BOATING

RECREATIONAL

rivers-rapids-streams-ponds-lakes-
sailboats-sloops-ketches-yawls-schooners-catboats-catamarans-trimarans-
motorboats-pontoon boats-houseboats-cruisers-fishing-runabouts-racing-speedboats-rowboats-rafts-kayaks-canoes



# Michigan Great Lakes Recreational Boating

a synthesis of current information



Daniel J. Stynes & Donald F. Holecek

MICHIGAN SEA GRANT—MICHU-SG-82-203

# MICHIGAN GREAT LAKES RECREATIONAL BOATING

## A SYNTHESIS OF CURRENT INFORMATION

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ABSTRACT

Based upon boat registration statistics, statewide boating surveys, marina inventories, and boating research in Michigan, this report summarizes information on Great Lakes recreational boating in Michigan from research and planning studies conducted prior to 1980. Information is reported in four major areas: (1) boat registration and use, (2) marina facilities, (3) economics of boating activity, and (4) boating and fuel use. Boating statistics are based upon boat registration data, recreational boating surveys conducted between 1965 and 1977, a 1977 marina inventory, and a number of boating research studies. An annotated bibliography summarizes 23 major boating studies conducted between 1967 and 1979.

Michigan has led the nation in the number of registered boats for many years. Just under 600,000 craft were registered in Michigan in 1980. The 1977 recreational boater survey estimated over 13 million boat days in Michigan during that year. This figure does not include boating by unregistered craft. About one third of this activity took place on the Great Lakes and connecting waters. Southeastern Michigan generates and receives about half of all Great Lakes boat days in the state. This region also contains half of the state's 27,000 Great Lakes boating slips. Great Lakes boaters spent about $176 million in 1980 on craft purchases, maintenance, equipment, and trip expenditures. Including indirect effects, it is estimated that Great Lakes boating contributes $313 million annually to Michigan's economy. The average boat consumes about 130 gallons of fuel in a year. Marine fuel accounts for 1.25% of the state's annual gasoline consumption.

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# INTRODUCTION

Michigan contains 3,200 miles of Great Lakes shoreline. This important resource provides a variety of recreational opportunities to the residents of Michigan and neighboring states. The resulting recreation and tourism activity in coastal communities contributes significantly to local economies and more generally to the quality of life in Michigan.

The presence of water has been found to be of considerable importance to most types of summer recreation activity. The Great Lakes resource therefore attracts many different types of people for recreation ranging from obvious water-based activities (swimming, fishing, and boating) to more general recreation activity (sightseeing, picnicking, and hiking) to specialized activities (hang gliding, riding off road vehicles). The Great Lakes shoreline is also a magnet for second home developments, condominiums, resorts, and tourist activity in general.

The magnitude and variety of activity within the Great Lakes coastal zone requires planning and management in order to maximize the social, economic, and environmental benefits from this resource while minimizing costs and use conflicts. Planning and management must be based upon information provided by research.

The Michigan Sea Grant program instituted a program of research in 1979 dealing with recreation and tourism in the Great Lakes coastal zone. The purpose of this program is to advance our knowledge of recreational activity along Michigan's Great Lakes shoreline and to provide information through Sea Grant's Advisory Service and Educational programs to managing and planning authorities, private and commercial interests, and individual recreationists.

One of the initial projects in this program involves a comprehensive statewide study of Great Lakes boating in Michigan. Boating was selected for

study for several reasons:

(1) Boating is one of the most important Great Lakes recreation activities,

(2) Boaters are more easily identified than many other recreationists since boats are registered in Michigan,

(3) A considerable body of boating research in Michigan already exists from which to draw, including a substantial data base,

(4) Boating groups had expressed a need for further research,

(5) Previous research suggests that boating has considerable economic impacts,

(6) Increasing energy costs, proposed recreation travel restrictions, inflation, unemployment, and other factors indicated possibly significant changes in boating activity and patterns in the 1980's.

While a greal deal of boating research has been done (probably more than any other recreation activity in Michigan with the possible exception of camping), potential users of this research are largely unaware of it. Much of this research is not readily available, and not assembled in a form that managers can easily digest and apply. Much of the data that has been collected has not been fully analyzed or evaluated.

This state of affairs provided two excellent opportunities: first, to pull together past research and data on Great Lakes boating in Michigan to provide a usable state-of-the-art report; and second, to use the existing data base to test refinements in planning methods and models that might be generalized to other important Great Lakes recreation activities. This report provides a synthesis of knowledge about Great Lakes boating in Michigan. It is developed entirely from secondary data sources including further analysis of major data bases. The figures represent information collected prior to 1980 and are based predominantly upon surveys conducted in 1976 and 1977.

## MICHIGAN GREAT LAKES RECREATIONAL BOATING INFORMATION

There has been no study that has specifically examined Great Lakes boating in Michigan on a statewide basis. What we know about recreational boating on Michigan Great Lakes must be assembled from four primary sources:

(1) National and regional studies. In some respects Michigan's Great Lakes boaters are similar to boaters in the North central region and the United States as a whole. The U.S. Coast Guard sponsored major national surveys of boaters in 1973 and 1976. Their survey reports include data on the national boating fleet, boaters, and boating safety. These studies have been summarized in a recent article by Marmo (1980).

The Heritage Conservation and Recreation Service (formerly Bureau of Outdoor Recreation) conducts national recreation surveys which estimate national and regional participation rates in a variety of recreation activities including boating. Their most recent survey conducted in 1977 (USDI, HCRS, 1979) includes data on five different types of boating.

Industry sources of boating information including Nielsen (1976) and Marex (1979) supplement agency sources with consumer information and boat manufacturing and sales statistics at the national level.

The Great Lakes Basin Commission (1975) and Upper Great Lakes Regional Commission (1974) are examples of regional authorities that have sponsored major studies of recreation, including boating, in the Great Lakes region.

(2) Statewide Boating Studies in Michigan. Waterways Division of Michigan's Department of Natural Resources has primary responsibility for statewide

planning related to boating. Their responsibilities include the Public Access Site Program on both inland and Great Lakes and Michigan's Harbors of Refuge on the Great Lakes. In planning for these programs Waterways Division periodically conducts a statewide boater survey. Mailed surveys of registered boaters have been conducted in 1965, 1968, 1971, 1974, and 1977. By using comparable methods each year, the Waterways surveys provide some of the best information on boating trends. These surveys of registered boaters include data on both inland and Great Lakes boating. In this report we extract the Great Lakes boating information.

(3) Statewide recreation studies in Michigan. Every five years, Recreation Services Division of Michigan's DNR conducts statewide recreation participa tion surveys as part of their statewide recreation planning. The most recent studies were conducted in 1972 and 1976 and appear in the State Recreation Plans published in 1974 and 1979 respectively. These surveys examine boating participation along with a variety of other recreation activities. Changes in the survey design make it difficult to establish trends and in general one cannot divide boating data into Great Lakes and inland categories. These studies do, however, help to put boating into a broader recreation context, and provide some checks on the Waterways registered boater surveys. The telephone surveys measure some kinds of boating not captured in studies of registered boat owners, such as boaters who use rental craft. Since these survey reports examine recreation in general, the boating data gathered are often not fully analyzed. We have extracted a subfile of boating participation from the 1976 Michigan Recreation survey and summarized it here for potential users.

(4) Other studies of Great Lakes boating in Michigan. There are a large number of research studies that focus upon particular problems or sites. While these are often difficult to generalize from one place or time to another, collectively they contribute to our knowledge of recreational boating on the Great Lakes. The Recreation Research and Planning Unit at Michigan State University has conducted a number of boating studies, many supported by Waterways Division of Michigan's DNR. These range from analysis of demand for public access sites, to carrying capacity studies, to feasibility and economic impact studies of local marina facilities. The Michigan Sea Grant program has supported research on underwater parks, diving safety, Great Lakes fisheries, coastal zone management, and more recently studies of boating. Since our focus in this report is to summarize statewide data on boating, the numerous site specific and problem oriented research studies are not treated in any depth.

It should be noted that our focus is on Great Lakes recreational boating in Michigan on a statewide basis. Great Lakes boating is defined to include the Great Lakes (Huron, Michigan, Superior, and Erie) and "Connecting waters" (Lake St. Clair and St. Marys, St. Clair, and Detroit Rivers). We will consistently use the abbreviation "GL" to designate "Great Lakes."

Wherever possible we present data on Great Lakes boating for the entire state. In some cases we have had to rely upon national or regional boating information, on boating data that does not distinguish where the activity took place (GL or inland), or upon data from subregions of Michigan or subpopulations of boaters. In these cases the reader should use some caution in applying the information to Great Lakes boating on a statewide basis in Michigan.

A listing of major boating studies of relevance to Michigan appears in Figure 1. Abstracts of these studies are provided in Appendix A.

I. STATEWIDE BOATING STUDIES - WATERWAYS DIVISION, MICHIGAN DNR

Outdoor Recreation Planning In Michigan by a Systems Analysis Approach: Part III: The Practical Application of "PROGRAM RECSYS" AND "SYMAP". Michael Chubb. Technical Report #12. State Resource Planning Program. Michigan Dept. of Conservation. Lansing, Michigan. 1967.

Planning Recreational Boating Facilities in Michigan. James Oakwood and Michael Chubb. Recreation Research and Planning Unit Technical Report #1. Michigan State University. 1968.

1968 Michigan Recreational Boating Study. Michael Chubb. Dept. of Park and Recreation Resources. Michigan State University. 1971.

1971 Michigan Recreational Boating Study. Recreation Resource Consultants. Report No. 2. East Lansing, Michigan. 1972.

1974 Michigan Recreational Boating Study. Recreation Resource Consultants. Report No. 4. East Lansing, Michigan. 1975.

1977 Michigan Recreational Boating Survey. Michigan Department of Natural Resources. Waterways Division. Lansing, Michigan. 1979.

II. NATIONAL, REGIONAL, AND STATEWIDE RECREATION STUDIES

Upper Great Lakes Regional Recreation Planning Study - Part Two: Recreation Demand Survey and Forecasts. Upper Great Lakes Regional Commission. Recreation Resources Center. University of Wisconsin. 1974.

1974 Michigan Recreation Plan. Michigan Department of Natural Resources. Office of Planning Services. Lansing, Michigan. 1975.

Michigan 1976 Recreation Design and Application. Michigan Department of Natural Resources. Recreation Services Division. 1976.

1979 Michigan Recreation Plan. Michigan Department of Natural Resources. Lansing, Michigan. 1979.

The Third Nationwide Outdoor Recreation Plan. Appendix II. Survey Technical Report 2: Survey Methodology and Process. Heritage Conservation and Recreation Service. U.S. Department of the Interior. Washington, D.C. 1979.

III. NATIONAL AND REGIONAL BOATING STUDIES

Great Lakes Basin Framework Study, Appendix No. 19, Recreational Boating. Great Lakes Basin Commission. Ann Arbor, Michigan. 1972.

Lake Michigan Regional Boating Survey and Analysis. Department of the Army, Corps of Engineers. Chicago District. Economic Branch. 1974.

Great Lakes Basin Framework Study: Appendix 21, Outdoor Recreation. Great Lakes Basin Commission. Ann Arbor, Michigan. 1975.

Recreational Boating in the United States in 1973 and 1976: The Nationwide Boating Survey. U.S. Coast Guard. Washington, D.C. 1978.

Energy Conservation Potential of Recreational Activity. Weinblatt, Herbert, and Michael Lawrence. U.S. Department of Transportation, Washington, D.C. 1979.

IV. SELECTED BOATING STUDIES WITHIN MICHIGAN

Public Marina Impact on Local Employment. Recreation Research and Planning Unit. Department of Park and Recreation Resources. Michigan State University. 1971.

1970 Gasoline Consumption for Out-of-State Boaters Operating in Michigan's Great Lakes Waters. Chubb, Michael and Wenner, Kenneth. Department of Park and Recreation Resources. Michigan State University. 1971.

An Analysis of Recreational Boating Expenditures (A Study of Lake Michigan Boaters. Warner, Thomas. M.S. Thesis. Michigan State University. 1974.

Projecting Use of a Proposed New Lake Michigan Marina -- A Spatial Analysis Approach. Han, Chien. Ph.D. Thesis. Michigan State University. 1975.

The Impact of Great Lakes Recreational Boating on the Economy of Michigan. Schott, Robert, M.S. Thesis. Michigan State University. 1975.

An Estimation of User Benefits Associated With the Michigan Public Access Site Program for Inland Lakes. Thomas D. Warner. Ph.D. Dissertation Dept. of Resource Development. Michigan State University. East Lansing. 1976.

Predicting Use Levels for Michigan's Public Access Sites: A Multiple Regression Approach With an Emphasis on Site Attractiveness. James Sluyter. M.S. Thesis. Dept. of Park and Recreation Resources. Michigan State University. East Lansing. 1977.

Figure 1. Michigan Great Lakes Recreational Boating Studies, Selected Bibliography

## OBJECTIVES

This state-of-the-art report on Michigan Great Lakes boating information has been assembled for five primary reasons:

1. To Document previous boating studies in Michigan. Prior to launching additional research it is important to obtain as complete a picture of previous research as possible. Review of prior research helps identify priorities and direction for further study, avoids the costly replication of past studies and mistakes, and provides the background necessary to proceed with a research program.

2. To Summarize boating information for potential users. Assembling what is known is of use to both researchers and practitioners. For many questions past research provides adequate answers. Yet many potential users of boating research are often unaware of what information and publications exist or where to go for information. Research and planning studies generally have uses and applications far beyond the original intentions or clients. By sharing boating information and making it more readily available we increase the benefits of research without adding substantially to the costs. By cataloguing past research in a single document we hope to increase research utilization.

3. To Provide access to boating data bases. A great deal of boating data collected in recent studies has not been fully analyzed. By setting up data bases in a convenient format and summarizing retrieval procedures we hope to encourage further analysis of existing data.

4. To Synthesize and compare existing knowledge about GL boating. The variety of different kinds of boating studies often make it difficult for potential users to interpret or evaluate boating information. By comparing and contrasting different studies we attempt to select out the

most up-to-date and accurate data available and present it in a single document.

5. To Provide direction for future research and data collection efforts. A thorough review of past studies and some experimentation with past data was essential to the design of data collection instruments in the 1980 and 1981 surveys. Studies have been specifically designed to test improved models and planning methods, to reduce data collection costs, and to fill in the gap in economic information related to GL boating. By building upon past research, we hope to advance research on GL boating in Michigan without unnecessary duplication of past efforts.

## OUTLINE OF THE REPORT

The report is divided into four sections:

I. Great Lakes Boating Use Patterns

II. Great Lakes Marina Facilities

III. Boating Economics

IV. Boating and Energy

Information on Great Lakes boating use patterns includes data on registered craft, characteristics of the Michigan boating fleet, characteristics of boat owners, measures of boating activity, and boater travel patterns. A 1977 Inventory of Great Lakes Marina facilities provides data on the numbers of Great Lakes marinas, the number of slips, and their geographic distribution. Comparisons between use data and facilities provides relative measures of needs for additional slips by region.

While fairly good data are available on boating use patterns, few studies have incorporated economic variables into boating studies to provide a picture of boating demand or the values and economic impacts associated with boating.

Those boating economics studies which do exist in Michigan or nationally are difficult to generalize to different areas in Michigan where they might be applied. A statewide boater expenditure and economic impact study is planned for 1981 to fill this gap in Michigan GL boating data. Until this study is completed, adjustments in previous local boating economic studies are provided to give rough estimates of the economic activity associated with boating.

Finally, using both Michigan and national data we provide estimates of energy use (gasoline) associated with boating activity in Michigan. In another Sea Grant project Joseph Fridgen is studying the impacts of changing energy costs on Great Lakes boaters. Here we provide some initial rough estimates based upon national data and some preliminary figures from Fridgen's study. A report dealing specifically with energy and boating will be completed by 1982.

# CHAPTER I

## GREAT LAKES BOATING USE PATTERNS

The preponderance of past Great Lakes boating research looks at the consumer; that is, the Great Lakes boater. By combining registration data with boater socio-economic profiles and boater use patterns, a fairly clear picture of the "demand" side of Great Lakes boating may be assembled. Data sources include registration statistics, household recreation surveys, boater surveys and origin-destination information. Within Michigan, mailed surveys of registered boaters conducted about every three years and general recreation surveys conducted every five years provide the information. Here we draw heavily from the most recent of these surveys, the 1977 Waterways Boater Survey and the 1976 DNR Recreation Survey.

In 1980, Michigan registered almost 600,000 boats, about one for every 16 residents in the state. The most recent boating use statistics are from 1977. In that year an estimated 14 million boat days occurred on Michigan's waters. Of these, about 31 percent took place on the Great Lakes and connecting waters, i.e., about 4.2 million GL boat days (Waterways Division, 1979). Popular boating activities include fishing, pleasure boating, sailing, waterskiing, canoeing, and rowing. Fishing accounts for the largest percentage of boating activity in Michigan. Boating activity is highly concentrated near population centers, especially southeastern Michigan which generates and receives about half of all GL boat days in Michigan. The proximity of GL boating opportunities to most of the Michigan population means that boaters needn't travel far from home to take part in GL boating. Indeed, over half of all GL boat days generated in Michigan occur within 30 miles of home, and over 80% take place within 90 miles of home (Figure 2).

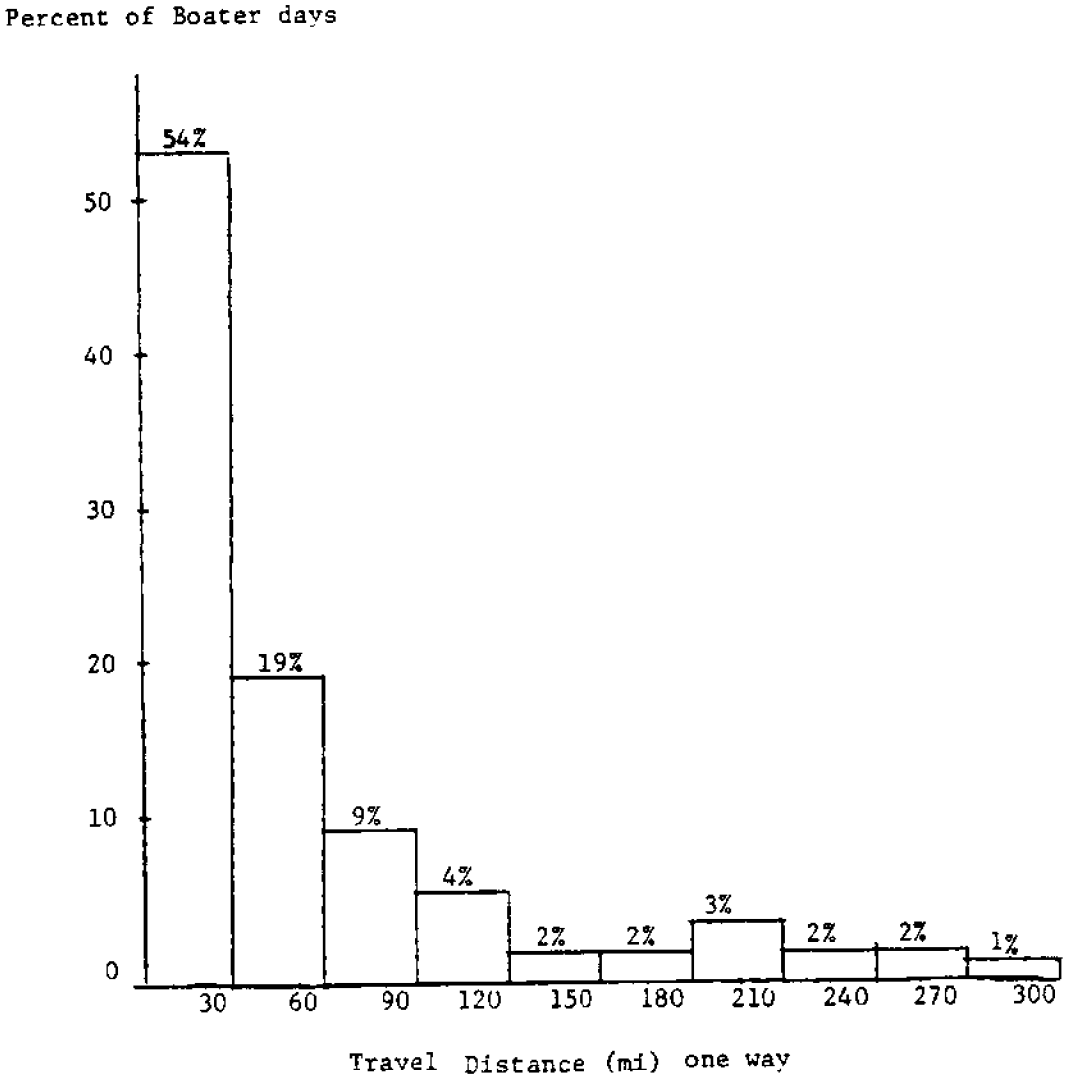



Figure 2 . Distance Decay Curve for Great Lakes Boating

SOURCE: 1977 Michigan Recreational Boating Survey. Analysis of data tapes provided by Waterways Division, MDNR.

