PLANNING FOR RECREATIONAL BOATING IN MICHIGAN: AN ANALYSIS OF THE WATERWAYS DIVISION'S PLANNING PROGRAM

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ABSTRACT

PLANNING FOR RECREATIONAL BOATING IN MICHIGAN:
AN ANALYSIS OF THE WATERWAYS DIVISION'S
PLANNING PROGRAM

By James Edward Oakwood

This thesis was initiated under the auspices of a research contract between the Waterways Division of the Michigan Department of Conservation and the Department of Resource Development of Michigan State University. The problem was to review the Waterways Division's boating survey, to make recommendations concerning the adequacy of its techniques and methodology, and to formulate a general planning process which could be used for developing future recreational boating facilities.

The problem was divided into three phases. First, criteria were developed for an ideal planning process which would serve the needs of the Waterways Division. Second, the Waterways Division's boating study was reviewed and compared with the ideal planning process formulated in the first phase. Special emphasis was given to the statistical adequacy of the Division's techniques and methodology in conducting its boating study. Finally, a complete planning process was formulated for the Division taking into account the findings of the first two phases.

It was found that several steps should be taken to institute a more comprehensive planning approach and to improve the methodological reliability. It was recommended that more variables be investigated in connection with determination and projection of demand for boating opportunities and that the significance of out-of-state as well as in-state boaters should be investigated. A continuous inventory of supply factors including the amount of boating water, its ability to sustain boating use, and the number and type of facilities serving the public was recommended. Several suggestions were made concerning the "Boating Needs Survey" in order that a probability sampling design could be instituted and more reliability attained. Also, use of the "RECSYS-SYMAP" technique was urged so that present and future demand and supply relationships could be examined in a spacial context.

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By

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James Edward Oakwood

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CHAPTER I

INTRODUCTION

Outline of the Problem

In recent years, statewide recreation planning has received more and more attention from both state and federal agencies. A growing population, higher incomes, and more leisure time have created a swelling demand for recreational facilities. This increased demand has not only taxed the ability of facilities to accommodate this demand, but has, in addition, rendered the traditional intuitive concepts of recreation planning obsolete.

Significant occurences on the federal level have increased interest in statewide comprehensive recreation planning. The Outdoor Recreation Resources Review Commission reports have focused attention on meeting recreational demand. The work of this commission also resulted in establishment of a Bureau of Outdoor Recreation within the Department of the Interior, and the creation of the Land and Water Conservation Fund which is intended to aid state and local governments in the planning, acquisition and development of recreation areas. For states to qualify for acquisition and development funds, they must submit to the Bureau of Outdoor Recreation a comprehensive plan for the development of recreational resources.

Other agencies oversee programs of a cost sharing nature which may be used for recreational purposes such as the Title VII program of the Housing Act of 1961 administered by the Department of Housing and Urban Development. This program provided for grants equal to 20 to 30 percent of the cost of acquisition of open space to cooperating urban authorities. The requirements here are that the local agency represents the urban area as a "whole" or secure the cooperation of agencies representing 60 percent of the urban area. Thus these programs are encouraging a more comprehensive approach to recreation planning.

This emphasis has left many state agencies in a very difficult position. They must allocate resources among an increasingly complex system of recreational elements and in such a fashion as to meet the more rigid standards of participating federal agencies. Many, therefore, need techniques which meet both necessities.

This state of affairs affects not only those agencies responsible for statewide recreational planning, but also those lesser agencies responsible for the planning of certain sectors of the recreation system. Although these agencies have neither the problem of integrating an entire system of recreational sectors into a unified plan nor the problem of meeting federal requirements for participation, they still must allocate a large amount of public funds and resources to increasingly complex sectors of recreation demand so that the maximum benefit accrues to the public. The problem would be not too difficult if reliable and operational planning techniques and processes existed so that demand for opportunities could be related quantitatively to the supply of resources and facilities. Although such techniques are being developed, they are not as yet usable for all types of recreational activities. The need is for a complete and reliable planning process based upon techniques which are objective rather than subjective and intuitive.

The Waterways Division of the Michigan Department of Conservation undertook a study of recreational boating demand in an effort to justify greater expenditures for recreational boating facilities which were forthcoming. After completing this study in 1966, the Division engaged the Department of Resource Development at Michigan State University to study the Division's planning effort.

Statement of the Problem

The problem, therefore, is to review this planning effort undertaken by the Waterways Division, to make recommendations as to the adequacy of its techniques and methodology, and to formulate a general planning process which the Division should follow in planning for future recreational demand. Although the Waterways Division has responsibility for and an interest in both the recreational and commercial facets of boating on the State's waters, this study was limited to only the recreational aspects of the Division's responsibility.

The problem is essentially threefold. First, the criteria for an ideal type of planning process need to be formulated. This should provide a standard with which to compare the current Waterways Division study and provide a basic outline for a continuing planning process. Next, a complete review of the earlier Waterways Division boating study, including its techniques, methodology and sources of information must be undertaken to detect its shortcomings. Finally, a complete planning process should be formulated, taking into account the specific needs of the Waterways Division as determined in the first two phases.

Significance of the Study

The Waterways Commission[1] is faced with the difficult task of allocating considerable monetary resources among its several programs and the various geographic areas of the State. The 1964-1966 Biennial Report of the Commission indicates that total receipts from the motor fuel tax, watercraft

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[1]The Waterways Commission is the policy making body of the Waterways Division, Department of Conservation, and directs the program policies of the Division.

license tax, and other revenue sources reached $1,571,446 for the year 1966. Receipts have increased every year since 1959 and reached a cumulative total of $11,194,137 at the end of 1966.[1] Further, revenues and expenditures will continue to increase in the future. Recently the proportion of the motor fuel tax allocated to the Commission has been increased from one half of one percent to one and one half percent, thus increasing the revenues from this sources some $1,747,000 for fiscal 1967-68, $3,662,000 by 1968-9 and by 1977-78 $5,443,000.[2] Decisions involving the allocation of funds of such a magnitude require a sound planning basis.

