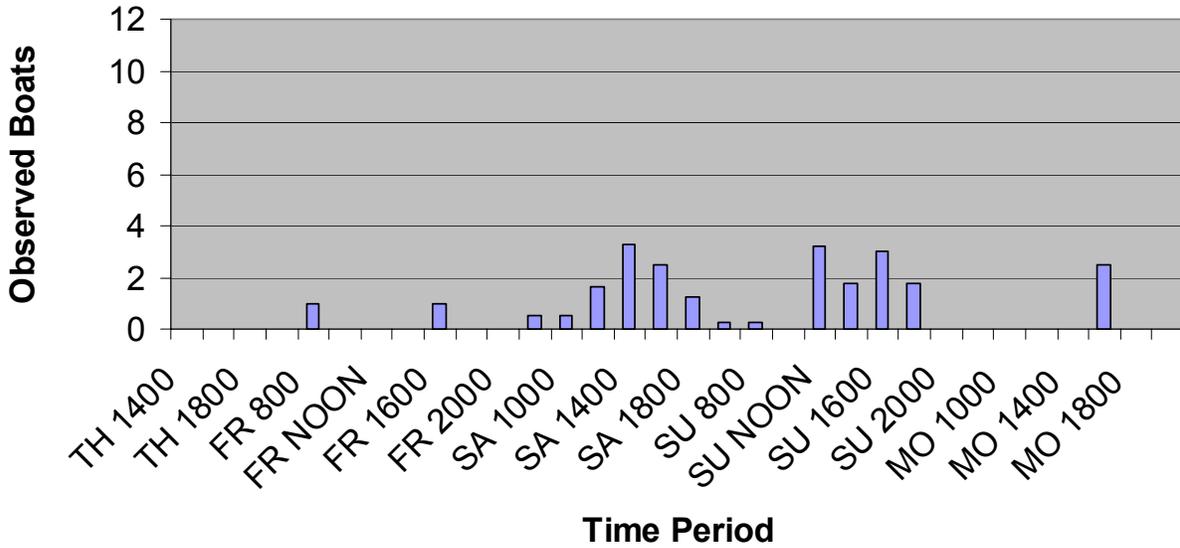
May 28 >10 hp No Wake



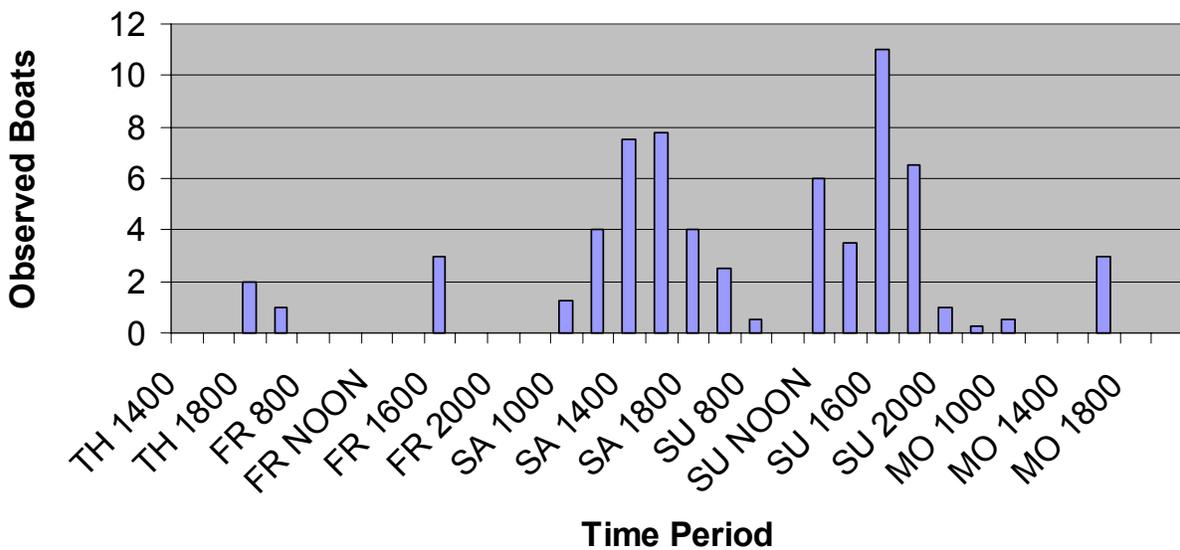
May 28 Other Boating Uses



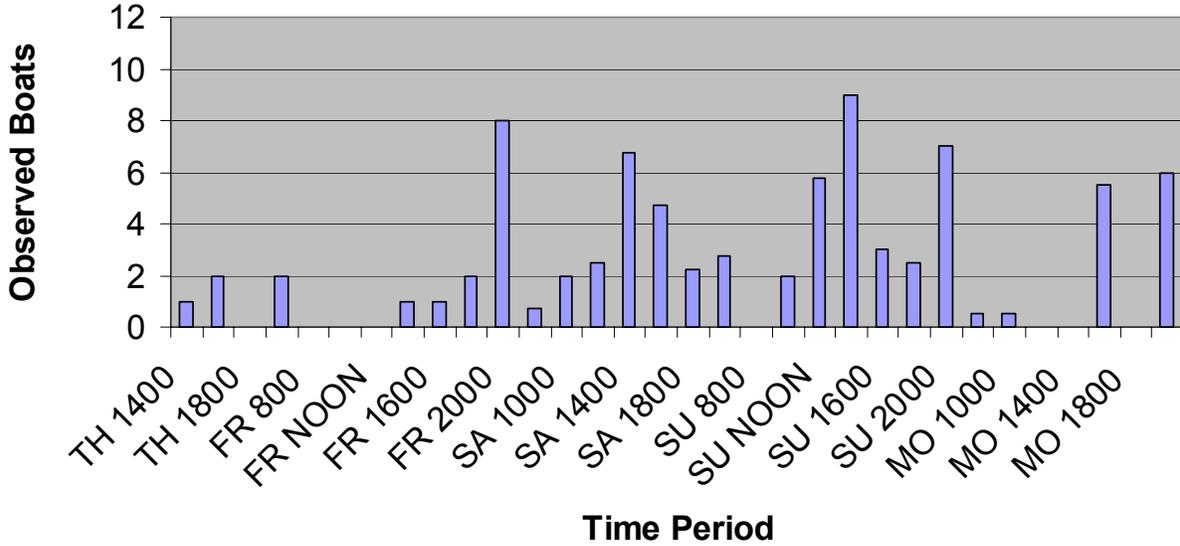
Memorial Weekend 2006, Main Body, Motorized >10 hp Towing



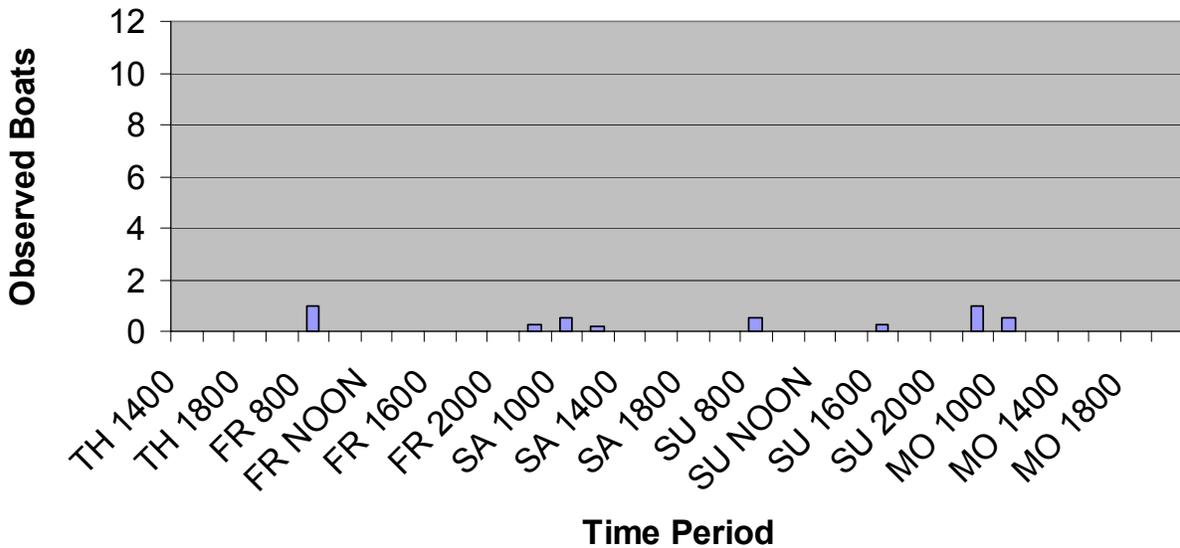
Memorial Weekend 2006, Main Body, Motorized >10 hp Cruising With Wake



