

Recreational Carrying Capacity in Lakes

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Indiana's lakes and reservoirs offer a great escape from everyday life. No one wants that escape to include traffic jams at the boat ramp, excess noise, or collisions. As lake use increases, environmental quality, user enjoyment, and safety may decrease. In the long run, less enjoyable, unhealthy lakes can translate to economic losses in the recreation and tourism industries and declining property values. To keep our lakes available for multiple uses, it's helpful to learn about their recreational carrying capacity.

Recreational carrying capacity is “the amount of development and activity a body of water can handle before it starts to deteriorate,” as defined by Jacquie Colburn of the New Hampshire Department of Environmental Services. On one hand, it's a simple concept that becomes clear to any recreationist attempting to use an overcrowded lake. However, determining the optimum use level for a lake is a complex process, which may vary from lake to lake. The general steps to determine carrying capacity are: census watercraft use, define goals, develop and apply a carrying capacity formula, and develop a plan to optimize use.



An overcrowded lake.

Source: Wisconsin Lakes Partnership

Watercraft census: get to know your lake

A watercraft census is a tool for learning about the peak level of recreational use, the types of use in demand, and the mix of public and private access. One way to conduct a census is to make observations at various times during the boating season. Observers should count number of boats on the lake, type of each boat (e.g. fishing, high-speed, personal watercraft), and the boat's approximate speed (stationary, no wake, or wake-producing speed). A census that captures activity at several points in time will provide the most accurate picture of actual usage.

Define goals: how to know what “too much” means

No carrying capacity formula is right for every lake. The demand for various activities and the condition of the lake must be considered to set realistic goals and standards. One factor to consider is the ecological or aesthetic value of the lake, which may not be captured in a boater survey. Perceptions of crowding may vary based on the history, remoteness, type of recreation, and public or private nature of the lake. Before evaluating carrying capacity, therefore, it is important to decide which interests must be protected, and what unacceptable consequences should be avoided.

For example, a boat carrying capacity on Marsh Lake, a fishing lake, would have a lower carrying capacity than Lake Tippecanoe, primarily a boating lake.

Boater surveys or questionnaires are tools that can shape these decisions. For example, lake managers on Lake Ripley in Wisconsin learned that increased safety risks, high chance of user interference, and high

probability of environmental harm were areas of concern for lake users, and focused their carrying capacity study on preventing these conditions.

Calculating carrying capacity: putting it all together

The next step in the process is to combine lake uses and goals with lake characteristics to calculate carrying capacity. The steps to follow include:

- 1) Calculate the **Useable Surface Area** of the lake. In Indiana, this should exclude areas within 200 feet of the shoreline, which are designated idle zones. Swimming areas, no-wake zones, sensitive habitat, and shallows (less than 5 feet deep) should also be subtracted from the lake's surface area.
- 2) Determine the minimum space required for each use. Space requirements estimated in past studies vary (Table 1), so it is important to look at studies that represent the conditions and type of use on the lake of interest. Multiply the minimum spatial requirement for a use type (e.g., high speed use) by the proportion of boats engaged in this activity. Add up the spatial requirements for each use to estimate the **Optimum Boating Density**, or average number of acres each boat needs. It's a good idea to build in a safety factor for high-use periods.
- 3) Determine the **Recreational Carrying Capacity** by dividing Useable Lake Area by the Optimum Boating Density (Table 2).
- 4) Compare the Recreational Carrying Capacity to the actual level of use found in the watercraft census.

Table 1. Summary of reported figures related to optimum boating density

Source	Boating Uses	Suggested Density
Ashton (1971)	All uses combined – Cass Lake	5-9 acres/boat
	All uses combined – Orchard Lake	4-9 acres/boat
	All uses combined – Union Lake	6-11 acres/boat
Kusler (1972)	Waterskiing & all other uses	40 acres/boat
	Waterskiing only	15-20 acres/boat
Jackson et al. (1989)	Waterskiing & motorboat cruising	20 acres/boat
	Fishing	10 acres/boat
	Canoeing, kayaking, sailing	8 acres/boat
	All uses combined	10 acres/boat
Wagner (1991)	All boating activities	25 acres/boat
Warback et al. (1994)	All motorized uses (>5HP)	30 acres/boat

Table 2. Example of calculating carrying capacity for a hypothetical 400-acre lake having 300 usable acres.

Information	Source	Example
Lake-Use Mix	Watercraft Census	50% Idle speed/stationary, 50% Fast-moving uses
Optimum Boating Density	Figures reported in the literature, boating safety rules	$(0.5 * 20 \text{ acres/boat}) + (0.5 * 10 \text{ acres/boat}) = 15 \text{ acres/boat}$
Useable Lake Area	Lake map and goals for preservation	300 acres
Recreational Carrying Capacity	Divided usable lake area by optimum boating density	$300 \text{ acres} / 15 \text{ acres/boat} = 20 \text{ boats}$

Throughout this process, it is important to keep in mind any special conditions that may cause you to adjust your calculations. For example, The Lagrange County and Steuben County Lakes Councils recently formed a joint committee to investigate carrying capacity on area lakes. The committee decreased the optimum boating density for Lake James because the presence of multiple uses, irregular shoreline, and lack of open water creates a greater chance of boater interference. This

study mentions several other factors that can guide studies of recreational carrying capacity.

Developing a plan

If actual lake use exceeds the carrying capacity for the lake, or may do so in the future, you will need a plan of action to keep use at a reasonable level. Lake managers and enthusiasts can work with state and local authorities to set policies that will protect their lakes.

In Indiana, regulations limiting the amount or type of boating activity require the authority of IDNR and State legislators. Speed limits decrease the space required per boat, allowing more boats to safely use the lake. Lake zoning ordinances allot a time or area of the lake for different uses. For example, a no-wake or low-speed period can be established for part of each day or on selected days.

Limiting public access may be necessary to keep recreational use below carrying capacity. Limited parking at landings affects the number of boats launched at public access sites, if convenient parking is not available elsewhere. Thus, carrying capacity should be considered in decisions to develop public access areas.

Because private access can contribute to overuse, zoning and pier regulations may help limit expansion of lake use to excessive levels. Land-use zoning or other policies can limit high density shoreline development and “keyhole” or “funnel” development patterns that may push lake use above carrying capacity (See Water Column, Spring 2006).

From problem to opportunity

No doubt, determining the carrying capacity of a lake and deciding how to prevent overcrowding will inspire some disagreement. However, studying a lake’s recreational carrying capacity can bring lake users and managers together, with the ultimate goal of increasing all users’ enjoyment of the lake. They can be involved through public meetings, surveys, or volunteering to help with the study. Assessing carrying capacity is a measure to protect lake users. The more they can be involved in finding ways to do this, the better the solution will be.

For more information:

See examples of Recreational Carrying Capacity Studies for:

- Lake James and Lake Gage, Steuben County, IN: <http://www.lagrangecountylakescouncil.org>
- Lake Ripley, WI: www.lakeripley.org
- Pine, Upper Crooked, Gull, & Sherman Lakes, MI:
<http://www.kbs.msu.edu/ftwrc/publications/Carryingcapacity.pdf>