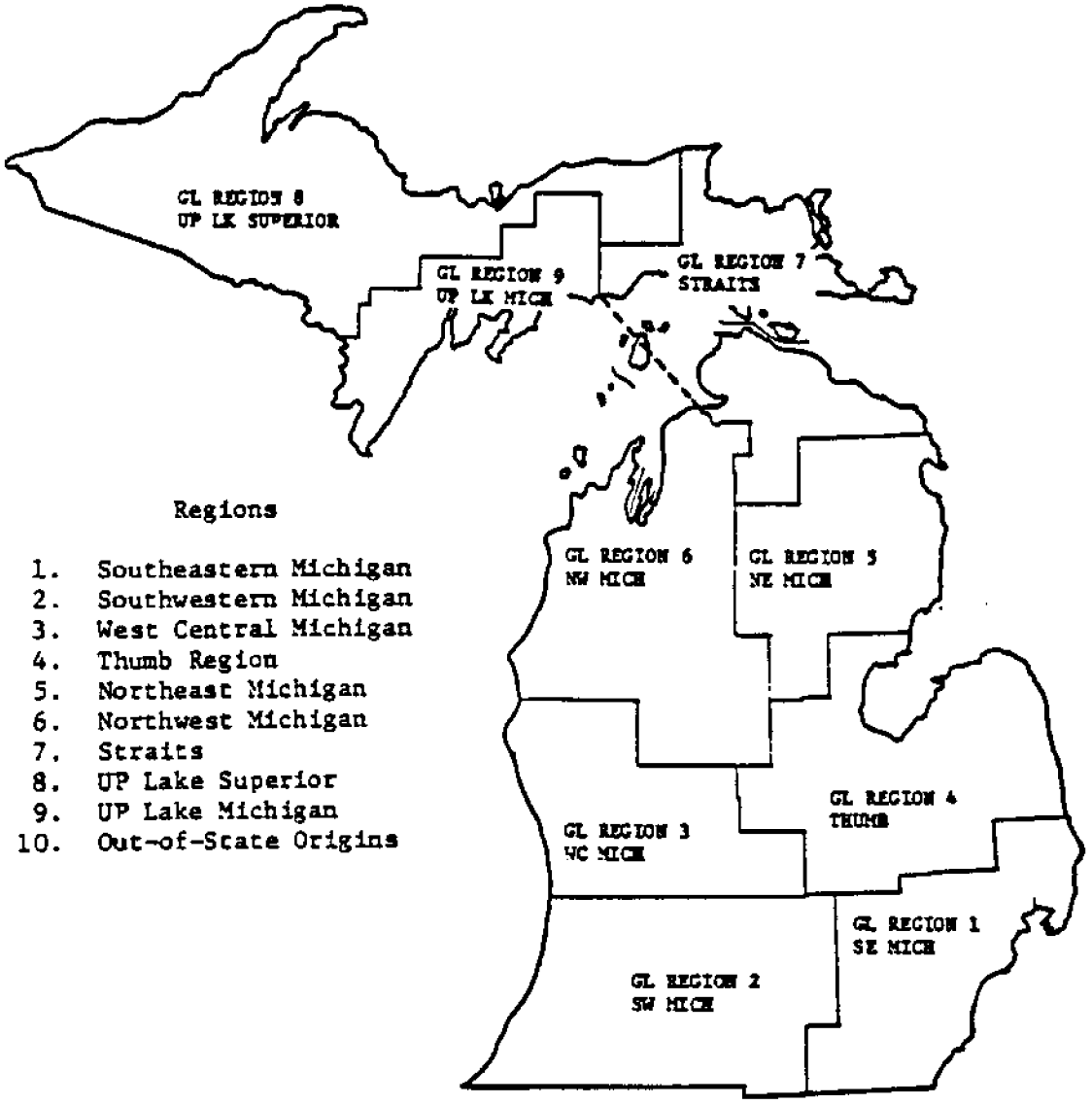
Regionalization

Before presenting use statistics we describe the regionalization to be used throughout this chapter. Michigan includes 14 official Planning and Development Regions.[1] The Department of Natural Resources typically subdivides the Grand Rapids region into two subregions and the Saginaw-Bay City region into three subregions. The Detroit region is also commonly subdivided into three subregions. This yields a total of up to 19 regions. These regions are not particularly well-suited to examination of Great Lakes boating patterns.

In looking at GL boating patterns we were particularly interested in forming "market areas" which would include GL destination counties along with those GL and inland counties which they serve. Further, it was decided that about 10 regions would be fine enough for regional analysis without requiring excessive data collection costs in order to estimate regional statistics.

By analyzing GL boater origin-destination patterns from the 1977 Waterways Division survey (raw data tapes) a new regionalization was developed for analysis of GL boating use patterns. These regions are illustrated in Figure 3. We believe the advantages of this regionalization outweigh possible confusion with other regionalizations, and therefore adopt this regionalization throughout this report. Notice that upper peninsula counties are divided between those using Lake Superior, Lake Michigan, or the "Straits" area. Region 7 includes counties on both sides of the Mackinac straits. Regions in the lower peninsula are divided into east and west by a line almost due south from the straits. Regions on the west side of Michigan tend to extend further inland than those on the east, reflecting a slight westward bias in GL boater patterns. Similarly one sees a northward bias in the shapes of these regions. These GL boating regions will help to portray GL boating use patterns in Michigan.

[1] See Figure C-1 in Appendix C for a map of these regions.




Regions

1. Southeastern Michigan
2. Southwestern Michigan
3. West Central Michigan
4. Thumb Region
5. Northeast Michigan
6. Northwest Michigan
7. Straits
8. UP Lake Superior
9. UP Lake Michigan
10. Out-of-State Origins

Figure 3. Michigan Great Lakes Boating Regions

## MICHIGAN'S REGISTERED BOATING FLEET

Michigan leads the nation in the number of registered boats, accounting for 7.2% of the national fleet (U.S. Coast Guard Boating Statistics, 1980). Michigan's Secretary of State maintains records of registered boats and annually produces summaries of the size and makeup of the boating fleet. This registration information is summarized in this section.

Michigan first began registering recreational boats in 1960. Private, nonpowered small craft such as canoes and row boats do not have to be registered and therefore are not included in the boating statistics. Prior to 1977 boats were registered for three year periods ending in 1968, 1971, 1974, and 1977. After January 1, 1977, registration periods extend three years from the year in which the boat is registered. This revision in the system requires some caution in interpreting trends in numbers of craft since 1977.

### Fleet Size

On December 31, 1980, the Secretary of State reported 595,097[1] registered boats in Michigan. During the period from 1965 through 1977 the numbers of craft increased at almost a constant rate of 3.2% per year (Figure 4). Changes in the registration system beginning in 1977 have caused some fluctuation in this pattern. The fleet increased to a peak of 615 thousand in 1978, dropped to 549 thousand in 1979 and then rose again to 595 thousand in 1980. Smoothing out these fluctuations since 1977 yields an average annual growth rate of less than 1 percent, suggesting a decrease in the rate of growth in the boating fleet.

### Fleet Composition

The present registered boating fleet is divided by size class and boat

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[1]There is some inconsistency in reporting of registrations. The figure we adopt here is based upon annual computer printouts from registration files, however, the Secretary of State reported 617,723 registered craft in 1980 to the U.S. Coast Guard.

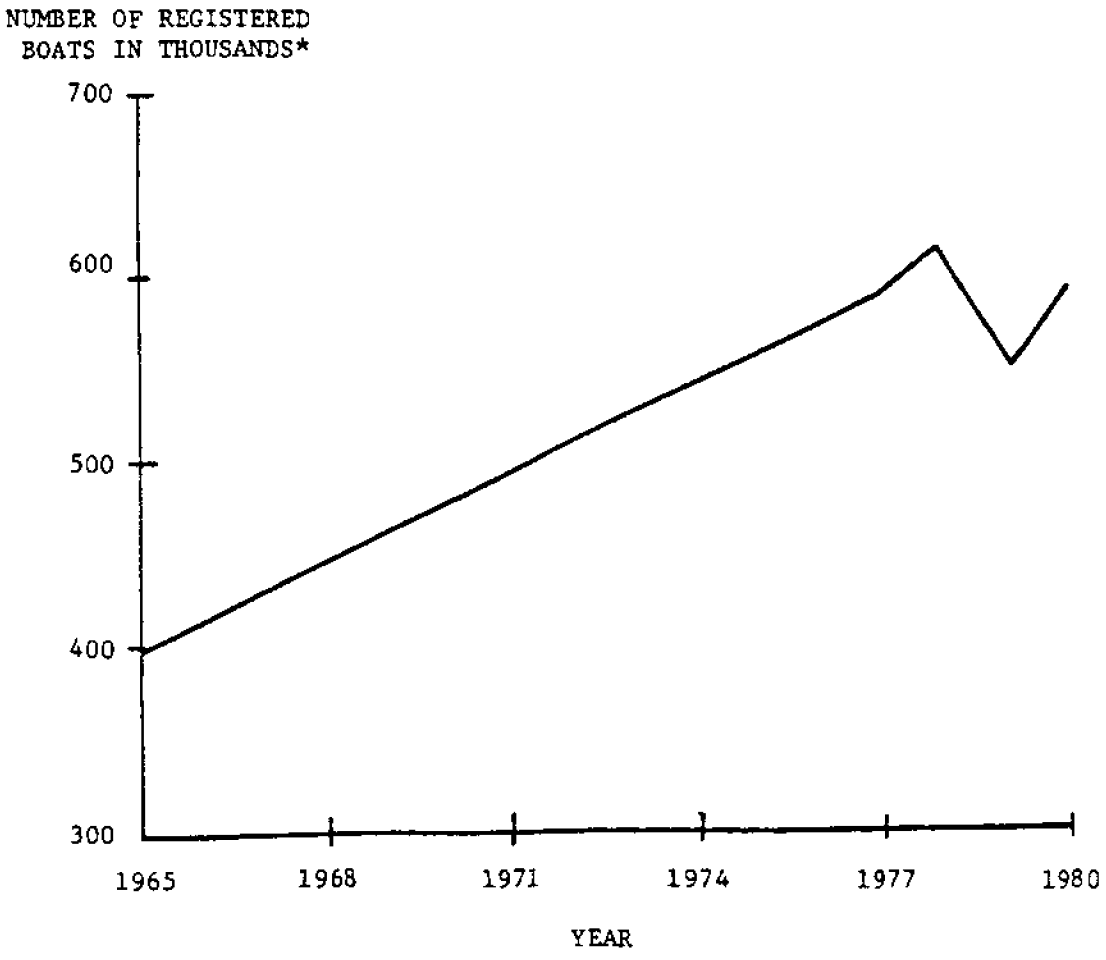


Figure 4. Trends in Registered Boats in Michigan 1965-1980

*Boats registered with Secretary of State on December 31 of the year.

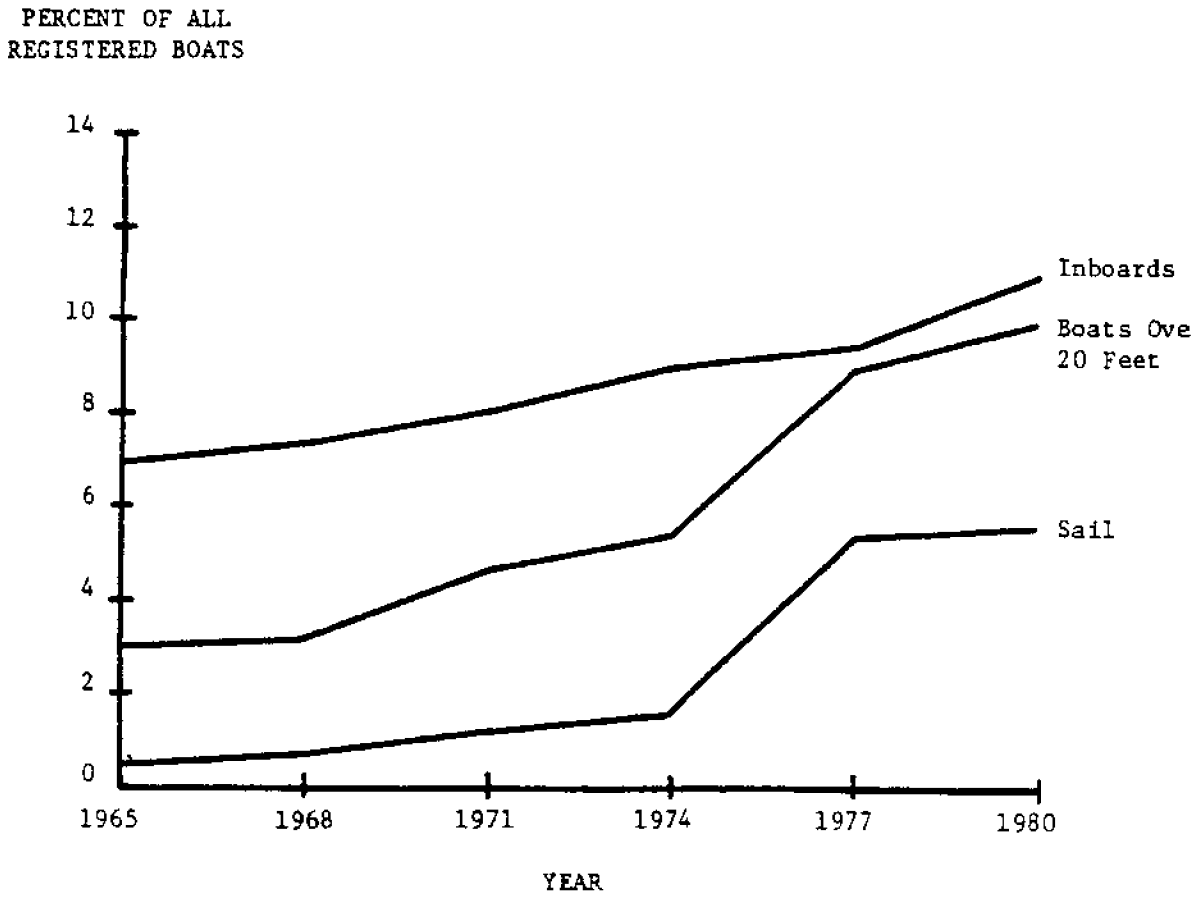


Figure 5. Trends in the Makeup of Michigan's Registered Boat Fleet, 1965-1980

type in Table 1. As the fleet has grown since 1965, some changes have been observed in its makeup. The general trend has been toward larger boats with higher percentages on inboards and sailing craft (Figure 5, Table 2). In spite of these trends, the fleet is still dominated by small outboards, which accounted for 73% of the registered fleet in 1980. Similar trends have been observed in the national boating fleet (Marmo, 1980).

Geographic Distribution

The distribution of registered craft in Michigan parallels population distributions. Wayne, Oakland, and Macomb counties account for almost 30% of Michigan's registered fleet. Kent and Genesee counties each contribute about 5% of the boating fleet. In comparison, northern Michigan counties each account for one percent or less of Michigan's registered boats.

Looking at boat registrations on a per capita basis yields a different picture (Table 3)[1]. Overall there are about six registered boats for every 100 people in Michigan. Northern counties of Mackinac (.28) and Roscommon (.27) have the highest per capita boat ownership with one registered boat for every four people residing in the county. The lowest per capita registration rates occur in counties that are densely populated or have limited nearby boating opportunities. Wayne county, for example, has the largest number of registered boats, but the smallest per capita registration rate. There is about one registered boat for every 33 people in the county. Other counties with per capita registration of .05 or less include Ingham, Lapeer, Macomb, Isabella, Oakland, Sanilac, and Washtenaw (Table 3).

Non-resident registrations account for 3% of the boating fleet. These are mostly from nearby residents of Ohio, Illinois, and Indiana.

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1. These calculations assume all boats are registered in the county of permanent residence of the boat owner. Some boats are registered in the county where the boat is stored, ie. a second home or marina

Table 1. Michigan's Registered Boating Fleet By Size and Type, 1980

| Boat Type | Boat Length: 20 feet and under Number | 20 feet and under Percent | Over 20 feet Number | Over 20 feet Percent | Total | Percent |
|---|---|---|---|---|---|---|
| Inboard | 35677 | 6.00 | 31125 | 5.23 | 66802 | 11.25 |
| Outboard | 433070 | 72.77 | 4658 | .78 | 437728 | 73.56 |
| Sail | 29750 | 5.00 | 1516 | .25 | 31266 | 5.25 |
| Sail/Aux | 1716 | .29 | 98 | .02 | 1814 | .30 |
| Canoe | 11447 | 1.92 | 76 | .01 | 11523 | 1.94 |
| Pontoon | 11597 | 1.95 | 21733 | 3.65 | 33330 | 5.60 |
| Other | 3873 | .65 | 8761 | 1.47 | 13634 | 2.12 |
| Total | 527130 | 88.58 | 67967 | 11.42 | 595097 | 100.00 |

Source: Waterways Division, MDNR

Table 2. Trends in Michigan Registered Boating Fleet, 1965-1980

| Boat Type | 20 feet and under: 1965 | 1980 | Percent Change | Over 20 feet: 1965 | 1980 | Percent Change |
|---|---|---|---|---|---|---|
| | --number of boats-- | | | --number of boats-- | | |
| Inboard | 12,533 | 35,677 | 184 | 15,103 | 31,125 | 106 |
| Outboard | 363,475 | 459,987 | 26 | 4,842 | 35,228 | 627 |
| Sail | 1,755 | 31,446 | 1691 | 1,194 | 1,614 | 35 |
| Total | 377,763 | 527,130 | 39 | 21,139 | 67,967 | 221 |