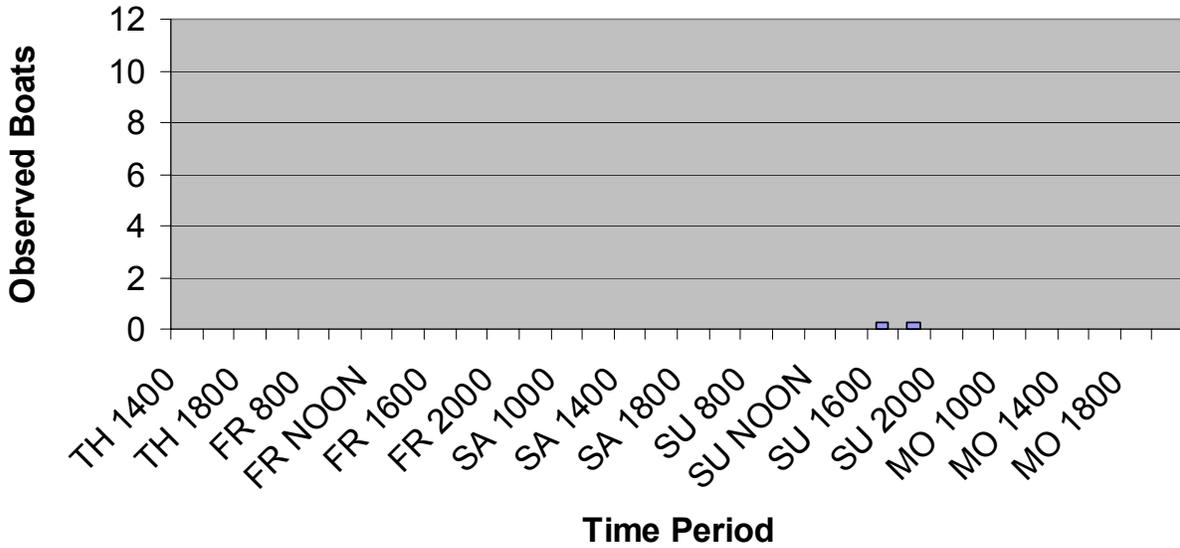
**Memorial Weekend 2006, Main Body,
Motorized >10 hp Without Wake**



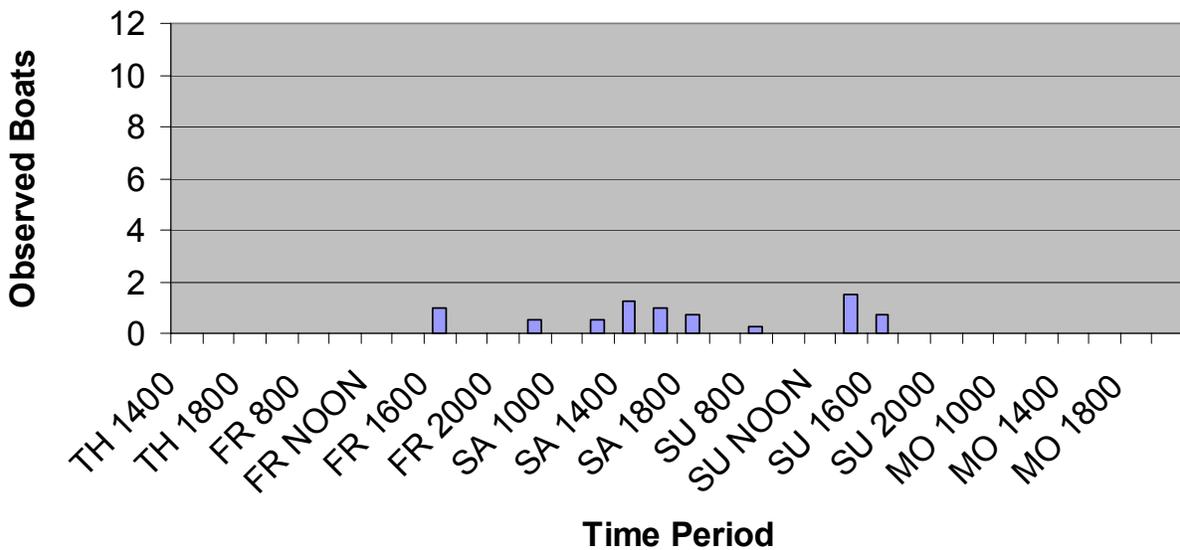
**Memorial Weekend 2006, Main Body,
Motorized >10 hp Fishing**



Memorial Weekend 2006, Main Body, Motorized <10 hp



Memorial Weekend 2006, Main Body, Non-Motorized

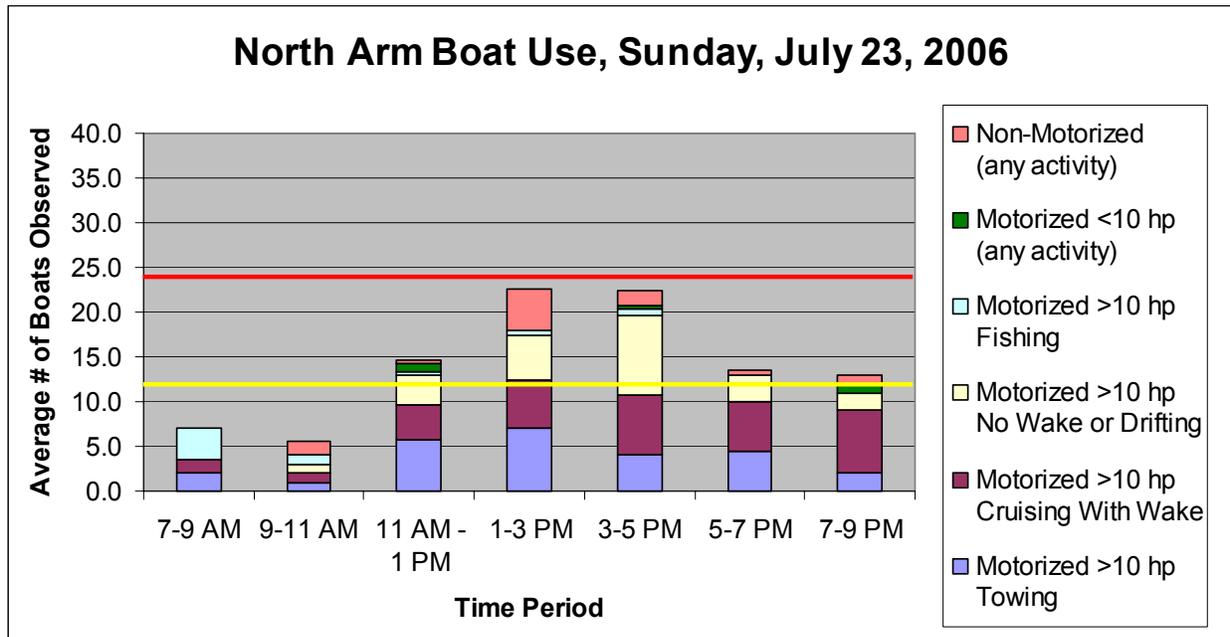


Lake Lure Boat Survey

Area of Survey: North Arm Date of Survey (mm/dd/yy): 7/23/2006 Observers: Wiggins & Wa

Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday Saturday **Sunday**

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Overcast	Drizzle Rain	Sunny	Sunny	Sunny	Sunny Overcast	Sunny
Boats Observed							
Motorized >10 hp Towing	2.0	1.0	5.7	7.0	4.0	4.5	2.0
Motorized >10 hp Cruising With Wake	1.5	1.0	4.0	5.5	6.7	5.5	7.0
Motorized >10 hp Cruising Without Wake or Drifting	0.0	1.0	3.3	5.0	9.0	3.0	2.0
Motorized >10 hp Fishing	3.5	1.0	0.3	0.5	0.7	0.0	0.0
Motorized <10 hp (any activity)	0.0	0.0	1.0	0.0	0.3	0.0	1.0
Non-Motorized (any activity)	0.0	1.5	0.3	4.5	1.7	0.5	1.0
Notes:							