The demand for facilities and services has increased considerably in the last few years. In 1958, the Department of State's Watercraft Registration Section had 217,553 registered power boats on record. By the end of 1965 this figure had risen to 398,902 boats, thus not quite doubling the 1958 figure. These figures do not represent the entire picture however, since these are only the power boats or sail boats with auxiliary power. There are an additional estimated

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[1] Michigan Department of Conservation, Waterways Division, Michigan State Waterways Commission: Biennial Report of the Waterways Commission, 1964-1966 (Lansing, Michigan: Michigan Department of Conservation, 1966), p. 27.

[2] Information supplied by Recreation Resource Planning Division of the Michigan Department of Conservation, January 30, 1968.

50,000 smaller craft not using motive power and thus not requiring registration with the State, plus 242 large craft registered with the Bureau of the Customs.[1] Considering these trends, it is reasonable to predict further increases in the numbers of boats will occur.

Determining the nature and characteristics of this demand, its extent, and where it will be exerted, presents perplexing problems for an agency attempting to meet it. An example of such a problem was discovered by the Boating Needs Survey conducted by the Waterways Division. It was discovered that there is apparently a significant number of multiple boat owners within the State, i.e., families who own and maintain more than one boat and who may require two (or more) different types of facilities depending on which boat they operate. Outside influences may also exert a pressure on the system. One notable example is the introduction of anadromous fish into the Great Lakes. It is too early to tell what the lasting effects of this program may be on recreational boating, but if the first phases are any indication of its success, a significant change in the patterns of demand may lie ahead.

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[1]Michigan Department of Conservation, Waterways Division, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping Technical Report No. 9C (Lansing, Michigan: State Resource Planning Program, Michigan Department of Commerce, December, 1966), pp. 4, 7.

The above are all examples of fluctuation and change which occur within the boating sector. If the allocation of monetary and other resources is to be effective in meeting eventualities, some means of locating these changes and assessing their effects must be present. Herein lies the significance of this study since if such means can be developed in this thesis, it will enable a line agency to solve some of the problems in the allocation of monetary and natural resources.

Hopefully, other benefits will be produced. The need for better analytical tools affects other agencies dealing with other recreational activities. Since the planning process, as viewed by the author, is applicable to many facets of recreation, the basic research involved will uncover techniques which may be helpful to other line agencies in developing their own planning programs.

Finally, it is hoped that this thesis may make some substantial contribution to statewide recreation planning. One may view a statewide recreation plan as essentially a combination of plans for the individual sectors of recreation. Since boating is such a sector and since this study attempts to formulate a process which will enable the development of a plan for recreational boating, it may make some contribution to the statewide effort.

CHAPTER II

AN OUTLINE AND DESCRIPTION OF THE GENERAL PLANNING PROCESS: THE BEGINNING OF AN IDEAL TYPE

Introduction

As mentioned in the previous chapter, the first portion of this study concerns the development of an ideal type of planning process which will serve as a basis of comparison for the Waterways Division's planning report, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping. The ideal type will also provide a basic outline around which a specific planning process can be developed and which can be used by the Waterways Division in planning for recreational boating demand. This chapter begins the development of that ideal type. It attempts to construct the basic foundation of the planning process and describe its stages or parts. The next chapter describes the particular characteristics of the process and the elements of recreational boating with which the process must deal. It begins then, to adapt, the general planning process as described in this chapter to the particular necessities of the Waterways Division.

The general planning process, as viewed by the author, consists of four essential phases; the background information stage, the data inventory and analysis phase, the goals formulation phase, and the plan design phase.[1] Each of these phases will be outlined and discussed below in reference to the designing of a plan for recreation boating and the Waterways Division. Usually a fifth stage, implementation, is included dealing with the legal and financial programs needed for application of "the Plan." In this case, however, there already exist ongoing programs of this nature. The departments, the legal authority, and the financial resources are present. What is needed is a program which will indicate what needs to be implemented.

The Background Information Phase

The background information stage is the first stage of the general process. It has essentially three purposes. First, it attempts to identify the problem in all of its facets and to provide a broad overview of the problem areas and their characteristics.[2] For instance, for recreational boating this particular stage should give a general idea of the size of the demand for boating facilities, the supply of available resources and facilities, and the approximate

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[1]Notes from U.P. 363, "Comprehensive Planning Process," April 4, 1967.

[2]*Ibid.*, April 13, 1967.

relationship between the two. It should also provide an insight into other problem areas such as the location or origin of most demand and the relationship between the areas of supply and the demand origins. It must also identify the characteristics of the supply and the problems related with it, such as the quality of the water for boating and the quantity of water available. Finally, it should assign responsibilities and orders of priority for data inventory.

Second, the background information stage gives initial direction to the whole planning process.[1] By identifying the problems and their approximate magnitude, the process then becomes directed toward the analysis of those problems and the solutions for them. For example, if it is found that the supply of inland water is not sufficient to handle the demand at some future time, this problem may then be analyzed in more detail in the data survey phase. Without this overview of the problem, particular phases of it may be overlooked thus producing irrelevant results.

Finally, the background information stage provides an objective look at those problems which previously had been matters of conjecture. A critical evaluation of existing problems can also help in convincing those people in policy making positions that problems do exist and action is necessary.

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[1] Ibid.

Topics to be Covered in the Background Information Stage

In order that an objective and purposive overview of the recreational boating situation can be obtained, several factors which relate directly to demand and supply considerations, should be investigated. The following subsections describe those factors and indicate what items of information should be investigated.

Growth and Development of Recreational Boating.--Technological change should be considered in planning for recreational boating facilities since they have a marked affect on who and how many go boating, and the type of craft used. The development of mass production techniques and the use of more metal and synthetic materials (such as aluminum and fiberglass) has resulted in a light weight craft which is larger, cheaper, and less difficult to maintain. These factors combined with the higher incomes and more leisure time has meant that more people have found it within their means to own and operate a boat. Also these changes in the type of craft used create needs for different types of facilities for launching and mooring.