Table 3. Michigan Boat Registrations by County and Study Region, 1980

| County # | County Name | Registered Boats No.[a] | Registered Boats Per Capita |
|---|---|---|---|
| REGION 1 | | | |
| 46 | Lenawee | 6511 | .07 |
| 47 | Livingston | 7843 | .08 |
| 50 | Macomb | 34372 | .05 |
| 58 | Monroe | 8438 | .06 |
| 63 | Oakland | 52967 | .05 |
| 74 | St. Clair | 9686 | .07 |
| 81 | Washenaw | 12524 | .05 |
| 82 | Wayne | 74850 | .03 |
| TOTAL | | 207191 | .04 |
| REGION 2 | | | |
| 3 | Allegan | 6596 | .08 |
| 8 | Barry | 5882 | .07 |
| 11 | Berrien | 11798 | .07 |
| 12 | Branch | 5852 | .15 |
| 13 | Calhoun | 9822 | .07 |
| 14 | Cass | 7691 | .16 |
| 23 | Eaton | 5949 | .07 |
| 30 | Hillsdale | 3296 | .08 |
| 33 | Ingham | 14323 | .05 |
| 38 | Jackson | 11735 | .08 |
| 39 | Kalamazoo | 15485 | .07 |
| 75 | St. Joseph | 6535 | .12 |
| 80 | Van Buren | 5926 | .09 |
| TOTAL | | 110890 | .08 |
| REGION 3 | | | |
| 19 | Clinton | 4169 | .07 |
| 34 | Ionia | 3537 | .07 |
| 41 | Kent | 31381 | .07 |
| 59 | Montcalm | 4315 | .09 |
| 61 | Muskegon | 11362 | .07 |
| 62 | Newaygo | 3512 | .10 |
| 64 | Oceana | 1618 | .07 |
| 70 | Ottawa | 12643 | .08 |
| TOTAL | | 72537 | .07 |
| REGION 4 | | | |
| 6 | Arenac | 1471 | .10 |
| 9 | Bay | 9271 | .08 |
| 25 | Genesee | 28490 | .06 |
| 29 | Gratiot | 2592 | .06 |
| 32 | Huron | 2619 | .07 |
| 44 | Lapeer | 3727 | .05 |
| 56 | Midland | 6679 | .09 |
| 73 | Saginaw | 15172 | .07 |
| 76 | Sanilac | 1399 | .03 |
| 78 | Shiawassee | 4136 | .06 |
| 79 | Tuscola | 3511 | .06 |
| TOTAL | | 79067 | .07 |
| REGION 5 | | | |
| 1 | Alcona | 1497 | .15 |
| 4 | Alpena | 4269 | .13 |
| 20 | Crawford | 1080 | .11 |
| 26 | Gladwin | 2538 | .13 |
| 35 | Iosco | 3755 | .13 |
| 60 | Montmorency | 1428 | .19 |
| 65 | Ogemaw | 1978 | .12 |
| 68 | Oscoda | 807 | .12 |
| 72 | Roscommon | 4352 | .27 |
| TOTAL | | 21704 | .15 |
| REGION 6 | | | |
| 5 | Antrim | 3393 | .21 |
| 10 | Benzie | 2136 | .19 |
| 15 | Charlevoix | 2856 | .14 |
| 18 | Clare | 2768 | .12 |
| 28 | Grand Traverse | 7543 | .14 |
| 37 | Isabella | 2655 | .09 |
| 40 | Kalkaska | 1436 | .13 |
| 43 | Lake | 860 | .11 |
| 45 | Leelanau | 2908 | .21 |
| 51 | Manistee | 2618 | .11 |
| 53 | Mason | 3170 | .12 |
| 54 | Mecosta | 2994 | .08 |
| 57 | Missaukee | 1055 | .11 |
| 67 | Osceola | 1433 | .08 |
| 83 | Wexford | 2696 | .11 |
| TOTAL | | 40521 | .11 |
| REGION 7 | | | |
| 16 | Cheboygan | 4169 | .20 |
| 17 | Chippewa | 3754 | .19 |
| 24 | Emmet | 3194 | .14 |
| 49 | Mackinac | 2857 | .28 |
| 69 | Otsego | 1753 | .12 |
| 71 | Presque Isle | 2036 | .14 |
| TOTAL | | 17763 | .17 |
| REGION 8 | | | |
| 2 | Alger | 1332 | .14 |
| 7 | Baraga | 789 | .09 |
| 22 | Dickinson | 2401 | .09 |
| 27 | Gogebic | 2252 | .11 |
| 31 | Houghton | 2476 | .07 |
| 36 | Iron | 2200 | .16 |
| 42 | Keweenaw | 262 | .13 |
| 48 | Luce | 1215 | .18 |
| 52 | Marquette | 5232 | .07 |
| 66 | Ontonagon | 1140 | .12 |
| TOTAL | | 19299 | .09 |
| REGION 9 | | | |
| 21 | Delta | 3651 | .09 |
| 55 | Menominee | 2000 | .08 |
| 77 | Schoolcraft | 1514 | .18 |
| TOTAL | | 7165 | .10 |
| STATE TOTALS | | 576137 | .06 |
| REGION 10 | | | |
| OUT OF STATE | | 18960 | |
| TOTALS | | 595097 | .06 |

[a] Boats registered with the Michigan Secretary of State as of December 31, 1980.

## BOATER CHARACTERISTICS

Information about boater demographics is important in managing, planning, and marketing boating services and facilities. This information has not been collected in the recent boater surveys sponsored by Waterways Division, but can be assembled from national boater surveys and data from Michigan's 1976 Recreation Survey. In many respects the Michigan boater is similar to the national boater profile.

### National Boater Profiles

The U. S. Coast Guard boating surveys present boaters as somewhat more educated and from higher income groups than the national average. A 1979 industry study of boaters found boat owning households have a median income of $23,500. Boaters mirror national occupational breakdowns quite closely (Marmo, 1980).

National studies by the U. S. Coast Guard report a decrease in the average age of boat operators from 34 years of age in 1973 to 31.5 years in 1976. Significant increases in the numbers of female boat operators were measured over this 4 year period (U.S. Dept. of Transportation, U.S. Coast Guard, 1978).

### Michigan Boater Profiles

Since boating involves a number of distinct types of activities it is important to divide boaters into distinct activity subgroups to identify demographic profiles. In Table 4, demographic profiles of eight different types of boaters are summarized. This reveals some common characteristics of boaters and some important differences among different types of boaters.

Fishing is popular among all socio-economic groups. Fishermen are somewhat different from other boating groups in that they include higher per-

Table 4 . Socioeconomic Characteristics of Michigan Boaters by Boating Activity

| Socioeconomic Characteristic | All Respondents N=3879 | River Recreation N=266 | Rowing N=95 | Sailing N=307 | Power Boating N=393 | Water Skiing N=427 | Tourist Boat Trip N=54 | GL fish from boat N=448 | IL fis from boat N=134 |
|---|---|---|---|---|---|---|---|---|---|
| GENDER | | | | | | | | | |
| Male | 63 | 58 | 32 | 56 | 53 | 55 | 50 | 83 | 70 |
| Female | 37 | 42 | 68 | 44 | 47 | 45 | 50 | 17 | 30 |
| AGE | | | | | | | | | |
| 1-17 | 20 | 32 | 36 | 25 | 19 | 31 | 9 | 10 | 17 |
| 18-28 | 19 | 35 | 10 | 31 | 16 | 32 | 31 | 10 | 14 |
| 29-43 | 20 | 12 | 26 | 23 | 23 | 25 | 17 | 24 | 17 |
| 44-56 | 20 | 15 | 21 | 18 | 24 | 7 | 24 | 27 | 21 |
| 57-84 | 20 | 6 | 7 | 4 | 18 | 5 | 19 | 28 | 31 |
| EDUCATION | | | | | | | | | |
| Some H.S. or less | 31 | 34 | 41 | 25 | 27 | 35 | 15 | 31 | 32 |
| High School Graduate | 31 | 23 | 16 | 13 | 33 | 24 | 38 | 35 | 37 |
| 1-3 years College | 20 | 16 | 21 | 19 | 23 | 21 | 15 | 20 | 20 |
| College Grad. or more | 18 | 27 | 22 | 43 | 17 | 20 | 32 | 15 | 11 |
| OCCUPATION | | | | | | | | | |
| White Collar | 28 | 31 | 25 | 41 | 36 | 31 | 48 | 25 | 19 |
| Blue Collar | 25 | 20 | 9 | 18 | 20 | 23 | 15 | 32 | 31 |
| Homemaker | 9 | 6 | 28 | 5 | 11 | 2 | 20 | 6 | 8 |
| Student | 21 | 33 | 32 | 31 | 18 | 38 | 7 | 12 | 16 |
| Retired | 13 | 6 | 0 | 3 | 9 | 1 | 7 | 24 | 22 |
| Other | 4 | 4 | 6 | 2 | 6 | 4 | 2 | 0 | 4 |
| INCOME (based on sample of 2613) | | | | | | | | | |
| Less than $7,000 | 12 | 10 | 14 | 3 | 8 | 5 | 9 | 10 | 19 |
| $ 7,000-$ 9,999 | 13 | 18 | 8 | 12 | 8 | 14 | 4 | 17 | 15 |
| $10,000-$14,999 | 28 | 26 | 18 | 11 | 28 | 21 | 26 | 29 | 35 |
| $15,000-$24,999 | 33 | 36 | 53 | 37 | 36 | 43 | 54 | 36 | 23 |
| Over $25,000 | 14 | 9 | 8 | 37 | 20 | 17 | 7 | 8 | 8 |

SOURCE: Michigan 1976 Recreation Survey. Analysis of data tapes supplied by Recreation Services Division, MDNR.

NOTE: The above characteristics are based upon boating participations. An individuals characteristics are weighted according to his frequency of participation.

centages of males, blue collar workers, retired, and boaters with lower incomes and education. By contrast, sailors generally have high incomes, high educational levels, and work in white collar, professional occupations. Power boaters as a group fall in between fishermen and sailors in most demographic and socioeconomic categories. Waterskiing and river recreation groups are the youngest boating groups and fishermen are the oldest.

These data do not differentiate inland boating from Great Lakes boating except in the fishing categories. Here we see some interesting differences between Great Lakes fishermen and inland fishermen. The Great Lakes fishermen have slightly higher incomes and education than their inland counterparts. They also include more middle-aged boaters and fewer boaters under 28 years of age.

## BOATING USE AND STORAGE

Information on boating use and storage is important in planning adequate boating facilities. Of the 13.8 million boat days estimated by the 1977 Waterways boater survey, 69% took place on inland waters and 31% on the Great Lakes and connecting waters. Small boat (20 feet and under in length) activity is concentrated on inland waters while about 63% of large boat (over 20 feet) activity occurs on the Great Lakes (Table 5).

Small boats make up 89% of the registered fleet and account for 82% of the boat days. This difference indicates that larger boats are used more frequently as they make up 11% of the fleet and account for almost 18% of boating activity (Table 5 and Figure 6).

Figure 6 provides a comprehensive breakdown of registered boats and their use and summer storage location in 1977. The registered boating fleet is first divided between small (89%) and large (11%) boats. Each of these are then

Table 5. Michigan Great Lakes and Inland Boat-Days by Size Class

| | -Thousands of Boat-Days- | | |
|---|---|---|---|
| Count (000's)<br>Row Pct.<br>Col. Pct.<br>Tot. Pct. | Great Lakes | Inland Waters | Totals |
| Small Boats (20 feet and under | 2,687<br>Row 24.1%<br>Col. 64.1%<br>Tot. 19.8% | 8,464<br>Row 75.9%<br>Col. 90.5%<br>Tot. 62.5% | 11,151<br>82.3% |
| Large Boats (over 20 feet) | 1,507<br>Row 62.8%<br>Col. 35.9%<br>Tot. 11.1% | 891<br>Row 37.2%<br>Col. 9.5%<br>Tot. 6.6% | 2,398<br>17.7% |
| Totals | 4,194<br>Row 31.0% | 9,355<br>Row 69.0% | 13,549<br>100% |

Source: 1977 DNR Waterways Boating Survey; analysis of raw data tapes.
Note: Cleaning of data and reanalysis resulted in small differences between these results and those reported in the 1977 Michigan Recreational Boating Survey Report.

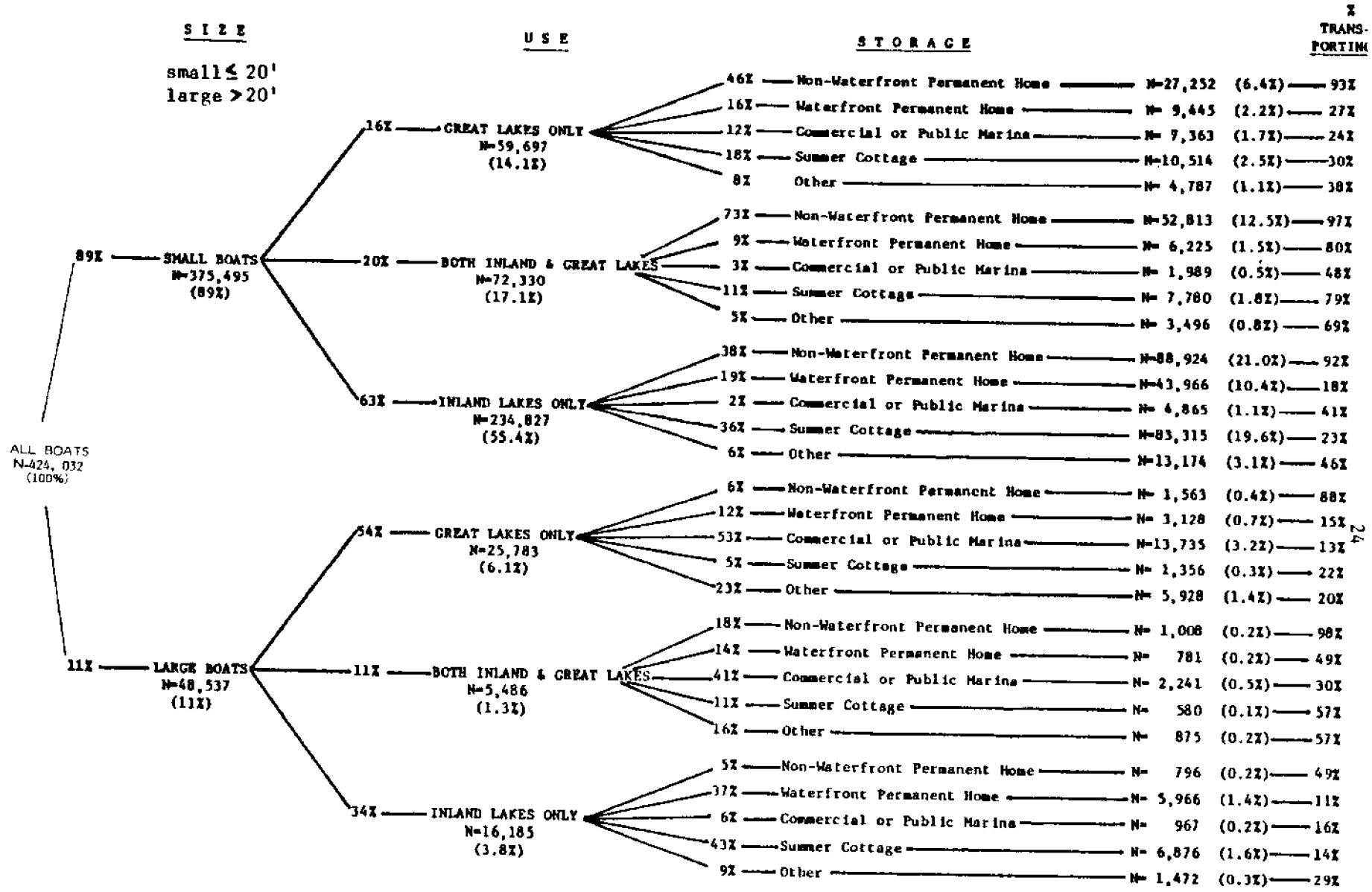


Figure 6. Michigan Registered Boats By Size Class, Great Lakes vs Inland Use, and Storage Category (1977)

in turn divided according to use on inland lakes, Great Lakes, or both. These categories are then broken down by storage. Estimates of the percent of boats in each category that were transported at least once from this location to a boating site are reported.

There are a variety of interesting relationships revealed in Figure 6. Small boats are more often used on inland lakes (63%) or both on inland and Great Lakes (20%), while 54% of large boats are used solely on the Great Lakes and only 11% are used on both inland and Great Lakes. Storage categories also tend to vary with boat size and use. Small boats are more often kept at non-waterfront permanent homes and transported to boating sites. Large boats used on the Great Lakes are predominantly located at commercial or public marinas while large boats used only on inland lakes are often kept at summer cottages or waterfront permanent homes (Figure 6).

Changes in boat storage locations between 1974 and 1977 were not large. Waterways surveys indicate small increases in numbers of boats kept at non-waterfront permanent homes and slight decreases in numbers of boats kept at summer cottages. This might be a result of some conversions of second homes to permanent homes. (Waterways Division, 1979). Waterways (1979) also estimated some decreases between 1974 and 1977 in the proportion of boats being transported.

## BOATING PARTICIPATION RATES

Nationally it is estimated that one in every five households in the United States includes at least one boat operator (U. S. Department of Transportation, U. S. Coast Guard, 1978). These boating households participate in a variety of different types of boating activity. Recreational fishing is the most popular boating-related activity followed by pleasure cruising or

sailing, water skiing and canoeing (Table 6).

The most recent national outdoor recreation participation survey estimates rates of participation in boating activities for persons 12 years of age and older (U.S. Dept. of Interior; Heritage, Conservation and Recreation Service, 1979). As above, fishing is the most popular activity with over half of the population participating at least once during 1976.[1] Pleasure boating ("other boating" category) is the next most popular boating activity with 35% participating, followed by canoeing and waterskiing (16% each) and then sailing (11%) (Table 7). Participation rates in boating activities are slightly higher in the Northcentral region, due in part to extensive water resources including the Great Lakes.

Comparable participation estimates for Michigan are difficult to obtain. First of all, nonresponse and other possible biases in the 1977 National Recreation Survey suggest that national estimates of participation rates may be somewhat inflated. The most comparable study conducted within Michigan dates back to 1972 and it is difficult to directly compare boating activity categories. The 1972 survey estimated the following participation rates: fishing 31%, power boating including water skiing 24%, canoeing 12%, and other boating 12%. The authors note that the "other boating" category included rowing and sailing as well as some reporting of power boating that should have been included in the "power boating, including waterskiing" category (Michigan Dept. of Natural Resources, 1975).

The 1976 Michigan Recreation Survey permits us to estimate boating "participations" rather than population participation rates. A "participation" is defined as "one person taking part in one activity for at least 15 minutes".

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[1]This estimate includes fishing from boats as well as fishing from shore.

Table 6. U.S. Household Participation in Boating Activities in 1976

| Activity | Households Participating | Percent of Households[1] | Percent of Time Spent |
|---|---|---|---|
| Pleasure Cruising or Sailing | 9,312,000 | 62.5 | 31.5 |
| Water Skiing | 5,617,000 | 37.7 | 13.7 |
| Recreational Fishing | 11,422,000 | 76.7 | 44.7 |
| Hunting | 1,023,000 | 6.9 | 1.6 |
| Racing | 712,000 | 4.8 | 1.3 |
| Commercial Use-Incl. Fishing | 391,000 | 2.6 | .8 |
| Whitewater Canoeing | 1,044,000 | 7.0 | 1.2 |
| Other Canoeing | 2,359,000 | 15.8 | 4.6 |
| Whitewater Rafting | 401,000 | 2.7 | .3 |
| Whitewater Kayaking | 161,000 | 1.1 | .1 |
| Other Kayaking | 289,000 | 1.9 | .2 |
| | | | 100.0 |

[1] More than one response is possible for each of the 14,895,000 boating households.

Source: U.S. Coast Guard, Recreational Boating in the Continental United States in 1973 and 1976; the Nationwide Boating Survey, Washington, D.C., March 1978, pp. 99 and 92.

TABLE 7. National and Regional Participation Rates in Boating-related Activities 1976[a]

| Activity | United States | North Central Region |
|---|---|---|
| | -----percent participating----- | |
| Canoeing, Kayaking, & River Running | 16 | 23 |
| Sailing | 11 | 12 |
| Waterskiing | 16 | 16 |
| Fishing | 53 | 56 |
| Other Boating | 34 | 37 |

[a]Figures represent the estimated percent of population 12 years of age and older taking part at least once in the activity during 1976.

SOURCE: 1976 National Telephone Survey Report. 1979 Nationwide Plan. Technical Appendix II.

The survey estimated a total of 52 million participations in boating by Michigan residents in 1976. Boating activity represented 5% of all recreation activity measured in the survey.[1] Table 8 summarizes the distribution of boating participations by activity category. Fishing accounts for almost 40% of all boating participation, waterskiing for 12% and rowing, sailing, and canoeing each account for about 6 percent of participations.

These figures provide a good general picture of boating activity in Michigan. The data does not permit us to distinguish inland boating from Great Lakes boating except in the fishing category where about one sixth of the fishing activity occurs on the Great Lakes.

## GREAT LAKES BOATING ORIGIN-DESTINATION PATTERNS

Statewide boating information is useful for general planning, identifying trends, and resource allocation. For specific management and planning decisions it is important to know where boaters originate from and where boating activity takes place. For this reason Waterways Division's boating surveys have been designed to estimate origin-destination patterns. The following analyses are based upon the 1977 Waterways boater survey. Only Great Lakes boating is discusse

We present the information by first looking at where Michigan's Great Lakes boaters live (by county), then at Great Lakes boating destinations (by county), and finally combining both origin and destination data to reveal boater travel patterns.