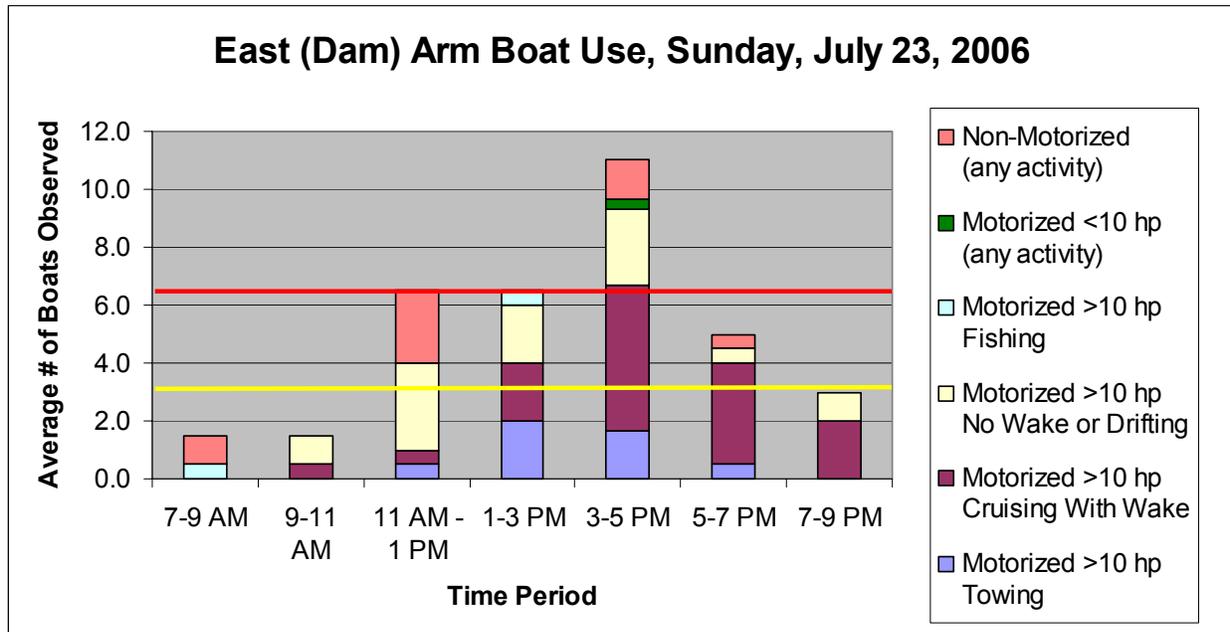


Lake Lure Boat Survey

Area of Survey: Dam Cove Date of Survey (mm/dd/yy): 7/23/2006 Observers: Wiggins & W

Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday Saturday **Sunday**

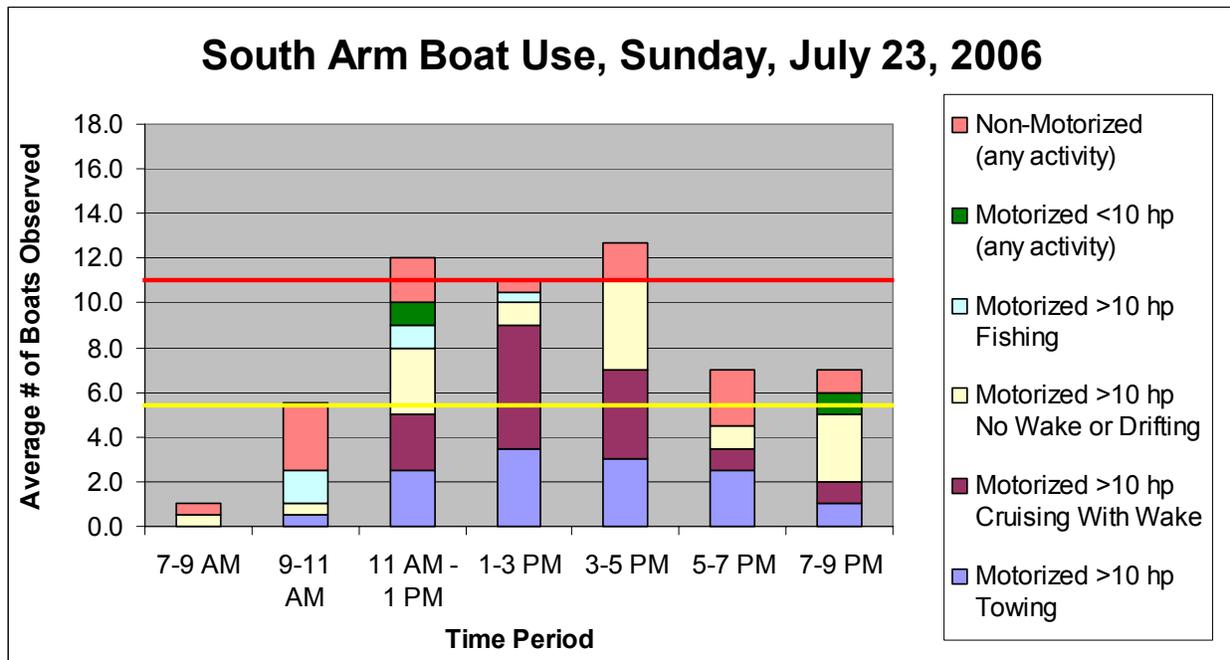
Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Overcast	Drizzle	Sunny	Sunny	Sunny	Sunny Overcast	Sunny
Boats Observed							
Motorized >10 hp Towing	0.0	0.0	0.5	2.0	1.7	0.5	0.0
Motorized >10 hp Cruising With Wake	0.0	0.5	0.5	2.0	5.0	3.5	2.0
Motorized >10 hp Cruising Without Wake or Drifting	0.0	1.0	3.0	2.0	2.7	0.5	1.0
Motorized >10 hp Fishing	0.5	0.0	0.0	0.5	0.0	0.0	0.0
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.3	0.0	0.0
Non-Motorized (any activity)	1.0	0.0	2.5	0.0	1.3	0.5	0.0
Notes:							



Lake Lure Boat Survey

Area of Survey: South Arm Date of Survey (mm/dd/yy): 7/23/2006 Observer: Wiggins & W
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday Saturday **Sunday**

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Overcast	Drizzle	Sunny	Sunny	Sunny	Sunny Overcast	Sunny
Boats Observed							
Motorized >10 hp Towing	0.0	0.5	2.5	3.5	3.0	2.5	1.0
Motorized >10 hp Cruising With Wake	0.0	0.0	2.5	5.5	4.0	1.0	1.0
Motorized >10 hp Cruising Without Wake or Drifting	0.5	0.5	3.0	1.0	4.0	1.0	3.0
Motorized >10 hp Fishing	0.0	1.5	1.0	0.5	0.0	0.0	0.0
Motorized <10 hp (any activity)	0.0	0.0	1.0	0.0	0.0	0.0	1.0
Non-Motorized (any activity)	0.5	3.0	2.0	0.5	1.7	2.5	1.0