The general growth of recreational boating within the State is translated into demand for facilities through the purchase and use of equipment. Because this factor is so important, the general size of the recreational fleet and its historical growth pattern should also be investigated. Information about boat and motor sales as well as boat registrations should be gathered and briefly analyzed. In addition, studies concerning the amount of use of recreational craft and participation in boating should be investigated to ascertain an approximation of the demand exerted at boating facilities. Next, a preliminary investigation of the amount of out-of-state boating should be undertaken to determine its significance and magnitude.

From this information trends can then be deduced concerning the various facets of demand such as the size of the current fleet, its physical makeup, the style of boats being used (inboard, outboard, runabouts, etc.), the average horsepower of the boats, and so on. From these trends preliminary projections of demand can be made to any desired planning target date. It should be pointed out that at this point in the planning process, extremely accurate estimates of these factors are not required. The purpose is to gain a general idea of the order of magnitude of the variables. Therefore, sophisticated projection techniques need not be employed. Straight line extrapolation along with socio-economic multipliers can be used for these purposes.

Growth of the State's Population.--The population of the state is another factor which should be investigated. It is reasonable to expect that as the State's population increases, more demand will be exerted for recreational facilities. Therefore, a general picture of the patterns of population growth as well as preliminary projections of its future size should be obtained.

The population factor should then be broken down into sub-factors which may be useful later in the data analysis phase. For instance, the age group distribution of the population, the sex ratio, and the geographical location may be extremely helpful at a later time. The _Michigan Outdoor Recreation Demand Study_ indicates that over two-thirds of the boat owners sampled in Michigan were between the ages of 25 and 54.[1] The _National Recreation Survey_ also indicates that the proximity to boatable waters as well as the sex of the participant also affect boating participation.[2]

Next, an analysis should be made of the relationships between population characteristics and boating demand. This should be done by examining trends in such factors as boat registrations and boat sales in connection with observed fluctuations in population characteristics. Again, sophisticated

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[1] Michigan State University, Department of Resource Development, _Michigan Outdoor Recreation Demand Study_ (Lansing, Michigan: State Resource Planning Program, Michigan Department of Commerce, Technical Report No. 6, June, 1966), Vol. II, p. 108.

[2] U.S. Congress, Outdoor Recreation Resources Review Commission, Study Report No. 19, _National Recreation Survey_ (Washington, D.C.: U.S. Government Printing Office), pp. 23-24.

methodologies should be reserved for a later time. The purpose is to discover which variables have observable relationships to boating demand.

Socio-Economic Characteristics.--In addition to population size and composition, the socio-economic trends of the population should be observed. Trends in such characteristics as the occupational groupings, the average income of families, and the population densities should be compared with changes in boating demand. Once again, the purpose is to establish what, if any, relationships exist between the variables under examination.

Quantity and Quality of Boatable Water.--The discussion so far has been centered around the analysis of trends and the establishment of basic relationships between variables associated with demand. This subsection, and the one to follow, deals with the factors of supply. It is essential to an objective overview, that these elements be examined since only by the comparison of requirements for facilities with the supply of existing resources and facilities can an accurate picture of needs and problems be determined.

An investigation of the total quantity of water suitable for boating as well as the opportunities it can provide should be undertaken. Different areas of the State have varying capacities to attract and sustain boating use. It is therefore essential that these factors be examined so that potential demand can be equated with the supply of opportunities in a geographical context.

Inventory of Facilities.--The second factor of supply which should be examined is the amount of facilities and their capability for handling demand. Analyses should be made of such factors as the total number of launching and mooring facilities, their capacity to handle boating demand, their locations in relation to prime areas of supply, and their locations in relation to major demand areas. Together with the preliminary demand projections and the probable locations where demand will be exerted, an idea can be obtained of problem areas and needs for facilities both now and in the future.

The Data Inventory and Analysis Phase

Once the background stages are completed, one should have in mind the parameters and relationships he wishes to examine in greater detail. These are the parameters which appear to have the most direct relationship to the boating system and therefore warrant further investigation. These parameters then become the independent variables in the data analysis phase and are investigated in relation to the dependent variable, boating demand, which in turn is related to the supply of facilities and resources. The objective is to measure as precisely as possible the variables themselves, the interaction between the variables, and the reactions of the system in general to new inputs of demand and/or supply.

The data survey and analysis phase consists primarily of three basic steps. They are: (1) The measurement of the desired variables, (2) determination of the specific relationships between the variables, and (3) projection of the variables to the desired planning target date to determine the future state of the system. Each of these steps is outlined below.

Measurement of the Variables

The first step in the data analysis phase is to measure the specific variables which have been determined as the most relevant. In the background stage these variables were studied and analyzed largely on a statewide basis. The problem is to collect data on these variables on a more suitable areal basis, or areas smaller than a state so that the data can be analyzed on a finer and more precise scale.

Before attempting to gather data, the appropriate subareas or planning units must be selected. The selection of these areas is largely a matter of choice, provided the spatial units selected are logically related to the problems of data analysis. For the purpose of the Waterways Division, the most probable planning unit would be the county. There are at least two reasons why the county level is considered best for analysis. First, this is probably the smallest areal unit for which adequate data exists. Secondly, to increase the scale would not provide adequate precision to enable analysis and decision making for such tasks as identifying the locations of needed facilities. If it is later necessary to regionalize information, the county data can be readily combined into the desired aggregates. In addition, different planning agencies use different planning regions. If data is not broken down by some more universal unit, it may be unusable if these regions are changed or if other agencies wish to utilize it.[1]

Once the analysis units have been chosen the data on the selected variables can be gathered and assigned to the analysis units. For some variables the data gathered for the background stage may already be in usable form. For other variables it may be necessary to reduce the data to a usable form or to seek other sources of information which have the desired data in the necessary form. In some instances it may even be necessary to generate the data using field surveys if it is not readily available.