### Boater Origins for Great Lakes Boating

In 1977 Michigan's Great Lakes provided an estimated 4.2 million

[1] Recreation was defined very broadly in this survey as "anything done mainly for pleasure or enjoyment outside a private home". This included cultural and entertainment activities as well as social, group, civic, craft, and hobby oriented activities. Sampled respondents recalled participation within the two week period prior to the interview. (See Michigan DNR, 1976 for survey design details).

Table 8. Michigan Boating Participation 1976

| Activity Category | Participations in 1000's | Percent | Avg. Duration (hours) |
|---|---|---|---|
| Fishing from Boat- GL | 3466 | 6.6 | 4.6 |
| Fishing from Boat - IL | 14152 | 27.2 | 3.6 |
| Fishing from Boat- Stream | 2689 | 5.2 | 3.6 |
| Fishing from Boat-Ocean | 219 | .4 | 3.5 |
| Fishing Subtotal | 20526 | 39.4 | |
| Canoeing | 3457 | 6.6 | 3.9 |
| Kayaking | 193 | .4 | 3.0 |
| Rowing | 3064 | 5.9 | 1.6 |
| Sailing | 3589 | 6.9 | 3.2 |
| Power Boating | 12785 | 24.6 | 3.2 |
| Water skiing | 6436 | 12.4 | 1.5 |
| River rafting | 205 | .4 | 2.5 |
| Tourist Boat trip | 367 | .7 | 2.0 |
| Other (Watercraft) | 126 | .2 | 1.6 |
| Ice Boating | 1278 | 2.4 | - |
| Boating subtotal | 31500 | 60.6 | |
| All Boating | 52026 | 100.0 | |

SOURCE: Michigan 1976 Recreation Survey

NOTE 1. The Michigan 1976 Recreation Survey estimated a total of 1,057,166,000 recreation participations by Michigan residents in 1976. The boating activities listed above account for 5% of this total.

NOTE 2. The 1977 Michigan Recreational Boating Survey estimated 13,782,500 boat days by registered boats in Michigan in 1977. Applying a figure of 4 people/boat yields an estimate of boating participations close to the independent 1976 telephone survey estimate. It should be noted that the telephone survey is counting some types of boating not included in the survey of registered boat owners.

Great Lakes boat days. Applying a party size figure of 3.75 people per boat[1] yields almost 16 million Great Lakes boater days. The vast majority of boaters reside in Michigan's principal population concentrations. This is borne out in Table 9 in which Michigan counties and out of state origins are ranked by the number of Great Lakes boat days generated in 1977. Four counties within the Detroit SMSA account for almost half of the Great Lakes boat days generated. These SE Michigan counties are followed in importance by Western Michigan counties with significant populations (Muskegon, Ottawa, Berrien) and then by other urban counties on or near the Great Lakes.

Southern lower peninsula counties account for three fourths of the Great Lakes boat days generated. The Northern lower peninsula contributes about 12%, the Upper peninsula 8%, and out of state origins less than 4%. Coastal counties generate 67% of the Great Lakes boat days in Michigan.

Great Lakes Boating Destinations

Michigan boaters tend to remain fairly close to home generating substantial pressures on boating facilities in urban areas. Forty-two percent of the Great Lakes boat days take place within Wayne, Macomb, and St. Clair counties. Half of the 41 coastal counties account for 86% of the Great Lakes boat days (Table 10).

Fifty-four percent of boat days on the Great Lakes occur within 30 minutes of home and 73% take place within an hour's drive (Figure 2). Thus, the distribution of boat days by destination county is similar to the rankings by origin, except that only coastal counties are included as potential destinations (Table 10).

[1] Empirical estimates of average boat party size are lacking. Dividing 52 million boater days from 1976 recreation survey by 13.8 million boat days from 1977 boater survey gives 3.75 people per boat.

Table 9. Ranking of Counties by Great Lakes Boat Days Generated in 1977

| Rank | County No. | County Name | Boat Days Generated | Percent of Total | Cumulative Percent |
|---|---|---|---|---|---|
| | --County of Registration-- | | | | |
| 1 | 82 | Wayne | 943,032 | 22.48 | 22.48 |
| 2 | 50 | Macomb | 623,635 | 14.87 | 37.35 |
| 3 | 63 | Oakland | 315,306 | 7.52 | 44.87 |
| 4 | 74 | St. Clair | 175,515 | 4.18 | 49.05 |
| 5 | 61 | Muskegon | 139,723 | 3.33 | 52.38 |
| 6 | 70 | Ottawa | 126,823 | 3.02 | 55.40 |
| 7 | 11 | Berrien | 105,440 | 2.51 | 57.91 |
| 8 | 41 | Kent | 101,789 | 2.43 | 60.34 |
| 9 | 58 | Monroe | 94,888 | 2.26 | 62.60 |
| 10 | 25 | Genesee | 91,497 | 2.18 | 64.78 |
| 11 | 73 | Saginaw | 88,920 | 2.12 | 66.90 |
| 12 | 09 | Bay | 87,198 | 2.08 | 68.98 |
| 13 | 17 | Chippewa | 86,617 | 2.07 | 71.05 |
| 14 | 28 | Grand Traverse | 84,346 | 2.01 | 73.06 |
| 15 | 84 | OHIO | 57,543 | 1.37 | 74.43 |
| 16 | 49 | Mackinac | 55,837 | 1.33 | 75.76 |
| 17 | 32 | Huron | 47,851 | 1.13 | 76.89 |
| 18 | 56 | Midland | 47,571 | 1.13 | 78.02 |
| 19 | 31 | Houghton | 46,050 | 1.10 | 79.12 |
| 20 | 04 | Alpena | 45,210 | 1.08 | 80.23 |
| 21 | 52 | Marquette | 44,217 | 1.05 | 81.25 |
| 22 | 03 | Allegan | 42,035 | 1.00 | 82.25 |
| 23 | 33 | Ingham | 40,285 | .96 | 83.21 |
| 24 | 39 | Kalamazoo | 39,563 | .94 | 84.15 |
| 25 | 21 | Delta | 39,274 | .94 | 85.09 |
| 26 | 87 | Other States, Provinces | 38,939 | .93 | 86.02 |
| 27 | 16 | Cheboygan | 37,220 | .89 | 86.91 |
| 28 | 86 | ILLINOIS | 33,539 | .80 | 87.71 |
| 29 | 80 | Van Buren | 31,766 | .76 | 88.47 |
| 30 | 81 | Washtenaw | 30,383 | .72 | 89.19 |
| 31 | 23 | Eaton | 25,435 | .61 | 89.80 |
| 32 | 35 | Iosco | 24,898 | .59 | 90.39 |
| 33 | 51 | Manistee | 23,490 | .56 | 90.95 |
| 34 | 15 | Charlevoix | 22,636 | .54 | 91.49 |
| 35 | 79 | Tuscola | 18,865 | .45 | 91.94 |
| 36 | 24 | Emmet | 18,861 | .45 | 92.39 |
| 37 | 64 | Oceana | 18,768 | .45 | 92.84 |
| 38 | 13 | Calhoun | 17,340 | .41 | 93.25 |
| 39 | 06 | Arenac | 15,647 | .37 | 93.62 |
| 40 | 53 | Mason | 15,515 | .37 | 93.99 |
| 41 | 85 | INDIANA | 15,231 | .36 | 94.35 |
| 42 | 14 | Cass | 13,416 | .32 | 94.67 |
| 43 | 45 | Leelanau | 13,097 | .31 | 94.98 |
| 44 | 07 | Baraga | 12,603 | .30 | 95.28 |
| 45 | 76 | Sanilac | 12,385 | .29 | 95.57 |
| 46 | 44 | Lapeer | 12,320 | .29 | 95.86 |

Table 9 (Continued)

| Rank | County No. | County Name | Boat Days Generated | Percent of Total | Cumulative Percent |
|---|---|---|---|---|---|
| | ---County of Registration--- | | | | |
| 47 | 75 | St. Joseph | 12,290 | .29 | 96.15 |
| 48 | 38 | Jackson | 11,673 | .28 | 96.43 |
| 49 | 05 | Antrim | 11,053 | .26 | 96.69 |
| 50 | 71 | Presque Isle | 9,338 | .22 | 96.91 |
| 51 | 46 | Lenawee | 8,609 | .21 | 97.12 |
| 52 | 02 | Alger | 8,449 | .20 | 97.32 |
| 53 | 66 | Ontonagon | 8,115 | .19 | 97.51 |
| 54 | 10 | Benzie | 8,042 | .19 | 97.70 |
| 55 | 62 | Newaygo | 7,937 | .19 | 97.89 |
| 56 | 59 | Montcalm | 6,983 | .17 | 98.06 |
| 57 | 47 | Livingston | 6,777 | .16 | 98.22 |
| 58 | 55 | Menominee | 6,124 | .15 | 98.37 |
| 59 | 34 | Ionia | 5,637 | .13 | 98.50 |
| 60 | 19 | Clinton | 5,135 | .12 | 98.62 |
| 61 | 01 | Alcona | 4,846 | .11 | 98.73 |
| 62 | 27 | Gogebic | 4,676 | .11 | 98.84 |
| 63 | 78 | Shiawassee | 4,574 | .11 | 98.95 |
| 64 | 48 | Luce | 3,852 | .09 | 99.04 |
| 65 | 42 | Keweenaw | 3,094 | .07 | 99.11 |
| 66 | 77 | Schoolcraft | 2,679 | .06 | 99.17 |
| 67 | 12 | Branch | 2,577 | .06 | 99.23 |
| 68 | 67 | Osceola | 2,524 | .06 | 99.29 |
| 69 | 40 | Kalkaska | 2,434 | .06 | 99.35 |
| 70 | 22 | Dickinson | 2,351 | .06 | 99.41 |
| 71 | 69 | Otsego | 2,320 | .05 | 99.46 |
| 72 | 72 | Roscommon | 2,314 | .05 | 99.51 |
| 73 | 20 | Crawford | 2,213 | .05 | 99.56 |
| 74 | 18 | Clare | 2,197 | .05 | 99.61 |
| 75 | 26 | Gladwin | 2,182 | .05 | 99.66 |
| 76 | 60 | Montmorency | 1,811 | .04 | 99.70 |
| 77 | 29 | Gratiot | 1,688 | .04 | 99.74 |
| 78 | 83 | Wexford | 1,338 | .03 | 99.77 |
| 79 | 08 | Barry | 1,184 | .03 | 99.80 |
| 80 | 43 | Lake | 1,086 | .03 | 99.83 |
| 81 | 36 | Iron | 905 | .02 | 99.85 |
| 82 | 65 | Ogemaw | 849 | .02 | 99.87 |
| 83 | 57 | Missaukee | 788 | .02 | 99.89 |
| 84 | 54 | Mecosta | 653 | .01 | 99.90 |
| 85 | 30 | Hillsdale | 493 | .01 | 99.91 |
| 86 | 68 | Oscoda | 394 | .01 | 99.92 |
| 87 | 37 | Isabella | 108 | .00 | |
| | | | 4,194,811 | | |

SOURCE : 1977 Michigan Recreational Boating Survey. Analysis of data tapes supplied by Waterways Division, MDNR.

Table 10. Ranking of Michigan Counties By Great Lakes Boat Days - Destination

| Rank | County No. | County Name | Great Lakes Boater Days in County | Percent of Total | Cumulative Percent |
|---|---|---|---|---|---|
| 1. | 50 | Macomb | 686,345 | 16.4 | 16.4 |
| 2. | 82 | Wayne | 632,746 | 15.1 | 31.5 |
| 3. | 74 | St. Clair | 486,112 | 11.6 | 42.1 |
| 4. | 70 | Ottawa | 188,678 | 4.5 | 46.6 |
| 5. | 49 | Mackinac | 178,008 | 4.2 | 50.8 |
| 6. | 32 | Huron | 172,965 | 4.1 | 54.9 |
| 7. | 58 | Monroe | 163,778 | 3.9 | 58.8 |
| 8. | 61 | Muskegon | 151,975 | 3.6 | 62.4 |
| 9. | 17 | Chippewa | 129,614 | 3.1 | 65.5 |
| 10. | 11 | Berrien | 126,470 | 3.0 | 68.5 |
| 11. | 9 | Bay | 114,558 | 2.7 | 71.2 |
| 12. | 28 | Grand Traverse | 93,457 | 2.2 | 73.4 |
| 13. | 3 | Allegan | 82,544 | 2.0 | 75.4 |
| 14. | 6 | Arenac | 73,898 | 1.7 | 77.1 |
| 15. | 35 | Iosco | 72,125 | 1.7 | 78.8 |
| 16. | 51 | Manistee | 66,529 | 1.6 | 80.4 |
| 17. | 15 | Charlevoix | 66,017 | 1.6 | 82.0 |
| 18. | 45 | Leelanau | 60,565 | 1.4 | 83.4 |
| 19. | 24 | Emmet | 57,804 | 1.4 | 84.8 |
| 20. | 16 | Cheboygan | 52,478 | 1.3 | 86.1 |
| 21. | 80 | VanBuren | 51,105 | 1.2 | 87.3 |
| 22. | 4 | Alpena | 49,916 | 1.2 | 88.5 |
| 23. | 64 | Oceana | 45,794 | 1.1 | 89.6 |
| 24. | 21 | Delta | 45,711 | 1.1 | 90.7 |
| 25. | 31 | Houghton | 40,582 | 1.0 | 91.7 |
| 26. | 52 | Marquette | 37,538 | .9 | 92.6 |
| 27. | 5 | Antrim | 36,779 | .9 | 93.5 |
| 28. | 10 | Benzie | 35,540 | .8 | 94.3 |
| 29. | 76 | Sanilac | 31,689 | .8 | 95.1 |
| 30. | 42 | Keweenaw | 26,715 | .6 | 95.7 |
| 31. | 53 | Mason | 25,289 | .6 | 96.3 |
| 32. | 1 | Alcona | 24,373 | .6 | 96.9 |
| 33. | 7 | Baraga | 19,406 | .5 | 97.4 |
| 34. | 2 | Alger | 16,898 | .4 | 97.8 |
| 35. | 71 | Presque Isle | 14,645 | .3 | 98.1 |
| 36. | 48 | Luce | 7,423 | .2 | 98.3 |
| 37. | 79 | Shiawassee | 7,106 | .2 | 98.5 |
| 38. | 66 | Ontonagon | 6,850 | .2 | 98.7 |
| 39. | 55 | Menominee | 6,650 | .2 | 98.9 |
| 40. | 77 | Schoolcraft | 5,178 | .1 | 99.0 |
| 41. | 27 | Gogebic | 2,959 | .1 | 99.1 |

SOURCE: 1977 Michigan Recreational Boating Survey. Analysis of data tapes supplied by Waterways Division, MDNR.

Travel Patterns

In order to provide a clearer picture of Great Lakes boating travel patterns, counties were grouped into nine Great Lakes boating regions. A tenth origin region was defined to include out of state boaters. The Great Lakes boating regions were described earlier and are depicted in Figure 3.

Boater flows between regions are illustrated in Table 11. The largest numbers of Great Lakes boat days appear on the diagonal of this origin-destination matrix since the majority of boaters boat within the region in which they live. The row percentages estimate the proportion of boat days from each origin region (row) destinating in the given destination region (column). The column percentages estimate the proportion of boat days occurring within the destination region (column) that originate from each origin region (row).

We illustrate with an example. Region 1 generates a total of 2.198 million Great Lakes boat days, and receives a total of 1.957 million Great Lakes boat days. Of these Great Lakes boat days, 1.883 million both originate and take place within region 1. That is, 86% of the boat days generated by region 1 remain within the region; and 96% of the boat days taking place within region 1 come from region 1.

Reading across the row for region 1 reveals where region 1 boaters go for Great Lakes boating. Of the 14% traveling outside of the region, 4% travel to region 4 (Thumb), 4% to region 7 (Straits), and smaller percentages travel to NW and NE Michigan. Reading down the column for region 1, the column percentages show only small inflows of Great Lakes boaters to region 1 from out-of-state and neighboring regions 3 and 4.

The row and column percentages along the diagonal of Table 11 give a general picture of import-export relationships. Southern Michigan regions

Table 11. Regional Origin Destination Matrix for Great Lakes Boating, 1977

| Boat days (1000's)<br>Row %<br>Column % | Region of Destination* 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Region of Origin* | | | | | | | | | | |
| 1 | 1883 | 2 | 17 | 92 | 40 | 63 | 83 | 13 | 3 | 2198 |
| | 86 | 0 | 1 | 4 | 2 | 3 | 4 | 1 | 0 | 100 |
| | 96 | 1 | 4 | 23 | 27 | 17 | 19 | 8 | 6 | 52 |
| 2 | 10 | 211 | 40 | 3 | 4 | 44 | 26 | 4 | 2 | 343 |
| | 3 | 61 | 12 | 1 | 1 | 13 | 8 | 1 | 1 | 100 |
| | 0 | 81 | 10 | 1 | 3 | 11 | 6 | 3 | 4 | 8 |
| 3 | 13 | 17 | 326 | 5 | 2 | 29 | 17 | 2 | 1 | 413 |
| | 3 | 4 | 79 | 1 | 1 | 7 | 4 | 1 | 0 | 100 |
| | 1 | 7 | 82 | 1 | 2 | 7 | 4 | 2 | 1 | 10 |
| 4 | 21 | 0 | 4 | 295 | 30 | 39 | 34 | 4 | 1 | 429 |
| | 5 | 0 | 1 | 69 | 7 | 9 | 8 | 1 | 0 | 100 |
| | 1 | 0 | 1 | 74 | 20 | 10 | 8 | 3 | 3 | 10 |
| 5 | 1 | 0 | 1 | 2 | 67 | 3 | 9 | 1 | 1 | 85 |
| | 1 | 0 | 1 | 2 | 80 | 3 | 11 | 1 | 1 | 100 |
| | 0 | 0 | 0 | 0 | 46 | 1 | 2 | 0 | 2 | 2 |
| 6 | 0 | 0 | 2 | 0 | 0 | 180 | 6 | 0 | 0 | 189 |
| | 0 | 0 | 1 | 0 | 0 | 95 | 3 | 0 | 0 | 100 |
| | 0 | 0 | 0 | 0 | 0 | 47 | 1 | 0 | 0 | 5 |
| 7 | 7 | 0 | 2 | 2 | 0 | 4 | 196 | 0 | 0 | 210 |
| | 3 | 0 | 1 | 1 | 0 | 2 | 93 | 0 | 0 | 100 |
| | 0 | 0 | 0 | 0 | 0 | 1 | 45 | 0 | 0 | 5 |
| 8 | 1 | 0 | 0 | 0 | 2 | 3 | 1 | 122 | 5 | 134 |
| | 1 | 0 | 0 | 0 | 1 | 2 | 1 | 91 | 4 | 100 |
| | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 77 | 9 | 3 |
| 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 43 | 48 |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 89 | 100 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 74 | 1 |
| 10 | 21 | 30 | 6 | 1 | 0 | 20 | 60 | 7 | 1 | 145 |
| (out of state) | 14 | 20 | 4 | 1 | 0 | 14 | 41 | 5 | 0 | 100 |
| | 1 | 11 | 2 | 0 | 0 | 5 | 14 | 4 | 1 | 3 |
| TOTAL | 1957 | 260 | 398 | 400 | 146 | 384 | 433 | 158 | 58 | 4194 |
| row percent | 47 | 6 | 9 | 10 | 3 | 9 | 10 | 4 | 1 | |

* See Figure 3 for definition of Regions

SOURCE : 1977 Michigan Recreational Boating Survey, Waterways Division, MDNR.

are net importers. Regions 5, 6 and 7 import over half of the Great Lakes boat days taking place within their regions. The Thumb and Upper peninsula regions import about 25% of their Great Lakes boat days.