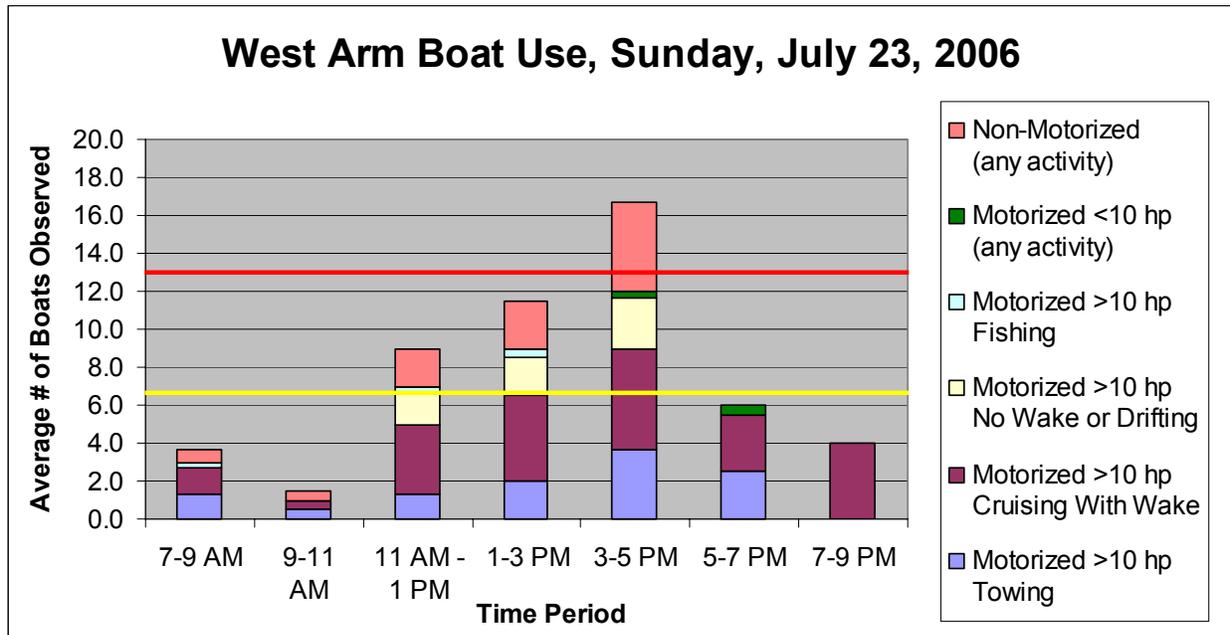


Lake Lure Boat Survey

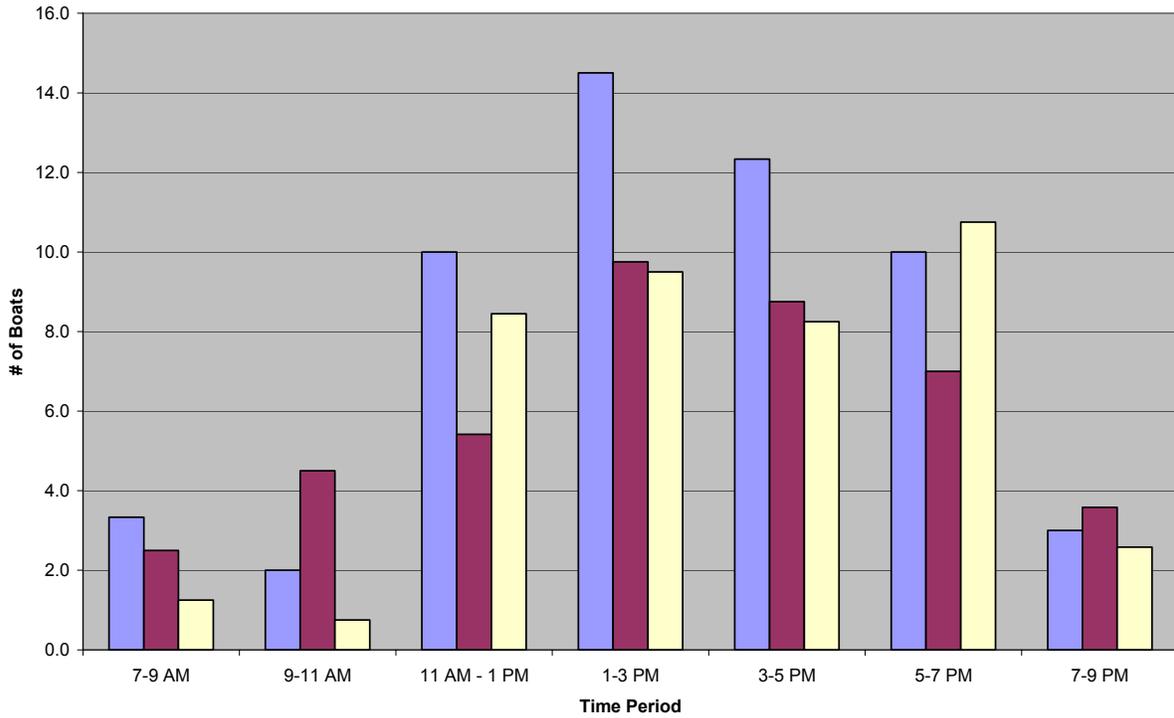
Area of Survey: West Arm Date of Survey (mm/dd/yy): 7/23/2006 Observers: Wiggins & W

Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday Saturday Sunday

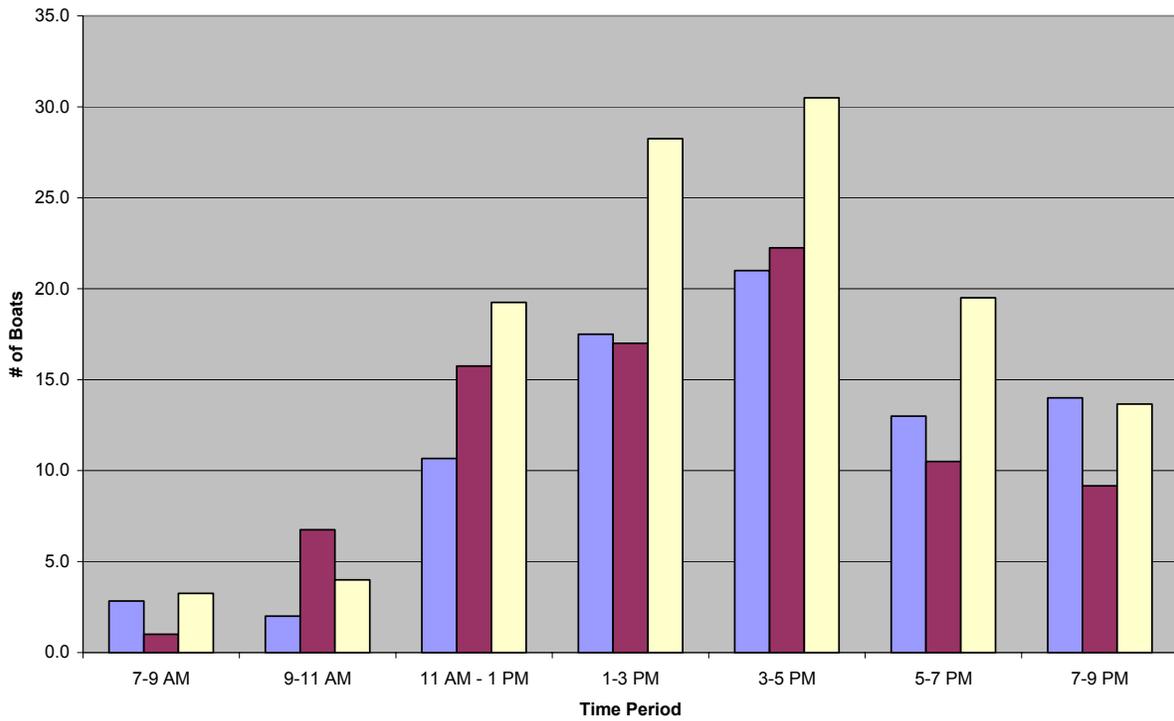
Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Overcast	Drizzle Rain	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	1.3	0.5	1.3	2.0	3.7	2.5	0.0
Motorized >10 hp Cruising With Wake	1.3	0.5	3.7	4.5	5.3	3.0	4.0
Motorized >10 hp Cruising Without Wake or Drifting	0.0	0.0	1.7	2.0	2.7	0.0	0.0
Motorized >10 hp Fishing	0.3	0.0	0.3	0.5	0.0	0.0	0.0
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.3	0.5	0.0
Non-Motorized (any activity)	0.7	0.5	2.0	2.5	4.7	0.0	0.0
Notes:							



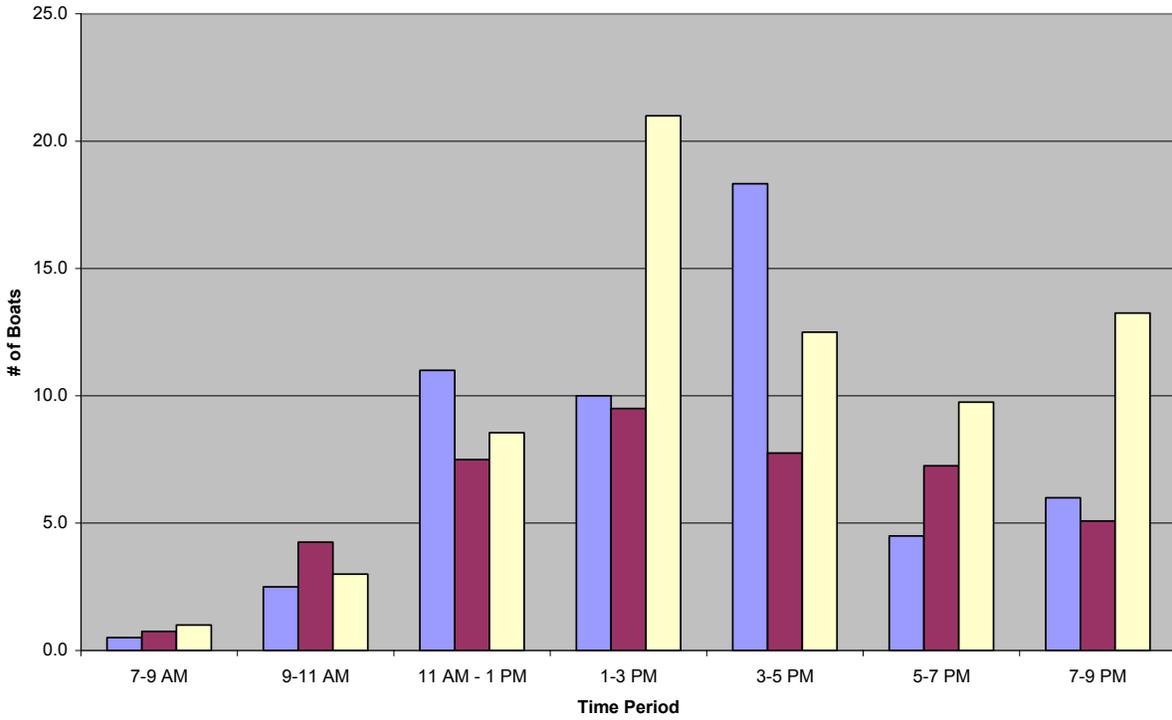
Motorboats >10 hp Towing, Clear Weekend Days