Once the data has been properly synthesized and recorded for each of the analysis units, the preparation for the final analysis has been completed.

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[1]For further discussion of this problem, see Michael Chubb, Outdoor Recreation Planning in Michigan by a Systems Analysis Approach: Part III-The Practical Application of "Program RECSYS" and SYMAP" (Lansing, Michigan: State Resource Planning Program, Michigan Department of Commerce, December, 1967, Technical Report No. 12), pp. 91-99.

Measurement of Specific Relationships

At this point in the planning process, the various parameters of the boating system such as socio-economic factors, population factors, and other demand factors as well as supply factors such as the quantity of boating water, its quality, and its ability to sustain boating use without deterioration, have all been recorded by counties or other suitable planning units. The demand for boating has thus been established as a function of certain socio-economic, population, boat registration, and other factors, and the supply of boating opportunities has likewise been established as a function of the quantity of available waters, their abilities to sustain boating, etc. The next task is to measure the specific functions as precisely as possible.

To measure such functions for the demand factors requires the application of more sophisticated statistical techniques. Such techniques as regression analysis and analyses of variance should be applied at this point to each of the demand variables in relation to the actual demand exerted on facilities and resources. Total demand for facilities is thus established as some function of variable A, plus some function of variable B, plus some function of variable C, and so on to the number of desired variables. In short, a sort of mathematical model is formulated for the demand for boating opportunities. When combined with information on the nature of the craft used in the boat fleet and participation rates, these relationships can be converted to demand for particular types of facilities.

This demand must then be related to the supply of opportunities. The carrying capacity of the resource as well as the capacity and amount of facilities must be considered, since it is not desirable to overload and diminish the quality of the resource or the recreational experience by allowing the overuse of a lake or stream for boating.

Determining the use that the waters can and should have, however, is a difficult problem. It is not the intention here to go into detail concerning the determination of standards regarding the use of boating waters. These standards should be based on observations of the water areas of the analysis units. The purpose in mentioning this factor here is to point out that an analysis of the supply of boating opportunities should include some measure of the capacity of the resource to sustain boating activity.

Once the relationships between the various factors of both supply and demand have been analyzed, units of demand can then be allocated to the analysis areas based on actual studies of the movement of demand units to supply locations. An origin-destination study or a destination or on site study should be used. This information should then enable a detailed analysis of the actual demand exerted in each of the analysis units in comparison with the supply of boating opportunities available there. This analysis should further indicate areas of possible problems where demand is approaching the maximum supply of opportunities available, or where facilities are inadequate but resources exist for future expansion of boating opportunities.

Projection of Possible Future Characteristics of Boating

Once the current state of the system has been analyzed it is then necessary to make some determinations concerning its future state. This should not be too difficult a problem provided precise estimates have been made of the functional relationships among the factors of demand as well as the factors of supply. If, for instance, regression analyses have been used to establish the relationships between the demand factors, it would then be possible to extend the regression lines into the future with acceptable accuracy. The supply of opportunities will change somewhat due to added facilities and changes in the nature of the fleet, but the amount of boating water will probably stay relatively constant.

Once these estimates have been made, the same techniques can be applied to the future state of the system as were applied to the current state for analysis purposes. Hopefully, the techniques used would be flexible enough to allow testing of various assumptions concerning changes in the factors of the systems.

The Policy Formulation Phase

Upon completion of the data analysis phase the specific problem areas of the boating system should have been clearly identified and analyzed. Further, the present state of the system as well as its possible future states, given various assumptions, should now be apparent.

The next step is to investigate current programs with respect to their policies and goals as they relate to the needs. More specifically, the purpose of the goal formulation stage is the establishment of a hierarchy of goals and policies from basic, broad questions concerning resource use on the one hand to goals and policies concerning construction of the actual facilities on the other.[1] These will then serve as a basis for comparison of the alternative plans and selection of the final one. Ultimately, then, this stage of the process should produce a sort of policy plan which sets up the ground rules for decision making regarding both the design of the final plans for facility development and the actual development of the facilities themselves.

The next task is to outline the policies which are needed in order to arrive at these goals. A number of

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[1]Class notes from Urban Planning 363, "The Comprehensive Planning Process," May 16, 1967.

alternative policies may be possible. For example, if added boating opportunities are needed in a particular area, a goal of encouraging use of other waters such as the Great Lakes or other inland lakes may be achieved by developing facilities in these alternative locations. Alternatively, the policy might be to develop artificial waterways within the area if possible or to improve existing waters so they might handle additional demand. The choice between these two policies would in turn depend upon other policies and goals.

It is not enough, however, to have general goals and policies. Development criteria or standards must also be evolved. Such criteria might be in the form of the number of acres of water required to support a unit of demand (i.e. boat day or boater day) or some other measure of resource capacity. Criteria should also be developed for the facilities themselves, that is the size and type of boat launching facilities needed and additional installations deemed necessary such as picnic areas or campsites. These criteria provide a means of regulating the amount of use a resource receives (at least from the general public) as well as providing a means for anticipating the amount of facilities required to meet a given demand.

The Plan Design Phase

Given the needs of the boating system and goals, policies and standards desired in the system, the task of designing solutions to the problems can then begin. Assuming that one goal is the optimum allocation of facilities among resources, this process becomes one of determining locations for facilities and reconciling these facilities and locations with the stated goals, policies and standards of the plan. Thus, the data analysis as well as the policy formulation stages should be reviewed so that problem areas, goals, policies, etc., are well in mind.

A significant objective in the design phase is the production of alternative plans and solutions to the problem. With so complex a system, it is clear that there would be more than one possible solution in the allocation of facilities and resources. Therefore, several possible alternatives to this allocation should be formulated and thoroughly investigated.