Southwest Michigan (Region 2) exports the largest percentages of their Great Lakes boating (39%) followed by Region 4 (31%), Region 3 (21%), Region 5 (20%), and Region 1 (14%). Northern regions generally export less than 10% of their Great Lakes boat days. It should be noted that while region 1 exports a smaller percentage of boat days than other southern Michigan regions, it exports significantly larger numbers of boat days due to the large volume of boat days generated in this region.

Out-of-state origins account for about 3% of Great Lakes boat days in Michigan. Forty-one percent of these occur within the Straits region with most of the remainder taking place in SW, SE, or NW Michigan. Eastern Michigan and Upper peninsula regions do not attract significant numbers of out-of-state boaters.

County to County Travel Patterns. - Region 1 (Southeast Michigan)

Our origin-destination figures are based upon the 1977 Waterways Division boater survey, which included 13,933 boaters. While this is a significant number of boaters it is not large enough to estimate statewide county to county origin-destination matrices. However, within southeastern Michigan sufficient numbers of responses were obtained to estimate patterns of travel at the county level. Since Region 1 accounts for about half of all boating activity in Michigan, a more detailed analysis is worthwhile.

Table 12 presents an origin-destination matrix for region 1 by county. Wayne and Macomb counties both generate and receive the largest percentages of

Table 12. Southeast Michigan (Region 1) Great Lakes Boating Origin-Destination Matrix (County to County), 1977

| Boat days (1000's)<br>Row percent<br>Column percent | County of Destination | | | | |
|---|---|---|---|---|---|
| | Macomb | Monroe | St. Clair | Wayne | Total |
| County of Origin | | | | | |
| Lenawee | 47 | 2,650 | 0 | 0 | 2,697 |
| | 2 | 98 | 0 | 0 | 100 |
| | 0 | 2 | 0 | 0 | 0 |
| Livingston | 459 | 0 | 353 | 256 | 1,068 |
| | 43 | 0 | 33 | 24 | 100 |
| | 0 | 0 | 0 | 0 | 0 |
| Macomb | 405,534 | 3,165 | 137,636 | 35,942 | 582,277 |
| | 70 | 1 | 24 | 6 | 100 |
| | 61 | 2 | 30 | 6 | 31 |
| Monroe | 265 | 76,676 | 772 | 3,596 | 81,309 |
| | 0 | 94 | 1 | 4 | 100 |
| | 0 | 53 | 0 | 1 | 4 |
| Oakland | 119,698 | 7,067 | 48,117 | 45,887 | 220,769 |
| | 54 | 3 | 22 | 21 | 100 |
| | 18 | 5 | 11 | 7 | 12 |
| St. Clair | 12,759 | 84 | 151,659 | 3,480 | 167,982 |
| | 8 | 0 | 90 | 2 | 100 |
| | 2 | 0 | 33 | 1 | 9 |
| Washtenaw | 1,612 | 9,057 | 2,285 | 3,635 | 16,589 |
| | 10 | 55 | 14 | 22 | 100 |
| | 0 | 6 | 1 | 1 | 1 |
| Wayne | 125,714 | 45,691 | 113,044 | 526,137 | 810,586 |
| | 16 | 6 | 14 | 65 | 100 |
| | 19 | 32 | 25 | 85 | 43 |
| Total | 666,088 | 144,390 | 453,866 | 618,933 | 1,883,277 |
| Row Percent | 35 | 8 | 24 | 33 | |

Great Lakes boat days within Region 1. Most of the Great Lakes boat days generated in Monroe and St. Clair Counties remain within those counties. Seventy percent of Macomb County's Great Lakes boating remains in Macomb County and 24% is exported to St. Clair County. Wayne County keeps about 65% of its boat days, exporting the rest to Macomb and St. Clair. Lenawee County boaters travel to Monroe County for Great Lake boating as do Washtenaw County boaters to a somewhat lesser degree. Livingston County boaters use Great Lakes facilities in Macomb, Wayne, and St. Clair Counties. These patterns indicate that boaters generally attempt to minimize travel distances and suburban boaters avoid, where possible, having to cross the congested Detroit area to reach a boating site.

# CHAPTER II

## GREAT LAKES MARINA FACILITIES

Waterways Division of Michigan's DNR periodically inventories marina facilities on the Great Lakes in Michigan. The 1977 inventory provides information by county on the number of marinas and their capacity (Table 13). Seventy percent of Great Lakes marina capacity is provided by commercial marinas. Public facilities dominate in the Upper peninsula while commercial marinas supply most of the rest of the state. Wayne County accounts for more than half of the private marina slips.

Great Lakes boating slips are concentrated in counties with large numbers of registered craft. Four southeastern Michigan counties (Macomb, Wayne, St. Clair and Monroe) account for 58% of total Great Lakes marina capacity. In comparison, most northern Michigan counties account for less than 2% of the state's marina slips.

Table 14 compares Great Lakes boating slips with measures of Great Lakes boating use. The state averages 9 registered boats per Great Lakes slip. Keep in mind that only about 20% of Michigan's registered boats use the Great Lakes exclusively. The majority of boats use only inland waters or boat both inland and on the Great Lakes. Many of these boats are stored at inland locations. Other Great Lake boats are stored at permanent or summer homes. The statewide average for number of Great Lakes boats using a given county to the number of slips in the county is 7.8. Here again, it must be noted that a boat may use more than one county and a portion of Great Lake marina capacity is allocated to transient traffic on the Great Lakes including craft registered in Michigan and adjoining states.

Variation by county in registered boats per slip ranges from a low of 3 in Huron, Monroe and St. Clair Counties to a high of over 100 in

Table 13. Ranking of Great Lakes Counties by Number of Marina Slips, 1977

| Rank | County | Public | | Commercial | | Private | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. | Slips | No. | Slips | No. | Slips | No. | Slips | Pct. | Cum. Pct. |
| 1 | Macomb | 2 | 356 | 49 | 5737 | 7 | 230 | 58 | 6323 | 23.02 | 23.02 |
| 2 | Wayne | 4 | 922 | 31 | 2190 | 18 | 2281 | 53 | 5393 | 19.64 | 42.66 |
| 3 | St. Clair | 3 | 252 | 54 | 2010 | 3 | 92 | 60 | 2354 | 8.57 | 51.23 |
| 4 | Monroe | 1 | 10 | 25 | 1630 | 4 | 390 | 30 | 2030 | 7.39 | 58.62 |
| 5 | Ottawa | 1 | 32 | 15 | 1551 | 1 | 69 | 17 | 1652 | 6.01 | 64.63 |
| 6 | Bay | 0 | 0 | 10 | 1007 | 2 | 263 | 12 | 1270 | 4.62 | 69.25 |
| 7 | Muskegon | 1 | 81 | 14 | 634 | 3 | 397 | 18 | 1112 | 4.05 | 73.30 |
| 8 | Berrien | 1 | 25 | 5 | 867 | 1 | 60 | 7 | 952 | 3.47 | 76.77 |
| 9 | Huron | 3 | 61 | 17 | 643 | 2 | 32 | 22 | 736 | 2.68 | 79.45 |
| 10 | Emmet | 2 | 141 | 9 | 473 | 1 | 0 | 12 | 614 | 2.24 | 81.69 |
| 11 | Cheboygan | 2 | 113 | 15 | 404 | 0 | 0 | 17 | 517 | 1.88 | 83.57 |
| 12 | Manistee | 1 | 40 | 10 | 322 | 0 | 0 | 11 | 362 | 1.32 | 84.89 |
| 13 | Allegan | 1 | 5 | 7 | 262 | 3 | 82 | 11 | 349 | 1.27 | 86.16 |
| 14 | Charlevoix | 4 | 93 | 11 | 184 | 2 | 48 | 17 | 325 | 1.18 | 87.34 |
| 15 | Mackinac | 5 | 155 | 10 | 167 | 0 | 0 | 15 | 322 | 1.17 | 88.51 |
| 16 | Leelanau | 4 | 266 | 3 | 37 | 1 | 7 | 8 | 310 | 1.13 | 89.64 |
| 17 | Iosco | 2 | 35 | 7 | 209 | 2 | 55 | 11 | 299 | 1.09 | 90.73 |
| 18 | Van Buren | 1 | 63 | 2 | 73 | 2 | 101 | 5 | 237 | .86 | 91.59 |
| 19 | Alpena | 1 | 60 | 3 | 145 | 0 | 0 | 4 | 205 | .75 | 92.34 |
| 20 | Grand Traverse | 1 | 111 | 3 | 93 | 0 | 0 | 4 | 204 | .74 | 93.08 |
| 21 | Arenac | 1 | 16 | 2 | 145 | 3 | 31 | 6 | 192 | .70 | 93.78 |
| 22 | Presque Isle | 2 | 100 | 1 | 79 | 0 | 0 | 3 | 179 | .65 | 94.43 |
| 23 | Chippewa | 2 | 40 | 3 | 83 | 1 | 35 | 6 | 158 | .57 | 95.00 |
| 24 | Oceana | 0 | 0 | 5 | 157 | 0 | 0 | 5 | 157 | .57 | 95.57 |
| 25 | Delta | 3 | 139 | 1 | 10 | 0 | 0 | 4 | 149 | .54 | 96.11 |
| 26 | Marquette | 2 | 103 | 4 | 43 | 0 | 0 | 6 | 146 | .53 | 96.64 |
| 27 | Mason | 0 | 0 | 4 | 105 | 2 | 34 | 6 | 139 | .51 | 97.15 |
| 28 | Sanilac | 1 | 93 | 1 | 42 | 0 | 0 | 2 | 135 | .49 | 97.64 |
| 29 | Antrim | 1 | 75 | 1 | 45 | 0 | 0 | 2 | 120 | .44 | 98.08 |
| 30 | Benzie | 2 | 68 | 4 | 39 | 0 | 0 | 6 | 107 | .39 | 98.47 |
| 31 | Menominee | 1 | 84 | 0 | 0 | 0 | 0 | 1 | 84 | .31 | 98.78 |
| 32 | Gogebic | 1 | 51 | 1 | 10 | 0 | 0 | 2 | 61 | .22 | 99.00 |
| 33 | Keweenaw | 5 | 46 | 1 | 6 | 0 | 0 | 6 | 52 | .19 | 99.19 |
| 34 | Tuscola | 0 | 0 | 1 | 50 | 0 | 0 | 1 | 50 | .18 | 99.37 |
| 35 | Baraga | 2 | 37 | 0 | 0 | 0 | 0 | 2 | 37 | .13 | 99.50 |
| 36 | Schoolcraft | 1 | 33 | 0 | 0 | 0 | 0 | 1 | 33 | .12 | 99.62 |
| 37 | Alcona | 1 | 28 | 0 | 0 | 0 | 0 | 1 | 28 | .10 | 99.72 |
| 38 | Ontonagon | 0 | 0 | 1 | 28 | 0 | 0 | 1 | 28 | .10 | 99.82 |
| 39 | Houghton | 1 | 25 | 0 | 0 | 0 | 0 | 1 | 25 | .09 | 99.91 |
| 40 | Alger | 1 | 13 | 0 | 0 | 0 | 0 | 1 | 13 | .05 | 99.96 |
| 41 | Luce | 1 | 5 | 0 | 0 | 0 | 0 | 1 | 5 | .02 | 99.98 |
| | TOTALS | 68 | 3777 | 330 | 19480 | 58 | 4207 | 456 | 27464 | 100.00 | 99.98 |

Source: 1977 Marina Inventory, Waterways Division, Michigan DNR

Table 14. Ratios of Great Lakes Boating "Supply" to "Demand" by County

| | Total Slips 1977 | Registered Boats/Slip | G1 Boats Using County/Slip |
|---|---|---|---|
| Alcona | 28 | 53.07 | 175.03 |
| Alger | 13 | 98.31 | 191.69 |
| Allegan | 349 | 17.74 | 18.70 |
| Alpena | 205 | 20.29 | 17.60 |
| Antrim | 120 | 27.02 | 33.85 |
| Arenac | 192 | 9.00 | 20.87 |
| Baraga | 37 | 21.73 | 29.65 |
| Bay | 1,270 | 7.06 | 4.65 |
| Benzie | 107 | 17.26 | 49.24 |
| Berrien | 952 | 13.07 | 7.87 |
| Charlevoix | 325 | 8.44 | 13.59 |
| Cheboygan | 517 | 6.56 | 13.91 |
| Chippewa | 158 | 28.45 | 35.89 |
| Delta | 149 | 23.11 | 20.69 |
| Emmet | 614 | 4.95 | 4.60 |
| Gegebic | 61 | 36.03 | 37.05 |
| Grand Traverse | 204 | 34.61 | 42.18 |
| Houghton | 25 | 103.92 | 70.88 |
| Huron | 736 | 3.31 | 11.27 |
| Iosco | 299 | 11.42 | 25.84 |
| Keweenaw | 52 | 5.12 | 16.15 |
| Leelanau | 310 | 9.03 | 14.02 |
| Luce | 5 | 229.20 | 434.40 |
| Mackinac | 322 | 8.17 | 12.85 |
| Macomb | 6,323 | 5.16 | 2.47 |
| Manistee | 362 | 7.11 | 22.28 |
| Marquette | 146 | 33.94 | 22.47 |
| Mason | 139 | 23.45 | 34.26 |
| Menominee | 84 | 22.65 | 16.17 |
| Monroe | 2,030 | 3.68 | 2.65 |
| Muskegon | 1,112 | 10.78 | 8.07 |
| Oceana | 157 | 10.04 | 19.82 |
| Ontonagon | 28 | 39.79 | 45.39 |
| Ottawa | 1,652 | 7.09 | 5.62 |
| Presque Isle | 179 | 10.33 | 13.67 |
| Sanilac | 135 | 9.88 | 69.91 |
| Schoolcraft | 33 | 45.85 | 56.36 |
| St. Clair | 2,354 | 3.75 | 1.23 |
| Tuscola | 50 | 61.82 | 37.40 |
| Van Buren | 237 | 24.91 | 21.94 |
| Wayne | 5,393 | 14.62 | 3.44 |
| Total | 27,464 | | |
| Mean | 669.9 | 9.63 | 7.80 |

Source: 1977 Marina Inventory, Waterways Division, Michigan DNR and Analysis of data from 1977 Michigan Recreational Boating Survey

Houghton and Luce Counties. Need estimates using Great Lakes boats using the county per slip yield similar results. In spite of heavy boating activity in southeastern Michigan, it appears that commerical and private facilities are meeting this demand. Counties where additional capacity may be needed include Luce, Houghton, Alger, Alcona, and Schoolcraft. These counties are each presently served by a single public marina with less than 50 slips.

# CHAPTER III

## GREAT LAKES BOATING ECONOMICS

There are two general types of economic benefits associated with Great Lakes recreational boating: direct benefits which accrue to boaters and indirect benefits in the form of jobs and income which are spawned by boater expenditures. Estimates of both types of benefit are useful to planners. Direct benefit estimates, for example, are used by public sector planners to prioritize investment options to achieve the objective of maximizing social benefit per dollar of public funds invested. Indirect benefit estimates provide planners with information useful in assessing the actual and potential impacts of investments on regional economies. What is currently known about each of these benefit types in relation to Great Lakes boating is discussed below.

### Direct Benefits of Great Lakes Boating

Direct benefits are equivalent to what boaters would be willing to pay for Great Lakes boating experiences. Several methods for imputing willingness to pay have been developed for recreation activities which are provided free or at a subsidized price (the latter is the case for Great Lakes boating with the user paying for equipment, transportation, etc. while launching facilities, roads and the water base are commonly made available at no direct charge to the user). Given the circumstances involved in Great Lakes boating, the two recommended direct value methods are the travel cost and survey methods.

Surprisingly, no comprehensive studies have been conducted to assess the direct benefits of Great Lakes boating. Warner (1976) developed models and value estimates for inland lake boating in Michigan. He employed the travel cost concept and appears to have demonstrated that the method is suitable for Great Lakes boating as well. Yet, the data required to develop estimates using this technique do not currently exist.

The participation data presented in Chapter I is the only basis presently available for imputing direct benefits. It is common practice to develop value estimates from participation data by multiplying participations by an average dollar value. This method, referred to as the unit day value method, was not employed herein because no appropriate unit day value exists for Great Lakes boating and more importantly because the method itself is highly subjective.

Indirect Benefits from Great Lakes Boating

Indirect benefits are commonly referred to as economic impact. Economic impact estimation techniques are reasonably well understood and accepted by most economists. Estimation of economic impact is basically a two stage process. The first step entails obtaining an accounting of what products and services are purchased by, in this case, Great Lakes boaters. The second step involves tracing the subsequent impacts of these expenditures as they circulate through the economy. Economists use the term "multiplier" to describe the combined impacts of these direct and subsequent rounds of spending.

The theory underlying economic impact analysis is reasonably clear, but developing estimates is hampered by lack of data and high data collection costs. Obviously, collecting boater expenditure data is costly especially if the analyst employs checks and balances to insure control of the several forms of bias (e.g. recall bias) inherent in collecting expenditure information. More significant than the cost of collecting expenditure information is the very high cost of determining subsequent impacts as these expenditures flow through the economy. For most studies the high costs of the latter can't be justified, and the analyst is forced to utilize multipliers from other studies making subjective adjustments to approximate differing circumstances. Thus, although the indirect benefit estimation process is reasonably straight forward, missing data is a common problem

encountered when one attempts to derive economic impact estimates.

Previous Studies of Economic Impact of Boaters in Michigan

In the early 1970's, Waterways Division, Michigan Division of Natural Resources, funded a series of Great Lakes boating studies conducted by researchers in the Department of Park and Recreation Resources, Michigan State University. In combination, these studies provide a base for developing an estimate of Great Lakes boating's economic impact. Warner (1974) collected expenditure information from a sample of boaters renting slips at commercial marinas located along Lake Michigan in southwestern Michigan. These data: 1) relate to expenditures made during the 1973 boating season, 2) apply to only one Great Lakes boating region, and 3) do not account for Great Lakes boaters other than those renting commercial slippage. All three of these characteristics of Warner's data limit generalization to Michigan's current total Great Lakes boating population, but they are the only recent data available on Great Lakes boaters' expenditure patterns. In 1975, Han conducted a survey of registered boaters residing in southwestern Michigan. Han's sample was drawn from the registered boater population residing in both inland and coastal counties in this region. His data provide a basis for estimating the number of recreational boats using Michigan's Great Lakes. Schott (1975) utilized the data generated by both Warner and Han to derive estimates of Great Lakes Recreational Boating's impact on the economy of Michigan.

Schott estimated that Great Lakes boaters spent $125 million in 1973. He estimated that these expenditures stimulated enough additional spending to produce a total economic impact on Michigan's economy of between $209 million and $230 million. Great Lakes boater expenditures were estimated to have resulted in 8,931 jobs.

Schott noted that it was necessary to make several assumptions (e.g. southwestern Michigan Great Lakes boaters' expenditures are typical of Michigan's total Great Lakes boater population) to arrive at his estimates. For lack of better information, or methods, Schott's assumptions and basic methods will be followed herein. It does seem desirable, however, to adjust Warner's boater expenditure data to reflect the significant inflation that has occurred since his study was conducted. Various indices, such as the commonly reported consumer price index, can be used to adjust 1973 boater expenditures to reflect 1980 prices if one can assume that boaters consumed the same quantity and quality of products and services in 1980 as they did in 1973. Although there is some evidence to suggest boaters have, in fact, modified their expenditure patterns, especially with regard to fuel consumption, not enough information is available to objectively modify the expenditure patterns presented by Warner. Thus, the 1973 data collected by Warner will be inflated without adjusting for quantity or quality shifts that may have occurred.

1980 Estimates of Economic Impacts of Great Lakes Recreational Boating

Boater expenditures can be grouped as follows:

1. CRAFT RELATED EXPENDITURES which include all purchases associated with owning and operating a boat other than the initial cost of the boat itself.
2. TRIP RELATED EXPENDITURES which include all non-craft related purchases associated with participating in boating other than transportation costs associated with travel to and from boating destinations.
3. TRANSPORTATION EXPENDITURES associated with travel to and from boating destinations on the Great Lakes.
4. CRAFT PURCHASE EXPENDITURES for boats used primarily on the Great Lakes.