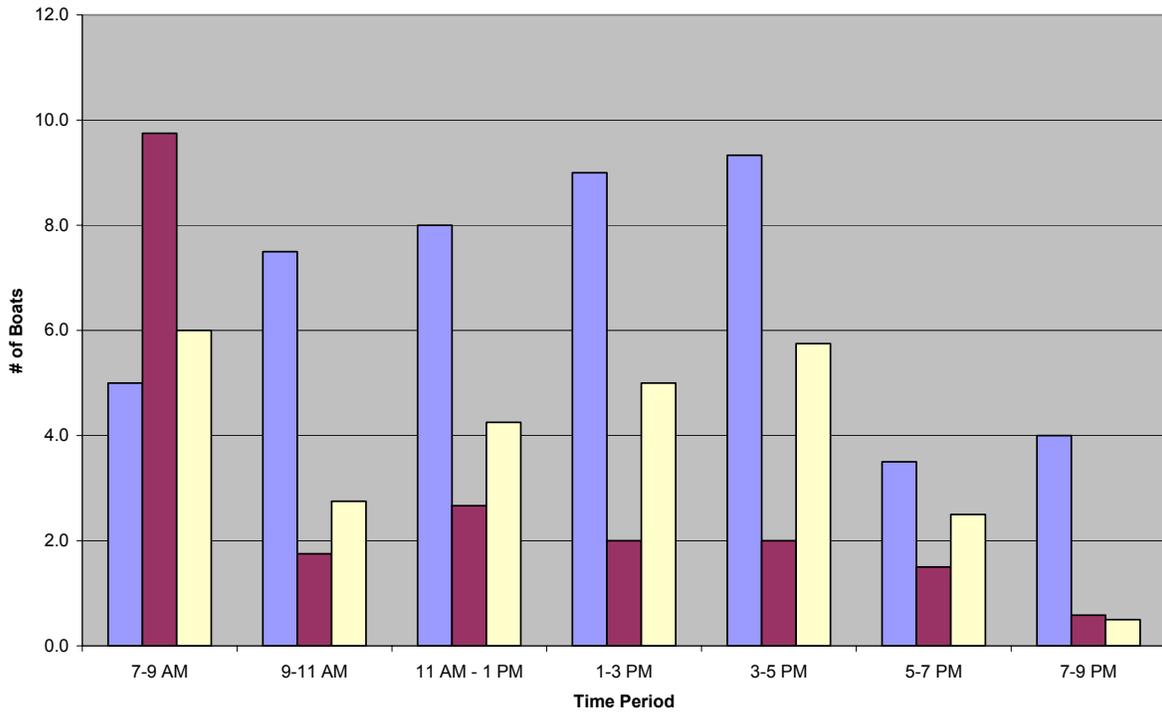
Motorboats >10 hp Cruising with Wake, Clear Weekend Days



Motorboats >10 hp Creating No Wake, Clear Weekend Days



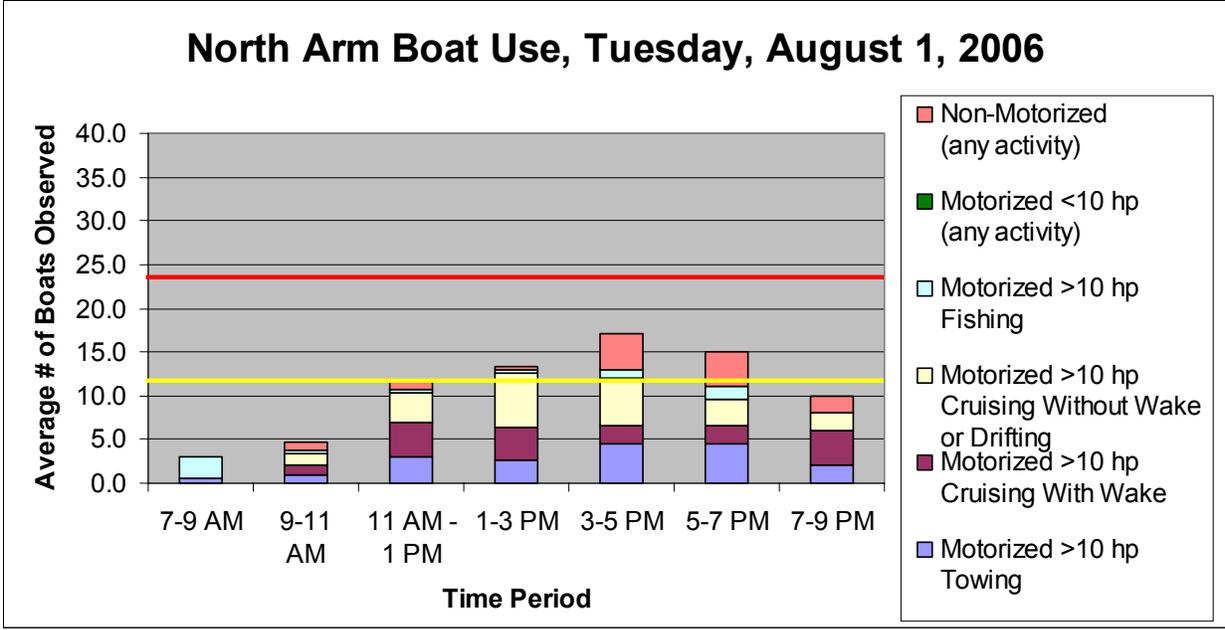
Motorboats Fishing or <10 hp (including non-motorized), Clear Weekend Days



Lake Lure Boat Survey

Area of Survey: North Arm Date of Survey (mm/dd/yy): 8/1/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday **Tuesday** Wednesday Thursday Friday Saturday Sunday

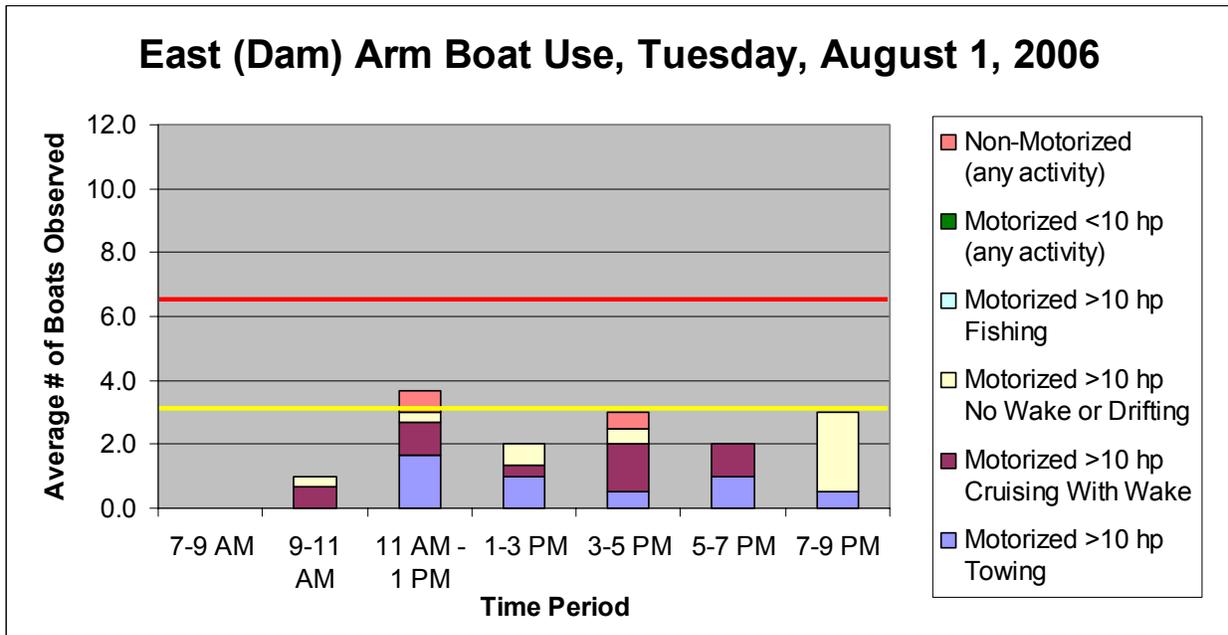
Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	0.5	1.0	3.0	2.7	4.5	4.5	2.0
Motorized >10 hp Cruising With Wake	0.0	1.0	4.0	3.7	2.0	2.0	4.0
Motorized >10 hp Cruising Without Wake or Drifting	0.0	1.3	3.3	6.3	5.5	3.0	2.0
Motorized >10 hp Fishing	2.5	0.3	0.3	0.3	1.0	1.5	0.0
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Motorized (any activity)	0.0	1.0	1.0	0.3	4.0	4.0	2.0
Notes:							