The final task is the selection of the best alternative. Each of the alternative solutions should be investigated in regard to the problems of the boating system, and the goals, policies, and standards formulated earlier. It may be discovered that no one alternative plan completely harmonizes all goals, policies, needs, etc. It may then be necessary to go through some sort of sub-optimization process in which the most appropriate goals are maximized. In any event, the task of selecting the final alternative should fall to those in policy making positions. The main objective of the planning process is that of producing the best possible solutions and not limiting the selection to one.

CHAPTER III

THE GOALS AND NEEDS OF A WATERWAYS DIVISION PLANNING PROGRAM

Introduction

In the preceding chapter the elements of a general planning process were outlined and explained. These elements are a broad conceptualization of the planning process. In order that problems may be solved, it is necessary that specifications be more precise. Each problem has unique characteristics and solutions, and these must be taken into account in the design of a planning process. The elements of the problem should serve as the general framework for construction of the process. The purpose of this chapter is to identify those problem elements of recreational boating which must be analyzed.

In addition, a planning program must have certain attributes which particularly adapt it to the agency which uses it and to the situation in which it will be used. These criteria act as constraints upon the design of the planning program and must therefore be identified.

Finally, the planning process to be designed will not be put into operation in a sterile world, devoid of programs and prior attempts at problem solutions. Existing programs and the policies behind them must be taken into account, since they represent plans already in operation.

The following chapter has then a threefold purpose:

1. It outlines the basic elements which a plan for recreational boating should encompass.

2. It identifies the basic criteria which the process itself should meet if it is to aid in solving the problems of recreational boating.

3. It describes the current programs and policies being used by the Waterways Division in its attempt to meet the demand.

The Elements of Recreational Boating

Recreational boating demand is a system or unique mixture of related elements in which the observed changes in demand are resultants of changes in these elements and their interrelationships. To plan for recreational boating demand, the following elements should be considered.

Number and Type of Boats

For the purposes of the Waterways Division, the unit of demand is the boat itself. The Division is primarily concerned with facilities which enable the use of State waterways by recreational craft. Therefore, the boat use period, as opposed to other measures of demand such as the boater day, seems to be the most logical unit of demand.

It follows then that an estimate of the total number of boats in the State is essential. Although all of these boats may not require public facilities in order to be used, an estimate of total boats would provide an estimate of potential demand.

The type of craft being used also affects the demand for facilities since different types of craft require different facilities. For example, larger craft such as cabin cruisers are usually left in the water between use periods. Smaller craft, however, may be transported on trailers and launched from ramps. Therefore, not only the number of potential user units but also the type of user unit must be identified.

Characteristics of Boat Owners and Place of Residence

The number and type of craft being used in the State are factors which are in turn affected by other characteristics within the population. For instance, both income and leisure time available are determining factors of participation in boating.[1] Age[2] and sex[3] are two characteristics

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[1]U.S. Congress, Outdoor Recreation Resources Review Commission, Study Report No. 19, National Recreation Survey (Washington, D.C.: U.S., Government Printing Office, 1962), p. 23.

[2]U.S. Congress, Outdoor Recreation Resources Review Commission, Study Report No. 20, Participation in Outdoor Recreation: Factors Affecting Demand Among American Adults (Washington, D.C.: U.S., Government Printing Office, 1962) p. 16.

[3]Ibid., p. 20.

which also affect participation. Occupation, although apparently related to income, seems to affect not only participation but also the type of boat owned.[1] All of these characteristics of the boating population are helpful in predicting both the extent and the nature of future demand.

In addition to the above mentioned socio-economic characteristics, other information such as the place of residence of the user are helpful. This information may help in determining the amount of demand generated at the various origin areas and thus identify places near which facilities should be located so that travel distance may be minimized.

Place of Use of Boats and Method of Moving from Origin to Destination

One of the purposes of planning is to determine a rational locational pattern for needed facilities. Such a geographical distribution depends upon knowledge as to where demand is or could be exerted. Thus it is necessary to determine the present destinations of boat users and where they will probably go in the future.

The method by which the user moves his craft will affect the type of facility needed at a location. If, for

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[1]Michigan State University, Department of Resource Development, Michigan Outdoor Recreation Demand Study, *op. cit.*, Vol. II, p. 10.9.

instance, the user transports his boat by trailer, a launching ramp plus parking for both car and trailer is required. Alternatively, the user may transport his boat by car top, thus requiring no ramp for a trailer nor a parking space for it. In other instances the boater rents a seasonal mooring for his craft and thus requires a facility to suit this need. Where the watercraft are used and how these craft reach their destinations are therefore determining factors in the location and type of facilities.

The Supply of Boating Waters

Another essential element with which the planning process must deal is the supply of waters where boating is done. The area of waters available for boating remains relatively constant over time. At the same time, the demand exerted on those waters tends to increase. This natural resource has its limits as to the amount of use it can sustain before depreciation becomes a factor. Thus, planning for the use of these waters must take into account not only the total area of waters available for use but also the aesthetic value of these waters.

Adequacy of Facilities

To initiate programs for additional boating facilities, it is necessary to relate boating demand to supply so that amounts, as well as geographic areas, of needed facilities can be determined. This must be done for present, known conditions as well as for future alternative situations if effective long range plans are to be designed.

Patterns and Influences of Special Programs

A final factor which may affect planning for recreational boating is the influence of programs and policies carried on by other agencies. An example of such an influence would be the anadromous fish program currently being instituted by the Fish Division of the Department of Conservation. As was mentioned earlier, the effects of this program are as yet unknown. If the success of this program approaches its expectations, significant changes may be expected in the pattern of demand for boating facilities. Such changes must be anticipated if the planning process is to be effective in meeting this demand.

Criteria for an Effective Planning Process

Besides being able to measure the elements and interrelationships of the recreational boating system, the planning process used must also meet the needs of both the agency which is to use it and the situation in which it will be used. The planning process adopted should therefore have the additional characteristics outlined below.