Estimates for each of these four groupings of expenditures are presented below.

Craft Related Expenditures

Craft related expenditures by craft type and size class are presented in Table 15. Thirteen expenditure categories were utilized by Warner to solicit craft related expenditures and both the 1973 mean annual values he derived and the 1980 price index inflated values are presented side by side in Table 15. The price indices utilized to adjust the 1973 values to 1980 levels are noted in the table footnotes. Finally, it should be noted that the sample size for both large (45+) motor and sail craft is small, and the resulting estimates are therefore of questionable reliability.

Trip Related Expenditures

All trip related expenditures except those associated with travel to and from the Great Lakes (e.g. gasoline for a vehicle) are reported in Table 16. Trip expenditures are broken down into eight categories, and the 1973 and 1980 estimates are presented side by side as in Table 15.

Mean annual craft and trip related expenditures are summarized in Table 17. The percentage increase in expenditures over the period 1973-80 are also presented in the table. These data do not include travel costs to and from Great Lakes boating destinations nor the original purchase price of craft. During this period, the overall cost of living increased by 81%. The costs of operating a boat on the Great Lakes, according to these estimates, are generally comparable to increases in overall cost of living with larger motor craft costs being somewhat greater and smaller motor craft and all sail craft costs being somewhat less than 81%.

The data in Table 17 can also be used to illustrate the relative operating cost differential between motor and sail craft. Both in 1973 and 1980, it cost

Table 15. Estimated Mean Annual Great Lakes Boater Craft Related Expenditures by Craft Type and Size.
(Original data collected in 1973 by Warner (1974) adjusted to reflect 1980 prices)

| EXPENDITURE CATEGORY (Index used to inflate 1973** costs to 1980 equivalents) | MOTOR CRAFT | | | | | | SAIL CRAFT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20-30' N=102 | | 30-45' N=89 | | 45'+ N=9 | | 20-30' N=79 | | 30-45' N=32 | | 45'+ N=1 | |
| | 1973$ | 1980$ | 1973$ | 1980$ | 1973$ | 1980$ | 1973$ | 1980$ | 1973$ | 1980$ | 1973$ | 1980$ |
| Pre-launch maintenance (1) | 148.56 | 268.89 | 322.39 | 583.53 | 679.56 | 1230.00 | 110.23 | 199.52 | 252.10 | 456.30 | NR* | NR |
| Launching fee (1) | 45.08 | 81.59 | 58.43 | 105.76 | 80.00 | 144.80 | 33.91 | 61.38 | 84.09 | 152.20 | NR | NR |
| Slip rental (1) | 207.69 | 375.92 | 284.29 | 514.56 | 499.78 | 904.60 | 182.43 | 330.20 | 247.25 | 447.52 | NR | NR |
| Boating equip - slip site (2) | 129.93 | 142.92 | 195.82 | 215.40 | 462.75 | 509.03 | 210.91 | 232.00 | 360.06 | 396.07 | NR | NR |
| Boating equip - home (2) | 226.59 | 249.25 | 159.14 | 175.05 | 235.00 | 258.50 | 93.96 | 103.36 | 321.13 | 353.24 | NR | NR |
| Boating equip - other (2) | 172.39 | 189.63 | 182.24 | 200.46 | 211.67 | 232.84 | 106.00 | 116.60 | 285.00 | 313.50 | NR | NR |
| Fuel and oil (3) | 217.90 | 636.27 | 427.61 | 1248.62 | 722.50 | 2109.70 | 24.91 | 72.74 | 75.93 | 221.72 | 100.00 | 292.00 |
| In-season maintenance (1) | 309.44 | 198.09 | 319.71 | 578.68 | 852.50 | 1543.03 | 33.57 | 60.76 | 97.31 | 176.13 | 1500.00 | 2715.00 |
| Craft haul-out (1) | 55.37 | 100.22 | 63.03 | 114.08 | 80.00 | 144.80 | 36.14 | 65.41 | 76.94 | 139.26 | NR | NR |
| Storage preparation (1) | 103.83 | 187.93 | 76.81 | 139.03 | 95.00 | 171.95 | 244.29 | 442.16 | 145.00 | 262.45 | NR | NR |
| Off-season storage (1) | 172.00 | 311.32 | 264.87 | 479.41 | 455.00 | 823.55 | 103.68 | 187.66 | 248.11 | 449.08 | NR | NR |
| Effluent pump-out (1) | 48.67 | 88.09 | 46.67 | 84.47 | 115.33 | 208.75 | 68.85 | 124.62 | 27.53 | 49.83 | 100.00 | 181.00 |
| Annual insurance (4) | 157.61 | 450.76 | 272.91 | 780.52 | 600.00 | 1716.00 | 121.91 | 348.66 | 288.12 | 824.02 | 1000.00 | 2860.00 |
| Total (rounded to nearest$) | 1795.00 | 3281.00 | 2674.00 | 5220.00 | 5089.00 | 9998.00 | 1371.00 | 2345.00 | 2509.00 | 4241.00 | 2700.00 | 6048.00 |

*NR = Not Reported

** 1 = general price index (multiplication factor = 1.81)
2 = sporting goods index (multiplication factor = 1.10)
3 = transportation - gasoline index (multiplication factor = 2.92)
4 = property insurance index (multiplication factor = 2.86)

Table 16. Estimated Mean Annual Great Lakes Boater Trip Related Expenditures Not Including Transportation Costs by Craft Type and Size. (Original Data collected in 1973 by Warner (1974) adjusted to reflect 1980 prices).

| EXPENDITURE CATEGORY (Index used to inflate 1973** costs to 1980 equivalents) | MOTOR CRAFT | | | | | | SAIL CRAFT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20-30' N=102 | | 30-45' N=89 | | 45'+ N=9 | | 20-30' N=79 | | 30-45' N=32 | | 45'+ N=1 | |
| | 1973$ | 1980$ | 1973$ | 1980$ | 1973$ | 1980$ | 1973$ | 1980$ | 1973$ | 1980$ | 1973$ | 1980$ |
| Groceries (1) | 192.28 | 324.95 | 365.66 | 617.97 | 336.75 | 569.11 | 163.04 | 275.54 | 301.12 | 508.89 | NR* | NR |
| Alcohol (2) | 124.91 | 191.11 | 156.65 | 239.67 | 129.78 | 198.56 | 78.16 | 119.58 | 155.48 | 237.88 | NR | NR |
| Prepared meals (3) | 151.77 | 276.22 | 210.22 | 382.60 | 211.25 | 384.48 | 106.73 | 194.25 | 241.18 | 438.95 | NR | NR |
| Off-craft lodging (4) | 26.93 | 41.20 | 16.29 | 24.92 | 0.00 | 0.00 | 45.75 | 70.00 | 0.00 | 0.00 | NR | NR |
| Recreation equipment - boating (5) | 155.44 | 170.98 | 152.43 | 167.67 | 226.25 | 248.88 | 102.17 | 112.39 | 111.45 | 122.60 | NR | NR |
| Rec. expenditures - non-boating (6) | 147.67 | 240.70 | 94.33 | 153.76 | 228.29 | 372.11 | 68.73 | 112.03 | 167.00 | 272.21 | NR | NR |
| Boating clothes (7) | 96.61 | 126.56 | 132.58 | 173.68 | 247.14 | 323.75 | 72.36 | 94.79 | 158.55 | 207.70 | NR | NR |
| Laundry costs (8) | 33.87 | 61.30 | 29.75 | 53.85 | 40.00 | 72.40 | 11.90 | 21.54 | 27.38 | 49.56 | NR | NR |
| TOTAL (Rounded to the nearest $) | 929.00 | 1,433.00 | 1,158.00 | 1,814.00 | 1,419.00 | 2,169.00 | 649.00 | 1,000.00 | 1,162.00 | 1,838.00 | | |

* = Not Reported

** 1 = food at home index (multiplication factor = 1.69)
2 = alcoholic beverage index (multiplication factor = 1.53)
3 = food away from home index (multiplication factor = 1.82)
4 = rent-residential index (multiplication factor = 1.53)
5 = sporting goods index (multiplication factor = 1.10)
6 = entertainment index (multiplication factor = 1.63)
7 = apparel index (multiplication factor = 1.31)
8 = general price index (multiplication factor = 1.81)

Table 17. Summary of Estimated Mean Annual Great Lakes Boater Craft and Trip Related Expenditures by Craft Type and Size.[a]

| Craft Type & Size Class | | Expenditures | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Craft Related | | | Trip Related | | | Total Craft And Trip Related | | |
| Motor Craft | | 1973$ | 1980$ | %Increase | 1973$ | 1980$ | %Increase | 1973$ | 1980$ | %Increase |
| 20-30' | N=102 | 1,795 | 3,281 | 83% | 929 | 1,433 | 54% | 2,724 | 4,714 | 73% |
| 30-45' | N=89 | 2,674 | 5,280 | 97% | 1,158 | 1,814 | 57% | 3,832 | 7,094 | 85% |
| 45' | N=9 | 5,089 | 9,998 | 96% | 1,419 | 2,169 | 53% | 6,408 | 12,167 | 87% |
| Sail Craft | | | | | | | | | | |
| 20-30' | N=79 | 1,371 | 2,345 | 71% | 649 | 1,000 | 54% | 2,020 | 3,345 | 66% |
| 30-45' | N=32 | 2,509 | 4,241 | 69% | 1,162 | 1,838 | 58% | 3,671 | 6,079 | 66% |

[a]Does not include travel related costs nor craft purchases

more to operate motor craft than sail craft in the same size class. In 1973, it cost about 35% more to operate a 20-30' motor craft than a sail craft in this size class. By 1980, this difference increased to 41%. The difference in operating costs of the 30-45' boat class was only 4% in 1973, but grew to 17% by 1980. These data support the commonly held perception that motor craft operating costs are increasing and at a greater rate than for sail craft ownership. Yet, the change has probably not been as dramatic as might have been expected.

Having developed updated Great Lakes boater expenditures by craft type and size, it is now possible to develop an estimate of total Great Lakes boater expenditures in Michigan for 1980. The procedure and results are presented in Table 18. Average annual expenditures by craft type and size are presented in column two. Estimates of the number of registered boats using the Great Lakes is presented in column three. Note that these estimates were developed from boating patterns of the 1974 southwestern Michigan registered boater population. The last column of Table 18 results from multiplying columns two and three. The total estimated Great Lakes boater expenditures for 1980 is $120,465,176. This figure does not include travel costs associated with getting to and from Great Lakes boating sites nor does it reflect boater expenditures for new (or used) boats purchased. Finally, it is likely a conservative estimate since the number of registered boats has grown over this period as discussed elsewhere in this report.

Transportation Expenditures

The 1977 Waterways Division boater origin-destination study was utilized to estimate miles traveled by Great Lakes boaters to and from boating sites. It was estimated that boaters traveled about 135 million miles in 1977. Assuming that the average per mile cost for operating a private automobile

Table 18. Estimated Mean Annual Craft and Trip Related Expenditures by Craft Type and Size for the Total Michigan Great Lakes Boating Population. [a]

| CRAFT TYPE & SIZE | 1980 Craft and Trip Related Expenditures | Estimated Number of * Boats Using Michigan's Great Lakes | Total Craft and Trip Related Expenditures |
|---|---|---|---|
| MOTOR CRAFT | | | |
| 20-30' | $4,714 | 14,002 | $66,005,428 |
| 30-45' | 7,094 | 4,830 | 34,264,020 |
| 45+ | 12,167 | 416 | 5,061,472 |
| SAIL CRAFT | | | |
| 20-30' | 3,345 | 3,227 | 10,794,315 |
| 30-45' | 6,079 | 699 | 4,249,221 |
| 45+ | 6,048 | 15 | 90,720 |
| TOTAL | | | $120,465,176 |

*Estimates from Schott (1975)

[a]Does not include travel related costs nor craft purchases

in 1980 was about 20¢ per mile and that there was no significant increase or decrease in miles traveled between 1977 and 1980, Great Lakes boaters expended about $27 million in travel expenses in 1980. Of this total, over $22 million was estimated to have been expended for gasoline purchases.

Craft Purchase Expenditures

The last major boater expenditure not thus far estimated is that of craft purchases. These may be estimated from sales and use tax collections on the sale of watercraft from the Revenue Division, Michigan Department of Treasury[1]. Sales tax is collected on sales of new boats at the rate of $.04 per dollar. The same rate is collected on used boat sales as a use tax.

In 1979-80 sales tax collections totalled $1.2 million dollars and use tax collections totalled $1.665 million dollars. At a rate of four percent on the dollar, this translates into $30.1 million dollars of new boat sales and $41.6 million dollars of used boat sales, for a combined total of $71.7 million dollars. In 1980 about 40% of registered boats used the Great Lakes (Stynes and Safronoff, 1981). Multiplying total boat sales by this percent yields an estimate of $29 million dollars in boat sales attributable to Great Lakes boating. It should be noted that Great Lakes boats are generally larger and more expensive than boats used on inland waters. This conservative bias in the estimates should, in part, compensate for the fact that about half of those boats using the Great Lakes also use inland lakes and streams.

The best estimate of total Great Lakes boater direct expenditures in Michigan thus is:

| | |
|---|---|
| Annual Craft and Trip related expenditures | $120,000,000 |
| Transportation expenditures | 27,000,000 |
| Craft purchases (new and used) | 29,000,000 |
| Total | $176,000,000 |

[1]Our thanks to Keith Wilson, Waterways Division, MDNR for bringing these data to our attention.

This direct expenditure total does not reflect the impact of respending of these dollars by recipients. Studies have revealed that subsequent spending often produces more than a double effect on an economy. The Michigan Travel Bureau currently uses a multiplier of 1.78 to reflect direct and subsequent spending impact of tourist dollars on Michigan's economy (Market Opinion Research, 1976). Applying this multiplier to direct Great Lakes boater expenditures yields a total economic impact on Michigan's economy from Great Lakes boating equal to about 313 million.

The number of jobs related to these expenditures, given the updating procedures employed, is not likely to be substantially different than Schott's estimate of 8,931. The inflation that has occurred in the products and services purchased by boaters is probably roughly equivalent to wage inflation. The estimated near doubling of boater expenditures between 1973 and 1980 has likely not resulted in significant increases in jobs. Thus, without evidence to the contrary, it seems that the best estimate of employment produced by Great Lakes boating is about 9,000 jobs.

In summary, of the two types of benefits associated with Great Lakes boating, it was not possible to develop even crude estimates of direct benefits which accrue to Great Lakes recreational boaters from boating since existing studies and secondary data sources are not available or not appropriate. It was possible to develop estimates of indirect benefits (economic impact) from a number of earlier studies. It was estimated that Michigan Great Lakes boaters spend about $176 million per year which, including subsequent spendings, yields a total impact on Michigan's economy of more than $300 million dollars. Approximately 9,000 full time jobs result from Great Lakes recreational boaters' expenditures. These estimates should be considered only crude at best given the long list of approximations employed in their

derivation. It is our subjective judgment that these estimates are likely conservative because we consistently favored conservative options throughout our analysis.

# CHAPTER IV

# BOATING AND ENERGY[1]

Significant increases in the price of gasoline and periodic fuel shortages during the 1970's prompted concern over the relationships between boating and energy use. Calls for the banning of boating and recreational travel on weekends, and predictions of significant changes in boating patterns were found to be lacking in adequate supporting data. While it seems clear that changes in the price and availability of gasoline will impact recreational boating, much data collection and research is needed to better assess the short and long term impacts and make informed policy and planning decisions. In this chapter we summarize existing data on energy-boating relationships. Additional research is presently underway to provide better information on these interrelationships.

We address two primary questions. First; "How much fuel is used in recreational boating in Michigan?" and second, "What are some of the likely impacts on boaters of increasing fuel prices?"

## Fuel Consumed by Boats

Recreational boating consumes gasoline in two ways (1) fuel consumed in travel to the boating site, and (2) fuel consumed in boats on site. The former can be estimated from travel patterns measured in the 1977 Boater Survey, if we make a few simplifying assumptions. Using county to county mileage estimates and applying these to county to county boater travel patterns from the 1977 Boater survey yields an average trip length of about 75 miles (round trip). Multiplying this times the 13.8 million boat days yields a total of 1,035 million miles of boater travel. Dividing by an estimated 20 miles per gallon, we estimate boaters consumed about 52 million gallons of fuel in travel to boating sites, or about 3.75 gallons per boat day. Great Lakes boating would account for roughly one third of these totals.

[1]Our thanks to Joseph Fridgen for providing preliminary estimates of fuel usage and review comments for this chapter.

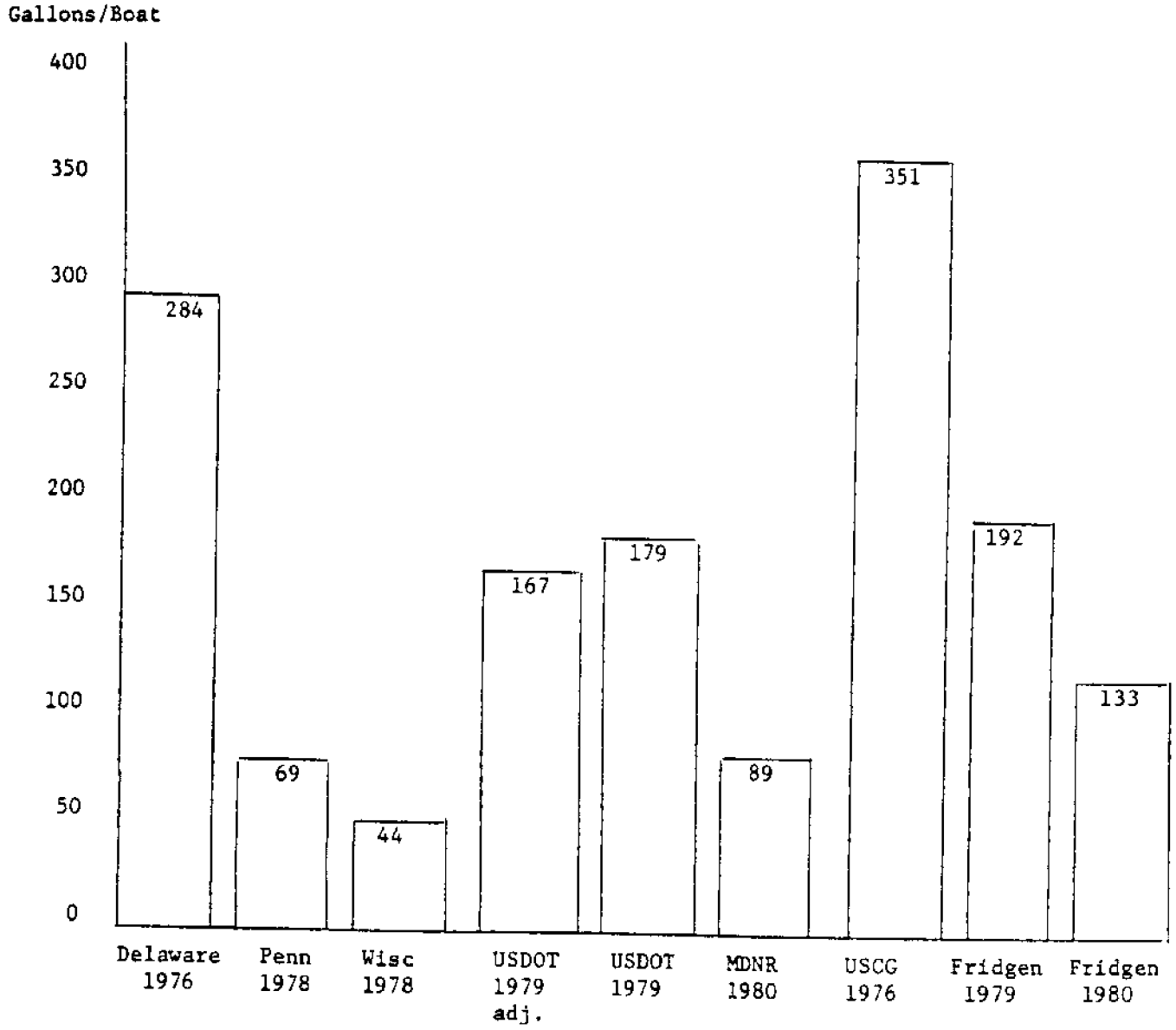


Figure 7. Estimates of Per Boat Fuel Consumption

The close proximity of boating opportunities to most of the Michigan population means that boating consumes less fuel in travel per participation than many other recreation activities in Michigan.