Lake Lure Boat Survey

Area of Survey: Dam Arm Date of Survey (mm/dd/yy): 8/1/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday **Tuesday** Wednesday Thursday Friday Saturday Sunday

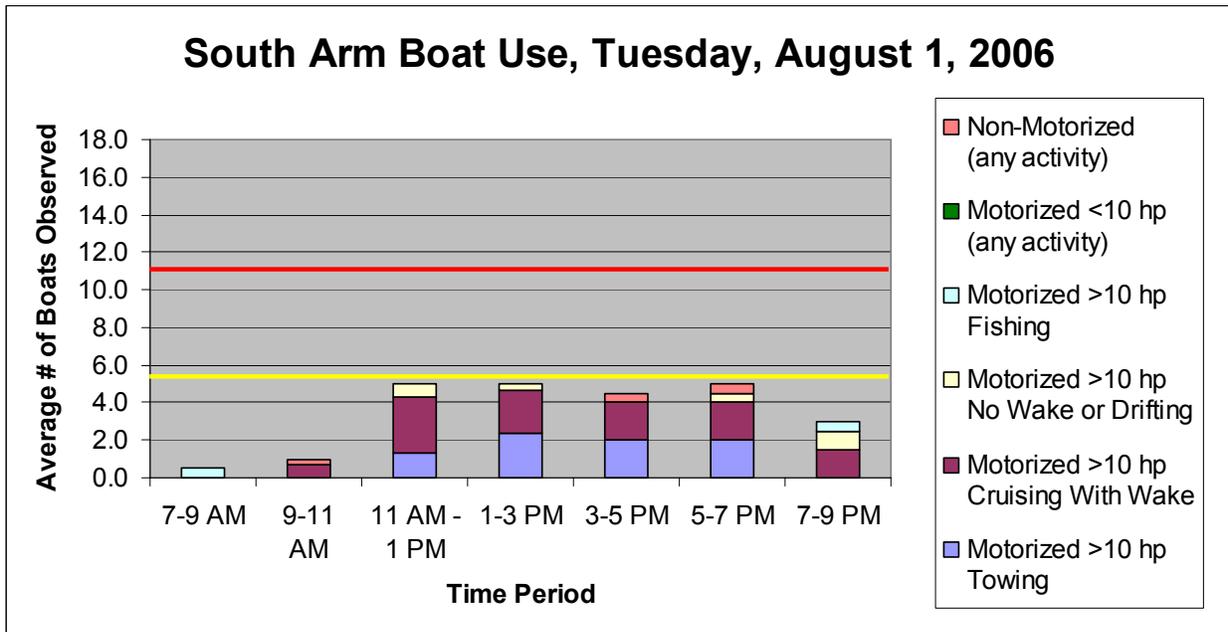
Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	0.0	0.0	1.7	1.0	0.5	1.0	0.5
Motorized >10 hp Cruising With Wake	0.0	0.7	1.0	0.3	1.5	1.0	0.0
Motorized >10 hp Cruising Without Wake or Drifting	0.0	0.3	0.3	0.7	0.5	0.0	2.5
Motorized >10 hp Fishing	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Motorized (any activity)	0.0	0.0	0.7	0.0	0.5	0.0	0.0
Notes:							



Lake Lure Boat Survey

Area of Survey: South Arm Date of Survey (mm/dd/yy): 8/1/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday **Tuesday** Wednesday Thursday Friday Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	0.0	0.0	1.3	2.3	2.0	2.0	0.0
Motorized >10 hp Cruising With Wake	0.0	0.7	3.0	2.3	2.0	2.0	1.5
Motorized >10 hp Cruising Without Wake or Drifting	0.0	0.0	0.7	0.3	0.0	0.5	1.0
Motorized >10 hp Fishing	0.5	0.0	0.0	0.0	0.0	0.0	0.5
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Motorized (any activity)	0.0	0.3	0.0	0.0	0.5	0.5	0.0
Notes:							

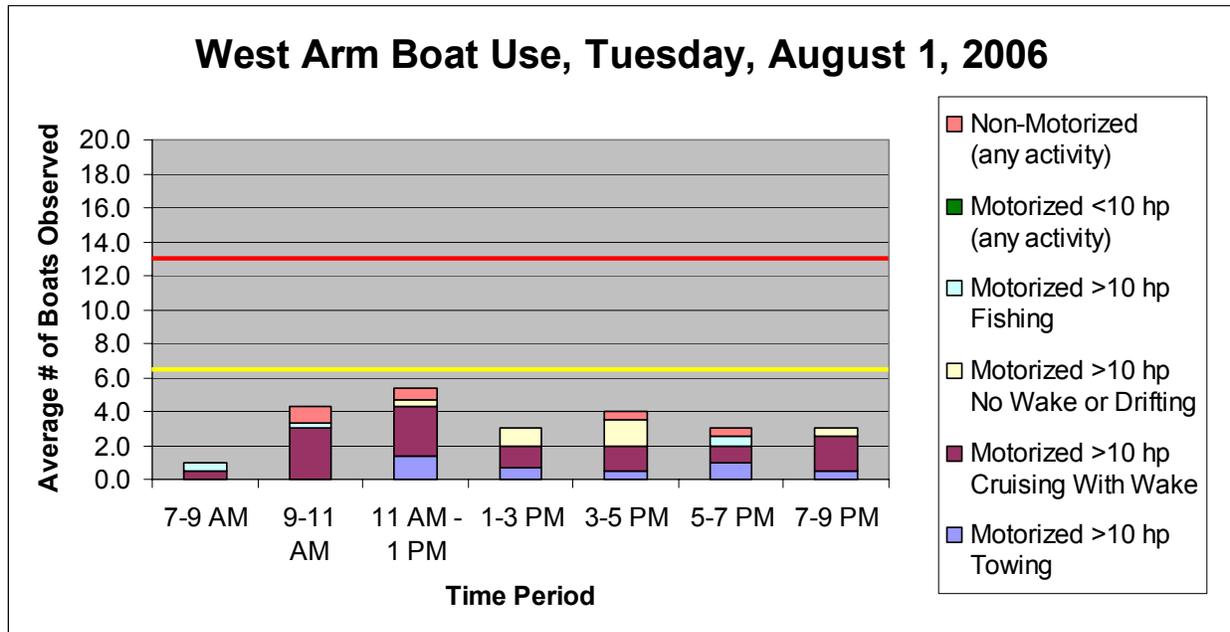


Lake Lure Boat Survey

Area of Survey: West Arm Date of Survey (mm/dd/yy): 8/1/2006 Observer: Wiggins

Day of Week: (circle day of week) Monday **Tuesday** Wednesday Thursday Friday Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Boats Observed							
Motorized >10 hp Towing	0.0	0.0	1.3	0.7	0.5	1.0	0.5
Motorized >10 hp Cruising With Wake	0.5	3.0	3.0	1.3	1.5	1.0	2.0
Motorized >10 hp Cruising Without Wake or Drifting	0.0	0.0	0.3	1.0	1.5	0.0	0.5
Motorized >10 hp Fishing	0.5	0.3	0.0	0.0	0.0	0.5	0.0
Motorized <10 hp (any activity)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-Motorized (any activity)	0.0	1.0	0.7	0.0	0.5	0.5	0.0
Notes:	Very hot and humid; high heat index						