Continuance

The planning process used should be capable of being used over and over again. The elements of recreational boating as outlined above are in a constant state of fluctuation. The characteristics of the participant, the type of craft used, the amount of time the craft is used, the origins and destinations of users, the programs of other agencies all change over time, thus creating changes in the relationships between these elements. The elements themselves may change as well, thus adding new effects and changes within the system. All of these create changes in the need for facilities and thus require the alteration of plans and programs to meet the needs. An effective planning process must anticipate these changes and use resources wisely to meet them.

Further, the Waterways Division must be able to assess or gauge the effects of alternative plans and programs. New solutions are constantly being proposed to solve the many problems. However, at present, no method exists by which solutions can be tested as to their effectiveness prior to their instigation. It would be helpful if proposed programs could be tested in advance of instigation.

Reliability

The planning program used should be reliable in the sense that it is accurate in its estimates of present and future conditions. The magnitude of the demand for recreational boating facilities and the amount of resources needed to meet this demand are continually increasing. Moreover, costs of facilities and programs constantly rise and can be expected to continue to climb. These costs rule out the possibility of trial and error techniques for testing programs and placement of facilities. It is simply too expensive to be wrong on decisions of such magnitude. Subjectivity and intuition can no longer provide the degree of precision needed in assessing the future. More precise techniques must be employed to facilitate rational decision making in the allocation of resources to meet future needs.

Modernity

The planning process should be modern or updated in the sense that it uses the newer, more sophisticated techniques which have become available of late. The fact that many agencies are using relatively unreliable techniques to determine demand has been discussed elsewhere.[1] The system of recreational boating becomes increasingly more complicated as time passes. As the system becomes more complex the task of planning becomes more laborious and time consuming. Once widely used techniques become unmanageable with complexity and the whole process becomes inefficient.

But new techniques of analysis utilizing computer technologies and other more sophisticated methods have

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[1]Michael Chubb, "A Systems Analysis and Spatial Demand Approach to Statewide Recreation Planning: A Case Study of Boating in Michigan." (East Lansing, Michigan: Unpublished Ph.D. dissertation, Michigan State University, Department of Geography, 1967), pp. 6-7.

been developed. These new technologies should be utilized in planning when decreases in time and increases in precision will result.

Manageable

The resources which the Waterways Division has at its disposal are limited. The Division is not in the enviable position of being able to hire a large planning staff. This in turn limits the design of a planning process. It must be capable of management by one or a few people.

At this point, one should not be misled into believing that a complete and reliable planning process which analyzes and solves all of the problems of statewide recreational boating can be designed for the undertaking by a lone person. To complete certain portions of such a large undertaking will undoubtedly need the attention of specialists and consultants. However, the complete process once it is set up, should be able to be operated by one or a few persons with some outside assistance for data gathering and technical problems.

Summary of Objectives and Areas of Operation of the Waterways Division, Michigan Department of Conservation

The following is a brief resume of the programs or areas of operation of the Waterways Division of the Michigan Department of Conservation. Its purpose is to outline the major operational programs and areas of interest of the

Waterways Division as they pertain to recreational boating, and to indicate its major objectives and policies. The underlying objective is to obtain an understanding of these factors so that they may be taken into account when recommending research and planning programs.

The Programs of the Waterways Division

The general areas of operation of the Waterways Division have been divided into five categories and are outlined below. The Division has a sixth interest area, that of commercial shipping, but this lies beyond the scope of the present investigation. Therefore, this discussion is limited to programs initiated primarily for recreational purposes.

The Harbors-of-Refuge Program.--An act of the United States Congress in 1945 authorized construction of 15 Harbors-of-Refuge on Michigan's Great Lakes shores. This act provides that the federal government will share half the cost of construction of navigational facilities (e.g., breakwaters, dredging of channels and mooring areas, etc.), the other half of these costs born by local interests. The actual construction of these facilities is carried on by the Army Corps of Engineers.[1]

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[1]Michigan Department of Conservation, Waterways Division, Biennial Report, op. cit., pp. 3, 16.

In 1947 the Michigan Legislature passed Public Act 320[1] which created the Waterways Commission and empowered it to represent the State in its "relationships with the Chief of Engineers, United States Army, and his authorized agents for the purposes set forth herein."[2] One of these purposes was to provide funds for local governments required as a condition for federal participation in the Harbors-of-Refuge program.[3] Harbors-of-Refuge are therefore facilities constructed and maintained by the Corps of Engineers with funds supplied by the federal government and the State through the Waterways Division.

The objective of the program is to provide harbor facilities where none previously existed in such a manner as to limit the maximum distance recreational craft would have to travel between ports on the Great Lakes to 30 miles. The original objective of the Waterways Division was to secure construction of the original 15 harbors designated by the U.S. Congress. The program has since been expanded to include additional installations to meet the 30 mile limit.[4]

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[1]Michigan, Public Acts, Act No. 320 of the Public Acts of 1947.

[2]*Ibid.*, 281.504, Sec. 4, (f).

[3]*Ibid.*, 281.507, Sec. 7.

[4]Michigan Department of Conservation, Waterways Division, Biennial Report, *op. cit.*, p. 3.

The policies followed by the Waterways Division pertaining to this program permit the following activities:

1. Participating with the Corps of Engineers in economic feasibility studies and in design and layout of the facilities,

2. actively soliciting Congress for construction funds for facilities,

3. providing the non-federal, local portion of the necessary funds,

4. negotiating with the local communities to provide for local docking and convenience facilities, establishment of a local harbor committee to control the use of public facilities, and to provide for an adequate number of transient mooring facilities so that the general public is served rather than just local interests,

5. when necessary, owning and operating these facilities, but, wherever possible, leaving this responsibility to the local authorities,

6. assigning responsibility to the Corps of Engineers for construction of such harbor facilities.

The Waterways Commission also requires that the local communities provide "the land, rights of way, and easements necessary for the proposed work, including suitable areas on shore for disposal of the material from dredging, where required," and "release the United States from all liability from claims of damage to lands and structures attributable to the dredging and construction operations."[1]

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[1]*Ibid.*, pp. 3-7.