Fuel consumed by boats in Michigan is difficult to estimate. The state consumed 4.3 billion gallons of motorfuel in 1980. Michigan presently estimates that 1.023% of this went to marine fuel. This percentage is not empirically based, but is used to allocate gasoline tax revenues to boating programs in Michigan. The percentage was recently reduced from 1.25% after an increase in the motorfuel tax rate. Applying the 1.023% figure to the 4.3 billion gallons of motorfuel consumed in Michigan yields about 44 million gallons of marine fuel in 1980. This translates into about 89 gallons per active, powered registered boat.

A number of recent surveys suggest this estimate may be conservative. Attempts to estimate boat fuel usage directly indicate that an average boat uses closer to 150 gallons per year. Annual boat fuel consumption is estimated by asking boaters to recall their annual fuel consumption and then expanding these averages to the total active, powered fleet. Figure 7 presents the average per boat fuel use estimates from several recent studies. The wide variation in results is in part due to regional differences in makeup of the fleet and length of boating season. Differences in survey methods and sampling are also involved here. Bias is evident in some of the studies.

Our review of the methods and results of these studies suggests that Fridgen's recent study in Michigan is the most accurate estimate for Michigan. Fridgen estimated boat fuel use in both 1979 and 1980. Consumption dropped from an average of 192 gallons per boat in 1979 to 133 gallons in 1980. A recent U. S. Department of Transportation (1979) report yields comparable figures. Nationally they estimated 179 gallons of fuel per registered boat. Adjusting

these figures to reflect the makeup of the Michigan boating fleet (see Table 19) yields an average of 167 gallons per boat for 1980 (Table 20). Mannesto (1981) estimated an average fuel consumption of 185 gallons per boat in a sample of Michigan boat show attendees in 1979. Unless there is a common upward bias in consumer reporting of fuel usage in these surveys, the comparability of these results suggests the true percent of motorfuel use by boats is closer to 1.75% than the present 1.023%.

Multiplying the per boat fuel usage estimates times the number of active, powered craft yields an estimate of total marine fuel consumption (Table 19). We have assumed that categories of inboard, outboard, sail/aux., canoe, and pontoon are powered craft. Total registered boats in these categories were reduced by 10% to reflect inactive boats. Empirically-based estimates range from 66 million gallons to 89 million gallons. Fridgen's 1980 estimate was made about half way through the 1980 boating season. Boaters were asked to estimate their anticipated use for that year. The 66 million gallon figure may therefore represent either a real reduction in fuel consumption in 1980 or a tendency among respondents to anticipate a reduction. For this reason we recommend a figure of 150 gallons per boat or about 75 million gallons of marine fuel (Table 19).

Combining this estimate with our previous estimate of fuel consumed in travel to boating sites gives a total of about 127 million gallons of fuel for boating, divided about 40 percent for travel to boating sites and 60 percent for on-site fuel use.

If Fridgen's fuel use figures are accurate, they indicate that boaters conserved about 20 million gallons of fuel in 1980. Sensitivity to fuel prices among boaters was greater than among motorists, as total motorfuel use dropped 11% while boat fuel use dropped 25% between 1979 and 1980.

Table 19. Michigan Boat Fuel Use By Boat Type

| Boat Type | No. of Active Boats[a] 1980 | Avg. Annual Fuel Use (gallons)[b] | Total Fuel Use (1000 gals) |
|---|---|---|---|
| Inboard | 60,122 | 282 | 16,954 |
| Outboard | 393,955 | 160 | 63,032 |
| Sail/Aux. | 1,632 | 41 | 67 |
| Canoe | 10,371 | 18 | 186 |
| Pontoon | 29,997 | 90 | 2,700 |
| TOTAL | 496,077 | 167 | 82,940 |

[a] Michigan Secretary of State, registration statistics for 1979 and 1980

[b] U.S. Department of Transportation (1979)

Table 20. Michigan Boating Fuel Consumption - Selected Estimates

| Study | Gallons/Boat X | # of powered craft (1000's)[a] = | Total Boat Fuel (million gals) | State motorfuel consumption (million gals)[b] = | Boat fuel as % of Total motorfuel |
|---|---|---|---|---|---|
| Michigan Admin. percent | 89 | 496 | 44 | 4,269 | 1.030 |
| USDOT, National average | 179 | 496 | 89 | 4,269 | 2.084 |
| USDOT, Adjusted to Michigan | 167 | 496 | 83 | 4,269 | 1.944 |
| Fridgen 1980 | 133 | 496 | 66 | 4,269 | 1.546 |
| Fridgen 1979 | 192 | 460 | 88 | 4,782 | 1.840 |

[a] Michigan Secretary of State, registration statistics for 1979 and 1980 less 10% for inactive craft. Figures include all inboards, outboards, canoes sail/aux., and pontoon boats as powered craft.

[b] Michigan Energy Administration, Dept. of Treasury, Motor Fuel Tax Division. Estimate is 4,269 for 1980 and 4,782 for 1979.

Impacts of Energy Trends on Boating

Changes in boating patterns resulting from a changing energy picture have only just begun to be documented in studies like Fridgen's. The apparent drop in fuel usage between 1979 and 1980 is indicative of some short-term adjustments. We have also seen some evidence of longer range adjustments such as increases in sailboating, a slowdown in the trend toward larger boats, and reduced trailering. DNR data on transient traffic in public marinas along the Great Lakes shows an increase in sailing craft and a reduction in powered craft, suggesting that large powered craft are staying closer to port and doing less long range cruising (Table 21). The availability and popularity of boating in Michigan indicates that most boaters will utilize a variety of coping strategies before dropping out of the boating market. These include boating less, taking fewer cruises, spending more time in port, doing less waterskiing, and other methods of conserving fuel and costs without giving up boating as a recreation pastime. Impacts of energy prices on boating will be explored further by Fridgen in future reports.

Table 21. Sail and Powerboat Transient Boating Traffic in Great Lake Public Marinas by Region, 1979 - 1980.

| Regions | Year | Powerboats Total | % Change | Sailboats Total | % Change | Sailboat portion of total |
|---|---|---|---|---|---|---|
| I | 1979 | 5452 | | 1540 | | 22.0% |
| Southeast Michigan | 1980 | 4975 | -8.% | 1913 | +24.2 | 27.8% |
| II | 1979 | 3766 | | 3836 | | 50.5% |
| Northeast Michigan | 1980 | 3660 | -2.8 | 4801 | +25.1 | 56.7% |
| III | 1979 | 5204 | | 5779 | | 52.6% |
| Northwest Michigan | 1980 | 4383 | -15.8 | 6743 | +16.7 | 60.6% |
| IV | 1979 | 1878 | | 1900 | | 50.3% |
| Southwest Michigan | 1980 | 1803 | -4.0 | 1993 | +4.9 | 52.5% |
| V | 1979 | 4291 | | 1632 | | 21.0% |
| Upper Peninsula | 1980 | 3785 | -11.8 | 2022 | +23.9 | 26.5% |

Source: DNR Waterways Division -- yearly summary reports from public marinas

# REFERENCES[1]

Mannesto, Gregory. 1981. Changes in Boat Use and Purchases Resulting from the Energy Situation. Cooperative Extension Service Bulletin E-1479. Michigan State University.

Market Opinion Research. 1976. The Travel Market for Michigan 1976. Prepared for Michigan Department of Commerce and the Michigan Travel Bureau.

Marmo, Albert J. "National Boating Trends." In Proceedings 1980 National Outdoor Recreation Trends Symposium. Volume I: 135-146. Northeast Forest Experiment Station, Broomall, PA. (USDA For. Ser. Gen. Tech. Rep. NE-57).

Stynes, Daniel J. and David Safronoff. 1981. 1980 Michigan Recreational Boating Survey. Department of Park and Recreation Resources, Michigan State University.

U.S. Coast Guard. 1981. U.S. Coast Guard Boating Statistics 1980. U.S. Government Printing Office.

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[1] This listing does not include primary references listed in Figure 1 and annotated in Appendix A.

# APPENDIX A

## ANNOTATED BIBLIOGRAPHY OF RELATED RECREATION AND BOATING RESEARCH STUDIES

I. WATERWAYS DIVISION STATEWIDE BOATER SURVEYS

II. NATIONAL, REGIONAL, AND STATEWIDE GENERAL RECREATION PARTICIPATION STUDIES

III. NATIONAL AND REGIONAL BOATING STUDIES

IV. SELECTED BOATING STUDIES WITHIN MICHIGAN

## I. WATERWAYS DIVISION STATEWIDE BOATER SURVEYS

Waterways Division, MDNR, sponsored statewide mailed surveys of registered boaters in 1965, 1968, 1971, 1974, and 1977. Since these surveys have employed fairly consistent survey techniques on a regular basis, they constitute the best source of trend data on boating in Michigan. Minor refinements in questionnaire design, sampling, and follow-up procedures have been made over time to improve the accuracy of boating estimates developed from these surveys.

Outdoor Recreation Planning in Michigan by a Systems Analysis Approach: Part III: The Practical Application of "PROGRAM RECSYS" AND "SYMAP". Michael Chubb. Technical Report #12. State Resource Planning Program. Michigan Dept. of Conservation. Lansing, Michigan. 1967.

*This study uses data from the Waterways Commission 1965 survey of boat owners to illustrate the application of state-of-the-art planning models for boating. The RECSYS-SYMAP program is a computer-based systems model for predicting statewide flows. Origin-destination data is used to calibrate a gravity type model of boating patterns. The model includes population data at origins, an extensive state highway network, and attractiveness/supply indices at destination. Flows are depicted graphically using computer mapping techniques (SYMAP). Simulations may be carried out on the model to forecast future boating levels and assess statewide impacts of planning decisions.*

*This initial Waterways survey of 13,760 registered boat owners resulted in 5,218 responses. The sample was stratified by size class. No follow-up mailings were used. This report analyzes boating use patterns by county of origin and destination. The 1965 survey collected data for the "boat used most often" in households owning more than one boat. The report includes a review of statewide recreation planning techniques, a discussion of the RECSYS-SYMAP approach, and boating projections to 1980.*

Planning Recreational Boating Facilities in Michigan. James Oakwood and Michael Chubb. Recreation Research and Planning Unit Technical Report #1. Michigan State University. 1968.

*A critique with recommendations to Waterways Division on planning techniques was developed prior to the 1968 survey. This report evaluates the 1965 survey, proposes criteria for an ideal planning approach, and recommends a comprehensive planning process for Waterways Division. Most of the recommendations in this report were incorporated into future boating surveys.*

1968 Michigan Recreational Boating Study. Michael Chubb. Dept. of Park and Recreation Resources, Michigan State University. 1971.

*The 1968 boater survey closely paralleled the 1965 survey. Sample size was increased to 21,764 and information was requested for the registered boat sampled, instead of the "boat used most often." Socio-economic data were collected. Only 5,647 useable responses were obtained. Analysis was similar to the 1965 study.*

1971 Michigan Recreational Boating Study. Recreation Resource Consultants. Report No. 2. East Lansing, Michigan. 1972.

*The 1971 study was similar to the 1968 survey. Five percent of small craft and twenty percent of large craft were sampled, except in urban counties. In these counties a smaller sample was selected. Total sample size was 13,204; 9,600 useable responses were coded.*

*The major differences between the 1968 and 1971 surveys were that: 1) follow-up mailings were used in 1971, increasing response rate from approximately 38% in 1968 to 73% in 1971; and, 2) sample selection was stratified by the number of registered boats in each county to insure an adequate response from each county. As in the previous studies, programs RECSYS and SYMAP were used for data analysis.*

1974 Michigan Recreational Boating Study. Recreation Resource Consultants. Report No. 4. East Lansing, Michigan. 1975.

*This survey was identical to the 1971 survey except for sample size and the rewording of a few questions. Sample size was 14,460, with 10,498 useable responses. The RECSYS-SYMAP analysis routines were no longer used after 1971. Analyses of the 1974 survey include boat storage, launchings, use patterns by origin and destination, and boating safety and law enforcement.*

1977 Michigan Recreational Boating Survey. Michigan Department of Natural Resources. Waterways Division. Lansing, Michigan. 1979.

*The 1977 survey instrument was identical to that used in 1974. The major change between this and previous surveys was that sample size for each county was based on the number of boating days (determined in the 1974 survey) generated by each county. Sample size was 17,120, with a useable response of 13,933.*

*Analysis routines were the same as those used in the 1974 survey. The 1977 survey report was produced in-house. The report provides tables of estimates of boating use by county of origin and county of destination. Boating use is divided by boat size class and Great Lakes vs. Inland Lakes. A very brief text accompanies the tables.*

## II. NATIONAL, REGIONAL, AND STATEWIDE GENERAL RECREATION PARTICIPATION STUDIES

Upper Great Lakes Regional Recreation Planning Study - Part Two: Recreation Demand Survey and Forecasts. Upper Great Lakes Regional Commission. Recreation Resources Center. University of Wisconsin. 1974.

*This study was undertaken for purposes of collecting data on trips and recreation activities of families visiting the Upper Great Lakes region. The study also projects trips and participation in outdoor recreation activities in the Upper Great Lakes region to 1980 by multi-county zones and by major outdoor recreation activities based on a regional survey. The primary demand region includes nine states which are within and surrounding the UGL region -- Michigan, Minnesota, Wisconsin, North Dakota, South Dakota, Iowa, Illinois, Ohio, and Indiana.*

*The survey was conducted during October and November, 1972. A telephone survey of 6,440 households in the nine-state area was made. Data on socio-economic characteristics, recreation trips over the preceding 12 months, availability of recreation facilities, recreation activity participations, and residence during youth of adult respondents was collected.*

*Using socio-economic, supply and youth-related factors as predictors, multiple regression prediction equations were estimated for the percent of families taking trips, visiting the Upper Great Lakes region, and participating in each of twelve recreation activities, including boating. These equations were used to project participation to 1980.*

1974 Michigan Recreation Plan. Michigan Department of Natural Resources. Office of Planning Services. Lansing, Michigan. 1975.

*The 1974 Michigan Recreation Plan was instituted in order to provide a comprehensive review of recreation opportunities in Michigan. Special attention was paid to the need for recreation opportunities in urban areas.*

*Four studies provided information used in the formulation of the conclusions of the Recreation Plan. The most important was the 1972 Michigan Recreation Survey. This was a telephone survey of 10,241 Michigan households. This survey solicited information on origin-destination patterns, participation rates, and socio-economic characteristics of recreation participants.*

*Categories of boating activity measured in the survey included 1) canoeing, 2) power boating, including waterskiing, and 3) other boating. The authors note confusion and double reporting resulting from these categories.*

1974 Michigan Recreation Plan (Con't)

*Other surveys reported in the 1974 Plan include a State Park Day Use survey, a local government facilities survey, and a campground survey.*

Michigan 1976 Recreation Design and Application. Michigan Department of Natural Resources. Recreation Services Division. 1976.

*This report summarizes the methods used in designing, administering and analyzing the 1976 Michigan Recreational Survey. The survey was initiated to provide information about recreation participation by Michigan residents.*

*The 1976 Michigan Recreation Survey employed an innovative design. The survey was administered from January through December, 1976. Individuals within 17,781 randomly selected households reported recreation activity within the two weeks prior to being contacted. A new sample was drawn every two weeks throughout the year. The survey did not employ a fixed list of recreation activities, but coded open ended responses into one of 130 different categories. Boating-related categories included 1) canoeing, 2) kayaking, 3) rowing, 4) sailing, 5) power boating, 6) water skiing, 7) river rafting, 8) tourist boat trip, 9) fishing from boat-Great Lakes, 10) fishing from boat-inland lake, 11) fishing from boat-stream, 12) fishing from boat-ocean, and 13) other watercraft.*

*Recreation participation was divided between day and overnight trips. The survey collected a wealth of data including expenditures, origin-destination, provider, and socio-economics. The design results in estimates of "participations" rather than the more traditional participation rates.*

1979 Michigan Recreation Plan. Michigan Department of Natural Resources. Lansing, Michigan. 1979.

*This recreation plan was similar in format to the 1974 Michigan Recreation Plan. Its purpose was to measure the recreation opportunities available to Michigan residents. It was also to provide a basis for policy direction and as a foundation for guiding and setting priorities for program direction. The report presents major issues and problems of resource management, identifies needs and recommends actions to meet those needs. The survey used to provide data for this study was the Michigan 1976 Recreation Survey described above.*

The Third Nationwide Outdoor Recreation Plan. Appendix II. Survey Technical Report 2: Survey Methodology and Process. Heritage Conservation and Recreation Service. U.S. Department of the Interior. Washington, D.C. 1979.

*Survey technique for this study involved two separate surveys.*

The Third Nationwide Outdoor Recreation Plan (Con't)

*The first was a national telephone survey of 4,029 respondents, conducted in June, 1977. The second survey was a personal interview survey of 13,829 persons at 155 Federal recreation areas during the winter, summer and fall of 1977.*

*The survey measured activity participation, socio-economic characteristics of participants, opinions about the importance of recreation, user satisfaction, and preferences regarding the allocation of Federal funds for recreation.*

*The survey included five boating related activities: 1) canoeing, kayaking, and river running; 2) sailing; 3) water skiing; 4) fishing; and, 5) other boating. Participation was also estimated for 25 other recreation activities.*

## III. NATIONAL AND REGIONAL BOATING STUDIES

Great Lakes Basin Framework Study, Appendix No. R9, Recreational Boating. Great Lakes Basin Commission. Ann Arbor, Michigan. 1972.

*This report contains the recreational boating information compiled as part of the Great Lakes Basin Framework Study. Data for the report was collected from existing state and federal boating studies of the Great Lakes region. No primary information was collected. The states involved in the study were the eight states bordering the Great Lakes. Data were aggregated and analyzed for five Great Lakes basin drainage regions and fifteen subregions.*

*Six criteria were determined to be within the scope of the study. They were:*

1) *To determine the size, composition, and areal distribution of the recreational boat fleet.*
2) *To determine the opportunities available for meeting the recreational boating requirements by evaluating the existing and potential capacity of the basin's surface waters.*
3) *Forecast fleet size and demand-supply relationships for the periods 1980, 2000, and 2020.*
4) *Evaluate a number of relevant structural and non-structural alternatives to meet existing and projected requirements.*
5) *Prepare a water resources development and management program for recreational boating, and provide cost estimates for program elements.*
6) *Develop priorities for future studies, investigations and research to be considered as part of the Great Lakes basin framework.*

Lake Michigan Regional Boating Survey and Analysis. Department of the Army, Corps of Engineers. Chicago District. Economic Branch. 1974.

*The objectives of the Lake Michigan Recreational Boating Study were two-fold. The first objective was to describe and analyze the present patterns of boating on Lake Michigan via the information provided by a sample survey of boaters in the region. The second objective was to estimate the change in demand for Lake Michigan boating facilities. The region of Lake Michigan which was studied in this report extended from Escanaba Harbor in Upper Michigan south along the western coast of Lake Michigan to Benton Harbor in Michigan. In addition, all the harbors on Green Bay and Lake Winnebago were included in the study region.*

*Forty-five hundred mail questionnaire instruments were sent to residents of counties within approximately 50 miles of Lake Michigan, Lake Winnebago, or Green Bay; 2,030 useable responses were returned. The survey was designed to solicit information about the largest boat owned by the respondent.*

*The data were analyzed by means of a multiple regression model. These data included socio-economic, transportation, dockage and cost information. An economic benefit evaluation of boating on Lake Michigan was also performed. This was done by calculating the total present dollar cost of boating incurred by the boat owner through the useful life of the boat.*

Great Lakes Basin Framework Study: Appendix 21, Outdoor Recreation. Great Lakes Basin Commission. Ann Arbor, Michigan. 1975.