Lake Lure Boat Survey

Area of Survey: North Arm Date of Survey (mm/dd/yy): 8/11/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday **Friday** Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)					Overcast	Overcast	Overcast
Boats Observed							
Motorized >10 hp Towing					4.0	2.0	1.0
Motorized >10 hp Cruising With Wake					7.0	6.0	1.0
Motorized >10 hp Cruising Without Wake or Drifting					7.0	2.0	0.0
Motorized >10 hp Fishing					0.0	0.0	0.0
Motorized <10 hp (any activity)					1.0	0.0	0.0
Non-Motorized (any activity)					1.0	0.0	0.0
Notes:	Scattered drizzles PM						

Lake Lure Boat Survey

Area of Survey: Dam Arm Date of Survey (mm/dd/yy): 8/11/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday **Friday** Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)					Overcast	Overcast	Overcast
Boats Observed							
Motorized >10 hp Towing					4.0	0.0	0.0
Motorized >10 hp Cruising With Wake					0.0	0.0	0.5
Motorized >10 hp Cruising Without Wake or Drifting					0.0	1.0	0.5
Motorized >10 hp Fishing					0.0	0.0	0.0
Motorized <10 hp (any activity)					0.0	0.0	0.0
Non-Motorized (any activity)					0.0	0.0	0.0
Notes:	Scattered drizzles PM						

Lake Lure Boat Survey

Area of Survey: South Arm Date of Survey (mm/dd/yy): 8/11/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday **Friday** Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)					Overcast	Overcast	Overcast
Boats Observed							
Motorized >10 hp Towing					2.0	1.0	0.0
Motorized >10 hp Cruising With Wake					2.0	2.0	0.0
Motorized >10 hp Cruising Without Wake or Drifting					1.0	0.0	1.5
Motorized >10 hp Fishing					0.0	0.0	0.0
Motorized <10 hp (any activity)					0.0	0.0	0.0
Non-Motorized (any activity)					0.0	0.0	0.0

Lake Lure Boat Survey

Area of Survey: West Arm Date of Survey (mm/dd/yy): 8/11/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday **Friday** Saturday Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)					Overcast	Overcast	Overcast
Boats Observed							
Motorized >10 hp Towing					2.0	2.0	0.5
Motorized >10 hp Cruising With Wake					3.0	3.0	1.0
Motorized >10 hp Cruising Without Wake or Drifting					0.0	1.0	1.0
Motorized >10 hp Fishing					0.0	0.0	0.0
Motorized <10 hp (any activity)					0.0	0.0	0.0
Non-Motorized (any activity)					0.0	0.0	0.0
Notes:	Scattered drizzles PM						

Lake Lure Boat Survey

Area of Survey: North Arm Date of Survey (mm/dd/yy): 8/12/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday **Saturday** Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Rain	Rain	Rain	Drizzle Rain	Overcast Drizzle	Overcast	
Boats Observed							
Motorized >10 hp Towing			0.0	1.0	1.0	1.0	
Motorized >10 hp Cruising With Wake			0.0	0.5	1.0	1.0	
Motorized >10 hp Cruising Without Wake or Drifting			0.0	0.0	0.5	1.0	
Motorized >10 hp Fishing			0.0	1.5	1.5	2.0	
Motorized <10 hp (any activity)			0.0	0.0	0.5	0.0	
Non-Motorized (any activity)			0.0	1.0	0.5	0.0	
Notes:	Heavy rains night before; off and on rain showers through most of the day;						

Lake Lure Boat Survey

Area of Survey: Dam Arm Date of Survey (mm/dd/yy): 8/12/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday **Saturday** Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Rain	Rain	Rain	Drizzle Rain	Overcast Drizzle	Overcast	
Boats Observed							
Motorized >10 hp Towing			0.0	0.0	0.5	0.0	
Motorized >10 hp Cruising With Wake			0.0	0.0	0.5	0.0	
Motorized >10 hp Cruising Without Wake or Drifting			0.0	0.0	0.0	0.0	
Motorized >10 hp Fishing			0.0	0.0	0.0	0.0	
Motorized <10 hp (any activity)			0.0	0.0	0.0	0.0	
Non-Motorized (any activity)			0.0	0.0	0.0	0.0	
Notes:	Heavy rains night before; off and on rain showers through most of the day;						

Lake Lure Boat Survey

Area of Survey: South Arm Date of Survey (mm/dd/yy): 8/12/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday **Saturday** Sunday

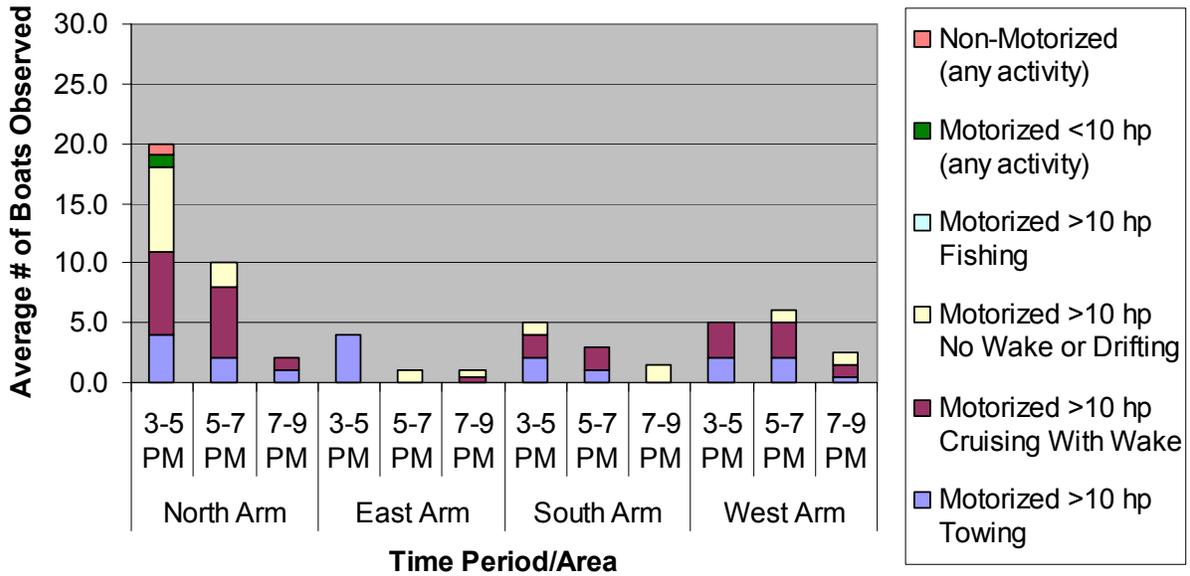
Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Rain	Rain	Rain	Drizzle Rain	Overcast Drizzle	Overcast	
Boats Observed							
Motorized >10 hp Towing			0.0	1.0	2.0	0.0	
Motorized >10 hp Cruising With Wake			0.0	0.0	1.0	1.0	
Motorized >10 hp Cruising Without Wake or Drifting			0.0	0.0	1.0	0.0	
Motorized >10 hp Fishing			0.0	0.5	0.0	0.0	
Motorized <10 hp (any activity)			0.0	0.0	0.0	0.0	
Non-Motorized (any activity)			0.0	0.0	0.0	0.0	
Notes:	Heavy rains night before; off and on rain showers through most of the day;						