Additional Harbors-of-Refuge.--The primary goal of this program is the provision of auxiliary harbors-of-refuge at 15 mile intervals along the Great Lakes shorelines near large population concentrations. The Waterways Division believes that the growth of facilities for recreational craft on the Great Lakes provide a relatively unlimited supply of boating water for the expansion of the recreational fleet. This program is, therefore, an attempt to draw greater numbers of small craft to the Great Lakes and relieve overcrowding of inland boating waters.[1]

The policies followed by the Waterways Division are essentially the same as those indicated for the regular Harbors-of-Refuge programs.

Other Navigational Projects.--This program is carried on independently of the Harbors-of-Refuge program but projects are authorized on the same basis. The goal of this program is to provide additional facilities and waterways improvements which may not fall under the Harbors-of-Refuge program but which are justifiable on the basis that the estimated potential benefits including those from recreation, exceed costs. This program extends to inland waterways as well as the Great Lakes, and the Waterways Division has provided study assistance to the Corps of Engineers and local authorities for projects involving inland waterways improvements

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[1] Ibid., p. 8.

as well as Great Lakes facilities. As in all waterways projects in which the State participates, approval of the Waterways Commission and the Corps of Engineers must be obtained. Construction is carried out by the Corps.

The policies followed for this program are essentially the same as those for the Harbors-of-Refuge program.

Community Assistance.--The goal of this program is to meet the demand placed on the Waterways Division by local communities for assistance in the construction of local marine facilities. The policies listed below are followed by the Division in the execution of this program.

1. Navigational facilities (e.g. harbor protective devices, dredged channels, and mooring areas, etc.) should benefit primarily transient boating for the project to qualify for Waterways Division aid.

2. An adequate number of mooring facilities constructed with public funds must be reserved for the exclusive use of the transient boater.

3. The general rule is that community projects are constructed with funds provided equally by the Commission and the community.

4. Generally, facilities constructed from the Commission's share of the program are to be solely used for transient boating in keeping with the general policy of providing facilities for use by the general public rather than local boating interests.

5. Any revenues derived from fees charged for use of the facilities must be placed in a special fund to be used only for the maintenance and development of the facilities.[1]

Marine Safety Regulations.--The Waterways Division is involved in two safety programs pertaining to recreational boating in the State. The Division maintains an active interest and role in establishing adequate safety rules and regulations pertaining to boat liveries and vessels carrying passengers for hire on both the Great Lakes and inland waters.[2]

Under the auspices of Public Act No. 257 of the Public Acts of 1952, the Waterways Division is empowered to inspect all craft being rented to the public from boat livery facilities. The Division sets maximum load and passenger capacities and issues tags to be placed on vessels meeting the requirements. The county sheriff does the actual inspection and is supplied by the Commission with necessary specifications and approval tags. The Waterways Commission also inspects vessels carrying passengers for hire. All such vessels operating on inland waters and those carrying up to six passengers on the Great Lakes are inspected by the Division.[3]

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[1] Ibid., pp. 16-17.

[2] Ibid., p. 23. Other agencies and authorities such as the Boat-Control Commission and the Cost Guard also conduct boating safety programs.

[3] Michigan, Public Acts, Act No. 257 of the Public Acts of 1952.

Inland Waters.--Act No. 320 of the Public Acts of 1947[1] authorizes the Waterways Division to construct boating facilities for recreational purposes on all navigable waterways within the State boundaries, and to obtain any property, easements, rights of way, etc., necessary to complete such facilities. However, the Division has previously maintained a policy of limiting construction of marina facilities to the Great Lakes for the following reasons:

1. The possibility of conflict with other agencies.[2]

2. Lack of funds.[3]

3. According to the Division, the typical craft used on inland waters is capable of being transported by trailer, car top, or other means, thus requiring only a launching site rather than extensive marina and docking facilities. Therefore, the Waterways Division has not felt justified in providing funds for construction of such facilities.[4]

Although this is the policy as it exists today, the Waterways Division anticipates a change in it. The Division previously received an allotment of one half of one percent of the revenues derived from all taxes on the sale of fuels

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[1]Michigan, Public Acts, Act No. 320 of the Public Acts of 1947.

[2]Personal correspondence with Mr. Keith Wilson, Director, Waterways Division, Michigan Department of Conservation, July, 1967.

[3]*Ibid.*

[4]Michigan Department of Conservation, Waterways Division, Biennial Report, *op. cit.*, p. 20.

used in internal combustion engines. The Division, however, felt that the amount of fuel consumed by the marine users was far greater than this,[1] and succeeded in persuading the Legislature to increase its allotment to one and one half percent of the revenues derived from this source.

The Division indicates that this increased allotment would enable it to allocate an estimated $1,566,000 to its "Public Access Site Program" for land acquisition, site development and site maintenance. This would permit the acquisition of some 45 sites per year (plus an estimated 15 sites per year which are acquired through lease and gift arrangements making a total of 60 sites per year), the development of 11 existing sites and approximately 24 new sites, and the maintenance of existing as well as new sites. Moreover, the Division expects to make application for federal grants which would double this acquisition program. The $1,566,000 alloted for inland site acquisition, development and maintenance would be divided as follows:[2]

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[1]Michigan Department of Conservation, Waterways Division, Recreational Boating in Michigan, February, 1966, Initial draft.

[2]Personal correspondence with Mr. Keith Wilson, Director, Waterways Division, op. cit., July, 1967.

Land Acquisition:	$ 716,000
Site Development:	500,000
Site Maintenance:	350,000
TOTAL	$1,566,000

Future Policies and Areas of Operation

The programs of the Waterways Division as outlined above show a general emphasis on development of facilities which provide access to the waterways of the State. The following quotation from Transportation Predictive Procedures: Recreational Boating and Commercial Shipping seems to be indicative of the Waterways Division's philosophy on facility development.