*This report is part of a comprehensive planning study for the entire Great Lakes Basin. The study relies upon existing data sources to develop an outdoor recreation plan for the Basin. A general analysis of supply and demand is presented by sub-region, along with recommendations to improve the quality and quantity of outdoor recreation opportunities. Recreational boating is treated separately in Appendix R9.*

Recreational Boating in the United States in 1973 and 1976: The Nationwide Boating Survey. U.S. Coast Guard. Washington, D.C. 1978.

*This study was conducted by means of telephone surveys of a stratified random sample of about 24,000 households conducted in the first half of 1974 and repeated (with a different sample of the same size) in 1977. Telephone interviews were conducted with 5,500 households who had owned or operated boats during the preceding year, and briefer interviews were conducted with 18,000 non-boating households. Estimates were developed of various characteristics of the nation's recreational boaters and their boats, with a particular emphasis on safety related characteristics.*

Energy Conservation Potential of Recreational Boating Activity. Weinblatt, Herbert, and Michael Lawrence. U.S. Department of Transportation, Washington, D.C. 1979.

*This report examines energy consumption by recreational boaters. It summarizes energy related surveys conducted by the U.S. Coast Guard, the boating industry, and several private, state and federal agencies. Information on the recreational boating fleet, including discussions of types of boats and engines and the fuel-consuming characteristics of the fleet are presented. Data on recent trends in fleet size and composition are reported, and expected changes in fleet size and fuel consumption through the year 2000 are discussed. Comparisons of various conflicting data sources are presented. The conclusion of the report presents some potential public policy options which might lead to a reduction in fuel used for recreational boating.*

## IV. SELECTED BOATING STUDIES WITHIN MICHIGAN

Public Marina Impact on Local Employment. Recreation Research and Planning Unit. Department of Park and Recreation Resources. Michigan State University. 1971.

*The purpose of this study was to measure the economic impact of a new marina site in a small Michigan city (population 10,000). This was done to provide documentation for the use of Economic Development Agency funds for marina construction. Because of a wish for anonymity by residents of the area, the study region was not identified in the report.*

*The method of analysis was a time series examination of employment, gross sales in boat-related economic sectors, and attendance. Secondary data were collected for the period 1955-1967, and primary data were collected for the study year, 1968. Employment before and after completion of the marina was compared in order to identify employment which could be attributed, both directly and indirectly, to the marina operation.*

*The effects of the marina were measured using a least squares estimation procedure. The result of the study indicated the addition of approximately six full-time jobs in the study area.*

1970 Gasoline Consumption Study for Out-of-State Boaters Operating in Michigan's Great Lakes Waters. Chubb, Michael and Wenner, Kenneth. Department of Park and Recreation Resources. Michigan State University. 1971.

*This study was designed to provide an estimate of the amount of gasoline purchased in Michigan for recreational boats registered at out-of-state locations and entering Michigan by water. The study was done by means of surveying Michigan marina operators. In 1970,*

1970 Gasoline Consumption Study (Con't)

*there were 509 marinas operating in the state. Of these, 31 provided information on sales of gasoline to out-of-state boaters for the period from June 15 to September 30. From this sample, gasoline consumption for out-of-state craft was calculated.*

*Gasoline purchases for all Michigan marinas were solicited from gasoline distributors. Given total marina sales, the percentage of gasoline used by out-of-state boaters was calculated. The major conclusions of the report were that Michigan marinas sold 7 million gallons of gasoline in 1970, of which 850,000 gallons were purchased by out-of-state boaters.*

An Analysis of Recreational Boating Expenditures (A Study of Lake Michigan Boaters. Warner, Thomas. M.S. Thesis. Michigan State University. 1974.

*This study measured boating related expenditures of boaters using Great Lakes marinas located on the western (Lake Michigan) coast of Michigan. Mail surveys were sent to 500 boaters that used nine selected marinas. Three-hundred and twelve useable responses were received.*

*The three primary purposes of the study were to determine 1) the extent to which socio-economic status characteristics affected boating expenditures, 2) to what degree craft type and size were factors related to expenditures, and 3) whether differences in craft utilization due to travel time or length of boating participation affected spending for recreational boating.*

*Data was analyzed using regression analysis and non-parametric two-way analysis of variance techniques. The results of the analysis of socio-economic characteristics showed that increases in income, family size, and age of the craft owner had a positive impact on boating expenditures. As the craft owner's level of education increased, expenditures decreased. Other significant findings were: 1) owners of motorized craft spend more on boating activity than owners of sail craft; 2) expenditures increased with craft size; 3) the greater the distance and/or travel time between the boat owner's residence and the marina, the greater the expenditures made by the boater; 4) the greater the number of days the boat was used, the greater the expenditures; 5) the longer the craft is kept in the water, the greater the expenditures; and 6) as boat maintenance increases, boating expenditures decrease.*

Projecting Use of a Proposed New Lake Michigan Marina -- A Spatial Analysis Approach. Han, Chien. Ph.D. Thesis. Michigan State University. 1975.

*The purpose of this study was to estimate the magnitude of the potential use for a proposed marina at Benton Harbor-St. Joseph, Michigan. The methodology used in the study was a spatial analysis*

Projecting Use of a Proposed New Lake Michigan Marina (Con't)

*approach. The basic concept of this method is that the number of visitors using a marina is a function of the distance to the marina site.*

*Two mail questionnaires were used to collect data. One was sent to marina operators, and was used to gain information about the availability of dockage in the study region. The other was sent to boaters, and provided data on the demand for slippage in the study area.*

*The conclusions of the study were that there was insufficient dockage in the study area. Demand was found to vary inversely with the distance between potential users and the proposed site. It was also found that intervening facilities were a major factor in determining the potential use of a site. The estimated number of boaters decreased drastically when the factor of intervening facilities was introduced into the analysis.*

The Impact of Great Lakes Recreational Boating on the Economy of Michigan. Schott, Robert. M.S. Thesis. Michigan State University. 1975.

*The goal of this study was to estimate the impact of Great Lakes recreational boating on the economy of Michigan. This impact was measured and reported in three different ways: 1) dollar flow into the economy of Michigan; 2) dollar flow into individual industries within the economy; and, 3) the number of jobs created within these industries. Two study regions for data collection and analysis were designated: (Region 1) SW Michigan, NW Illinois, and NE Indiana; (Region 2) the entire state of Michigan. Expenditure data were obtained from surveys conducted by Warner (1974) and Han (1975).*

An Estimation of User Benefits Associated With the Michigan Public Access Site Program for Inland Lakes. Thomas D. Warner. Ph.D. Dissertation Dept. of Resource Development. Michigan State University. East Lansing. 1976.

*This study estimated total dollar benefits to users of Michigan's 339 inland lake access sites at $20 billion dollars annually. The travel cost method was applied to data collected at 16 public access sites in order to estimate demand curves for these sites. Demand curves were estimated for each of the 16 sites and more general regional and statewide models were developed and applied to non-surveyed public access sites. Use prediction models were tested against actual site use for sites with vehicle counters.*

Predicting Use Levels for Michigan's Public Access Sites : A Multiple Regression Approach With an Emphasis on Site Attractiveness.
James Sluyter. M.S. Thesis. Dept. of Park and Recreation Resources. Michigan State University. East Lansing. 1977.

*This study developed and tested refinements in use estimation models developed by Warner in the above study. Refinements included aggregating origin zones into concentric rings around each site, separating boating from non-boating use of public access sites, and adding attractiveness and accessibility variables to the prediction model. The refinements resulted in some improvements in the predictive ability of Warner's model based upon vehicle counter data. The wide variability in boating access site characteristics and hypothesized inaccuracy of vehicle counter data posed difficulties in generalizing the model from the 16 sampled sites.*

## APPENDIX B

### COMPUTER DATA BASE - MICHIGAN RECREATIONAL BOATING

The following data bases have been assembled and stored on tape at Michigan State University. Researchers or planners wishing to access these files should contact the Department of Park and Recreation Resources, Michigan State University for access and retrieval procedures.

1. WATERWAYS 1977 RECREATIONAL BOATING SURVEY

    a. Sample of 13,933 registered boaters
    b. Origin-destination data by county for Great Lakes and inland boating, transporting of boats, launching, storage, and boating safety.
    c. FILES include a raw data file of survey data, an SPSS file, and FORTRAN programs for analysis of origin-destination patterns.

2. MICHIGAN 1976 RECREATION SURVEY

    a. A telephone survey of 17,781 households in Michigan
    b. Comprehensive data on socioeconomics, recreation participation, trips, expenditures on trips. Includes 73,890 recreation participations, 3896 of which involve boating in 13 boating activity categories.
    c. FILES include a raw data file of participants, raw data file of participations, and SPSS file of boating participations.

3. 1980 SEA GRANT RECREATION BOATING SURVEY

    a. Sample of 3341 registered boaters
    b. Data comparable to 1977 WATERWAYS survey plus socioeconomics, boating activity, reasons for boating, evaluations of quality & quantity of local boating opportunities.
    c. FILES include a raw data file, an SPSS file, and origin destination matrices for boating activity by county.

Other boating data bases for Michigan will be added to these as they become available.

## APPENDIX C

## DEVELOPMENT OF MICHIGAN GREAT LAKES BOATING REGIONS

An examination of regionalizations presently in use within Michigan resulted in a decision to develop regions specifically tailored to Great Lakes boating rather than to employ existing multiple use regionalizations. Three criteria were used to develop the Great Lakes boating regions:

1. The regions should reflect Great Lakes boating market areas.
2. Regions should be assembled as collections of counties and should be geographically connected.
3. Regions should to some extent reflect recognized sub-areas of the Great Lakes shoreline in Michigan.

Data from the 1977 Recreational Boating survey were analyzed in order to develop market-oriented Great Lakes boating regions. The regionalization employed in the 1977 Boater survey is depicted in Figure C-1. Table C-1 breaks down the GL boat days generated by origin and destination region. Notice that inland regions are not associated with their coastal markets in this regionalization. Even regions with coastal counties send as much as 68% of their GL boat days out of the region.

In developing a market-oriented regionalization we utilized county to county origin-destination data from the 1977 survey to group counties into regions. The regionalization was begun by examining the origin-destination patterns of Great Lakes coastal counties. Adjacent counties were examined for flow interactions. Counties with large intercounty flows were grouped. Counties adjacent to these groups were then examined for participation interactions with the preliminary groups. Those with strong flows to or from the groups were included in the group. This process was iterated until nine regions became distinct. It was felt that further aggregation would

obscure regional differences, and these groups were finalized. A tenth region, representing out-of-state participations, was also added to the regionalization. Once coastal regions had been established, inland counties were assigned to regions. Each inland county was assigned to the contiguous region that received the majority of GL boat-days of participation generated within the county. This assignment process was designed to identify flows of participation from inland counties to the coastal region of greatest participation, allowing for interregional flow comparisons.

Table C-2 summarizes 1977 boating activity in Michigan for the Great Lakes boating regions. An average of 82% of all GL boat days generated in Michigan remains within the region of origin. More importantly, over 60% of the market area of each Great Lakes destination region is included within the region, with most regions containing more than 75% of their market. This is a significant improvement over the present DNR regionalization.

Table C-3 illustrates the performance of the regionalization on coastal and inland portions of each region. A quite consistent 90% of boat days generated within coastal portions of the region remain within the region. An average of 59% of boat days from inland portions of the regions remain in region of origin. The Michigan Great Lakes boating regions graphically illustrate the east-west split in the lower peninsula and depict a northward and westward consumer orientation for Great Lakes boating in Michigan (see Figure 3, page 13).

Figure C-1. Michigan Planning Regions

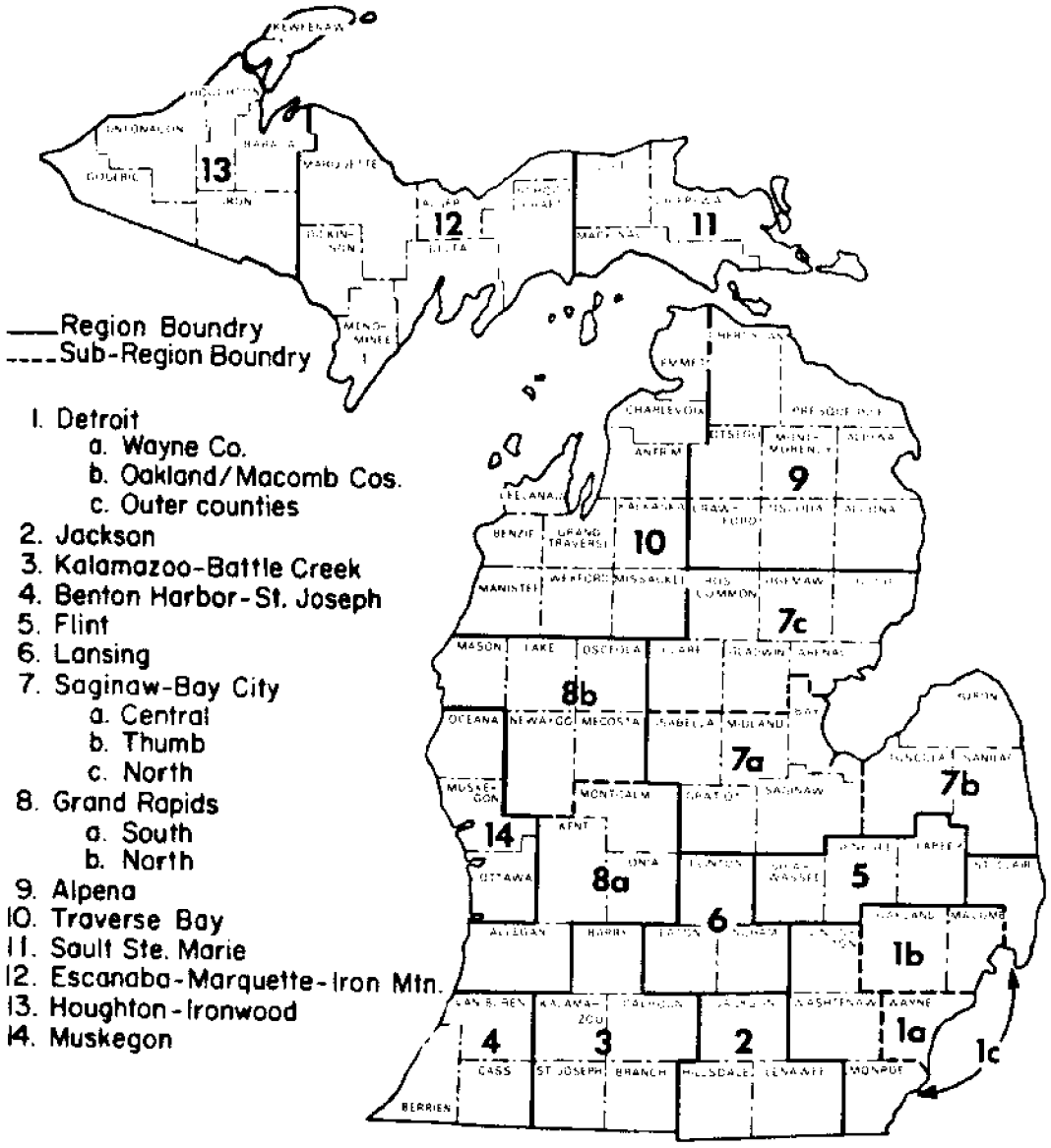

Table C-1. Great Lakes boat-days generated by MDNR regions

| Region | Boat-Days Generated (1000's) | Boat-Days Remaining In Region (1000's) | Percent Remaining In Region |
|---|---|---|---|
| 1 | 2190 | 1881 | 85.89 |
| 2 | 21 | 0 | 0.0 |
| 3 | 73 | 0 | 0.0 |
| 4 | 151 | 128 | 84.77 |
| 5 | 108 | 0 | 0.0 |
| 6 | 71 | 0 | 0.0 |
| 7A | 225 | 105 | 46.67 |
| 7B | 79 | 71 | 89.87 |
| 7C | 48 | 39 | 32.88 |
| 8A | 156 | 36 | 53.21 |
| 8B | 28 | 14 | 50.00 |
| 9 | 103 | 72 | 69.90 |
| 10 | 186 | 179 | 96.24 |
| 11 | 146 | 139 | 95.21 |
| 12 | 103 | 94 | 91.26 |
| 13 | 75 | 72 | 96.00 |
| 14 | 285 | 242 | 84.91 |
| Out-of-State | 145 | 0 | 0.0 |
| Totals | 4193 | 3072 | 73.26 |

Source: Analysis of 1977 Michigan Recreational Boating Study, Raw Data Tapes

Table C-2. Great Lakes Boat-days generated by Great Lakes Boating

| Region | Boat-Days Generated (1000's) | Boat-Days Remaining In Region (1000's) | Percent Remaining In Region |
|---|---|---|---|
| 1 | 2198 | 1883 | 85.67 |
| 2 | 343 | 211 | 61.52 |
| 3 | 413 | 326 | 78.45 |
| 4 | 429 | 295 | 68.76 |
| 5 | 85 | 67 | 78.82 |
| 6 | 189 | 180 | 95.24 |
| 7 | 210 | 196 | 93.33 |
| 8 | 134 | 122 | 91.04 |
| 9 | 48 | 43 | 89.58 |
| Out-of-State | 145 | 0 | 0.0 |
| Totals | 4194 | 3323 | 79.23 |

SOURCE: Analysis of 1977 Michigan Recreational Boating Survey, Raw Data Tapes

Table C-3. Great Lakes Boat-days generated within coastal and inland portions of Great Lakes Boating Regions

| Region | Coastal Portion of Region | | | | Inland Portion of Region | | | |
|---|---|---|---|---|---|---|---|---|
| | Participation Generated (1000's) | Percent of Total | Remaining In Region (1000's) | Percent Remaining | Participation Generated (1000's) | Percent of Total | Remaining In Region (1000's) | Percent Remaining |
| 1 | 1837 | 43.8 | 1642 | 89 | 361 | 8.6 | 241 | 67 |
| 2 | 179 | 4.3 | 159 | 89 | 164 | 3.9 | 51 | 31 |
| 3 | 285 | 6.8 | 242 | 85 | 127 | 3.0 | 84 | 66 |
| 4 | 182 | 4.4 | 159 | 88 | 247 | 5.9 | 136 | 55 |
| 5 | 75 | 1.8 | 65 | 86 | 10 | .3 | 3 | 26 |
| 6 | 178 | 4.2 | 173 | 97 | 11 | .3 | 7 | 60 |
| 7 | 208 | 4.9 | 194 | 93 | 2 | .1 | 2 | 81 |
| 8 | 131 | 3.1 | 119 | 91 | 3 | .1 | 3 | 89 |
| 9 | 48 | 1.1 | 43 | 89 | No Inland Counties | | | |
| 10 | No Great Lakes Counties | | | | 145 | 3.5 | Unknown | |
| Totals | 3123 | 74.4 | 2796 | | 1070 | 25.2 | 527 | |
| Mean | | | | 90. | | | | 59 |

# APPENDIX D

## GREAT LAKES BOATING INFORMATION SOURCES

# MICHIGAN SEA GRANT PROGRAM

## ADMINISTRATION

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# OTHER SOURCES OF GREAT LAKES BOATING INFORMATION

## MICHIGAN DEPARTMENT OF NATURAL RESOURCES

### LAW ENFORCEMENT DIVISION

Marine Safety Section
4th floor, Mason Building
P.O. Box 30028, Lansing 48909

### RECREATION SERVICES DIVISION

Recreation Services Division
5th Floor, Mason Building
P.O. Box 30028, Lansing 48909

### WATERWAYS DIVISION

Waterways Division
Genenal Office Building, Secondary Complex
P.O. Box 30023, Lansing 48909

## GREAT LAKES BASIN COMMISSION

Great Lakes Basin Commission
3475 Plymouth Road
P.O. Box 999
Ann Arbor, Michigan 48106

## UNITED STATES COAST GUARD

Publications Department
477 Michigan Avenue
Detroit, Michigan 48226

## UNITED STATES ARMY COPPS OF ENGINEERS

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477 Michigan Avenue
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## BOATING INDUSTRY ASSOCIATIONS

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