Lake Lure Boat Survey

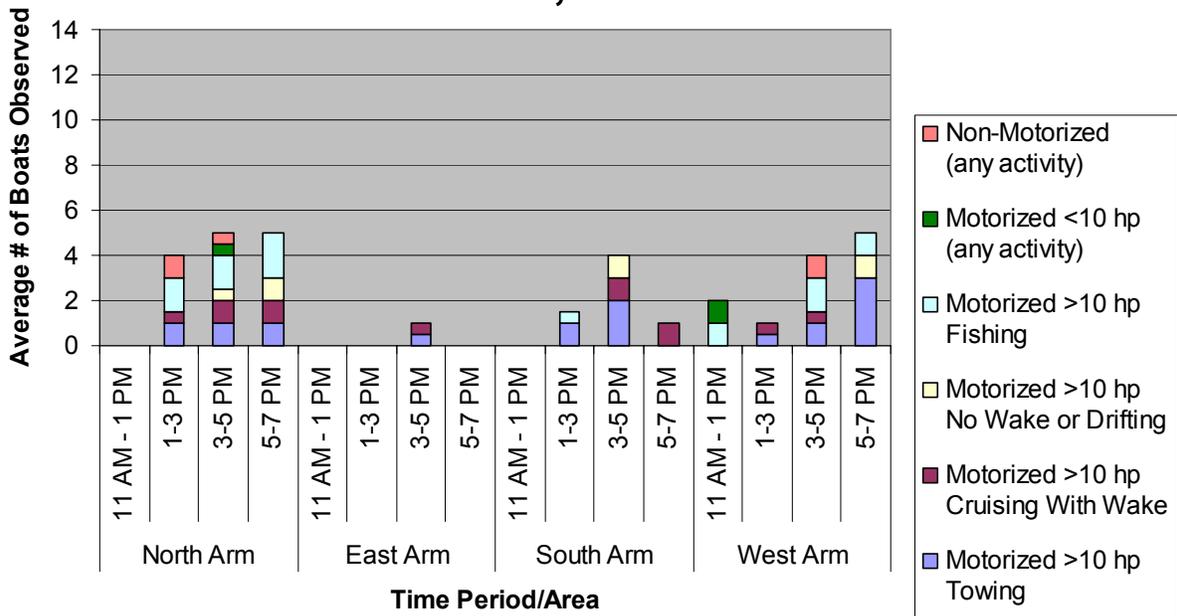
Area of Survey: West Arm Date of Survey (mm/dd/yy): 8/12/2006 Observer: Wiggins
 Day of Week: (circle day of week) Monday Tuesday Wednesday Thursday Friday **Saturday** Sunday

Time Period: (enter data below time slot)	7-9 AM	9-11 AM	11 AM - 1 PM	1-3 PM	3-5 PM	5-7 PM	7-9 PM
Weather: (circle conditions)	Rain	Rain	Rain	Drizzle Rain	Overcast Drizzle	Overcast	
Boats Observed							
Motorized >10 hp Towing	0.0		0.0	0.5	1.0	3.0	
Motorized >10 hp Cruising With Wake	0.0		0.0	0.5	0.5	0.0	
Motorized >10 hp Cruising Without Wake or Drifting	0.0		0.0	0.0	0.0	1.0	
Motorized >10 hp Fishing	0.0		1.0	0.0	1.5	1.0	
Motorized <10 hp (any activity)	0.0		1.0	0.0	0.0	0.0	
Non-Motorized (any activity)	0.0		0.0	0.0	1.0	0.0	
Notes:	Heavy rains night before; off and on rain showers through most of the day; 7-9 am observation from L. Pitts						

Boat Use in All Areas, Friday, August 11, 2006



Boat Use in All Areas, Saturday, August 12, 2006



APPENDIX C
DECISION DOCUMENT
NOVEMBER 2006

Decision Framework for Lake Lure Boat Management

Objective #1: Prevent crowding beyond safe density.

Primary Option: Limit number of permits for boats >10 hp. Based on experience and data for Lake Lure, 1000 peak season permits can be issued. It is unlikely that more than 1100 permits can be issued. 15 weekly permits count as 1 peak season permit. Permits issued in 2005 and 2006 <1000, so not restricting anyone yet. Start with 1000 permits, perform boat surveys when limit is reached, determine if average boat density on nice weather, summer weekends and holidays has noticeably increased. If not, may be able to add 25-50 permits. Repeat study until 10 ac/boat threshold is crossed at unacceptable level (happened in one 2-hr period over 3 days of observation in 2006; suggest threshold at one 2-hr period on all 3 days of observation going forward).

Auxiliary Options: Boating operator training/licensing may limit the number of boats on the lake by virtue of need for trained operator at all times. Although there is no limit on how many operators become trained, this may limit access by transient potential boaters, allowing more permits to be offered with no increase in actual boat density, on average. Additionally, a transferable permit could be issued to all holders of multiple permits for boats >10 hp, ensuring that only one boat could be used on the lake during peak season weekends and holidays.

Benefits: Maintains overall boat use pattern at something approximating the current level, which is only unacceptable on a few days of the year. The targeted limit of 1000 non-commercial permits for boats >10 hp has not been reached in recent years, so no one currently holding a permit has to be denied one. Ability to offer more permits is tied to measurement of boat density, which is linked to safety. Use of transferable permit provides some equity among boaters.

Drawbacks: With as many as 800 more lots to be built upon near the lake, there could be more potential users than the maximum number of conceivable permits. At some point, someone will be denied a permit under this system while neighbors can renew theirs (some of which may hold multiple permits). Additionally, a shift to linking permits to dwellings may prevent current landowners without dwellings from getting a permit, unless grandfathered. It is not clear that multiple permit holders currently use more than one boat at once, so the transferable permit may not actually limit peak boat density.

Objective #2: Maximize boating safety on the lake at all times, independent of boat density.

Primary Option: Education and training of boat operators. Require all operators to complete a boat operation and safety course, either a standard course like that offered by the Coast Guard or a specific course developed for Lake Lure. Provide information on local rules and courtesy policies, and require a signature on a form acknowledging that the operator understands these rules and policies. Provide trained operators with a Lake Lure Boating License.

Auxiliary Options: Require a trained operator to be on any boat >10 hp whenever it is operated. Require anyone under the age of 16 (trained or not) to be accompanied by a trained operator 16 years of age or older.

Benefits: Knowledge of safe operating procedures and the local rules governing operation on Lake Lure should minimize risk of accidents. Making operators responsible for the activities on the boats they operate will increase safe behavior, and may transfer some liability to those operators.

Drawbacks: Not everyone who completes a boating safety course is a competent operator. Physical skills and judgment will vary. Risk will be minimized but not eliminated.

Objective #3: Maximize safety when crowding does occur, as some periods of elevated boat densities appear unavoidable.

Primary Option: Establish a rule that boats moving at more than “headway” speed (can be defined as no wake or a specified speed limit, typically 6 mph) must remain >75 ft from any other boat or person (swimmer, downed skier, etc.). Where boat density increases to a potentially unsafe level, this will restrict high speed activities, eliminating towing and faster cruising.

Auxiliary Options: None recommended; a ban on towing or establishment of a speed limit on summer weekends and holidays appears to be an unacceptable option, as it would restrict privileges unnecessarily much of the time.

Benefits: Allows access and many activities, but limits the highest risk uses when boat densities are too high to support that risk.

Drawbacks: Requires enforcement, limits freedom.

Objective #4: Maximize adherence to boating rules on Lake Lure.

Primary Option: Provide appropriate enforcement. Based on documented use pattern, a patrol boat should be on the lake at all times from 11 AM to 7 PM on nice weather, summer weekends or holidays. The patrol boat can be on the lake less continuously at other times and on other days. Enforcement should focus on education of boaters and record keeping for infractions, with fines or other actions directed against repeat offenders.

Auxiliary Options: Provide a call in number for citizens to contact the enforcement agency or lake operations director to report observed violations. Respond to notification within 30 minutes. Keep records of calls to track both offense frequency and possible abuse of the system. Additionally, consider a “license plate” system (to replace stickers) that would provide more information to enforcement officers.

Benefits: Done properly, patrol presence will both increase safety and give the boating community a sense of security. Over time, boaters will learn to adhere to the rules or be subject to fines or removal from the lake. Allowing reporting of infractions and being able to identify specific boats and owners by their license plates will increase effectiveness and accountability.

Drawbacks: Enforcement requires a complicated blend of authority, teaching, and relationship building in a situation like this. Exact measurements (as with distance from shore or between boats, or for speed or wake generation) will not be made on any regular basis, so judgment is involved and disputes are likely. A gradual phase in period is needed. Some shoreline residents may use the call in system to discourage use of the lake near their properties.

Objective #5: Maximize opportunity for boaters on Lake Lure while recognizing necessary safety limits.

Primary Option: Offer weekday only permits during the peak season. There is unused capacity during the week (except on holidays); at least a 25% increase in traffic by boats >10 hp could be sustained with minimal increase in risk. An initial limit of 250 weekday only permits is suggested.

Auxiliary Options: Make “Weekly Permits” a weekday only permit. Also, if pressure to get more boats >10 hp on the lake increases beyond what the permit system can accommodate, it would be advantageous to establish a “yacht club” with community owned boats that could be signed out by members. This would come out of the commercial allocation of acre-hours (with possible expansion of that allocation), and would provide opportunity for those who can’t get or

don't want boat permits but would like to use the lake for higher speed activities. The community ownership concept allows much greater predictability and control with regard to boat density and operator safety.

Benefits: Prevents increases in weekend and holiday boat densities while providing access and opportunity to would-be users.

Drawbacks: Prevents use during days when people are most likely to want to use the lake. Also may diminish the weekday experience for those who enjoy less crowded conditions at that time.