> Although boating traffic is generally thought of as being 'on the water,' our concern is with the facilities which constitute the 'doorway' to the water. These are mooring and launching facilities. Without a place to keep the boat, or a method or device to put a boat in the water, there would be no traffic on the water. Boating traffic, then, is dependent on these facilities and a measurement of the demand for them is a good measurement of boating traffic.[1]

Some officials within the Conservation Department have some reservations concerning this philosophy. According to these officials, this particular philosophy is too narrow primarily because it permits little or no multiple use of access sites.[2] This conclusion is apparently based on the

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[1]Michigan Department of Conservation, Waterways Division, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping, *op. cit.*, p. 30.

[2]Interview with Messrs. Smith and Colburn, Recreation Resource Planning Division, Michigan Department of Conservation, October, 1967.

premise that people who use boating facilities do not go there exclusively for boating but also desire other recreational pursuits not necessarily requiring a boat for participation. For instance, in addition to waterskiing and/or cruising, boaters may also desire to participate in swimming, picnicking, and other such activities which may be enhanced or enabled by a proximity to water. The proponents of this philosophy feel that in some areas it would be desirable to have facilities for picnicking, camping, etc., in addition to boat launching ramps and parking areas.

The purpose here is not to determine which of these differing philosophies of development is the more logical or desirable. To answer such a question would involve an examination of the organization of the Conservation Department and its purposes, policies, and authority. Such an examination would be beyond the scope of this thesis. The purpose is to point out that there is no clear policy statement by the Conservation Department on such matters and that this must be recognized in reviewing the research and planning needs of the Waterways Division.

CHAPTER IV

SOURCES OF AVAILABLE DATA AND INFORMATION

Introduction

The purpose of this chapter is to examine certain documents, research reports, and other sources of information which have some relevance to or make some contribution toward recreational boat planning. Each of these sources will be reviewed in reference to their possible application to or use in recreational boat planning in Michigan.

Michigan Department of State, Watercraft Registration

In 1958, the Michigan legislature passed a law that each boat owner who propels his boat with auxiliary power (other than oars or sail) and operates such a boat on the waters of the State must register this craft with the Department of State's Watercraft Registration Section.[1] This act now extends to the owners of out-of-state boats who operate such boats primarily in the State of Michigan.[2]

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[1]Michigan Department of State, Michigan Law Relating to Registration and Operation of Vessels and Motorboats, Act 245 of 1959, August, 1965. Sec. 271.652, 281.653.

[2]Interview with Mr. Howard Swanson, Office Manager, Watercraft Registration Section, Michigan Department of State, September 28, 1967.

The original legislation apparently was intended as a permanent identification only and no renewal of the registration was necessary. Once a number was affixed to the registrant's craft, that number remained with the craft until its destruction. Owners were only required to notify the Secretary of State if the boat was destroyed or sold. However, the original registration law has since been amended. It now requires that the registration certificate be renewed every three years.[1] The same registration number first assigned to a craft remains with that craft until the craft is destroyed.

Information Available from Registration Forms

The registration certificates indicate a variety of information which could be useful for planning purposes. Information on the owner, his name, address, city, state, and county are all indicated on the registration form. Information on the type of craft is also provided such as the hull material, type of power (inboard, outboard, etc.), and the size of the craft. In addition, the registrant is also asked to check the type of use for which the craft is intended, i.e., pleasure or commercial. The Watercraft Registration Section also provides statistical compilations

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[1]Michigan Department of State, *op. cit.*, Sec. 281.658.

of this information for various purposes. A numerical listing of all craft registered with the State along with information on ownership and craft type is provided for law enforcement agencies. Summaries of registrants by county of residence and alphabetical listings of registrants are also prepared. Finally, summaries of total registrations by counties of registration are provided for the Coast Guard at their request.[1]

In addition to the above information it may be possible to glean other information from this data source. For instance, there are two different types of registration forms which are used by the Watercraft Registration Section, a green form for renewals and transfers and a yellow, pre-numbered form for original registrations. Assuming that the yellow form represents the purchase of a new boat and the green form all other craft, some information could be gained concerning new boat sales during that period by observing the number of yellow registration forms for a selected period of time.

The Department of State also requires that registered craft operating on the Great Lakes obtain additional registration "plates." By observing the sales of these plates, information could be obtained about the number of craft which

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[1]Interview with Mr. Howard Swanson, Office Manager, Watercraft Registration Section, Michigan Department of State, op. cit.

are or intends to be used on the Great Lakes. One could not assume that this use was exclusively on the Great Lakes, however. Neither would this provide any indication of the extent of use. It would, however, give information on the size of the potential boat population using Great Lakes facilities.

Problems with the Registration Data

The registration information represents the best source of information dealing with the question of fleet size and type for the State. There are, however, certain shortcomings in it. First, the data does not include those boats which do not have auxiliary power. The exact size of this portion of the fleet is thus an unknown quantity which cannot be determined from registration data unless the registration law is changed to include these craft.

Secondly, it appears that there may be a problem with registration numbers being illegally transferred from boat to boat without registration. According to Mr. Swanson's office, it is not uncommon to find that upon renewal of a registration, the description of the boat on the renewal form is different than the original registration, indicating that a new boat had been purchased and the registration hull number transferred by the owner to the new craft.[1] This situation

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[1] Ibid.

may create a significant bias in the data concerning both the number of registered craft and the number of new registrants per registration period.

Another problem with this source of data is the inadequacy of its out-of-state information. The registration law requires that those boats which are operated primarily within the State are to be registered with the Department of State. However, this does not include the occasional out-of-state user, which means that a possibly significant amount of use by trailer craft from adjacent states goes undetected by the registration procedure. In addition, the out-of-state registration requirement would seem a difficult, if not impossible one to adminster and enforce. Therefore, the reliability of any out-of-state information would be dubious.

Ideally, the registration procedure would be an excellent place to obtain additional information on such things as types of activity (fishing, cruising, etc.) for which the boat is used. There is, in fact, one question on the registration form concerning use, as was mentioned. The author therefore, investigated the possibility of getting additional questions added to the registration form concerning use of the craft. This appears to be an unfruitful avenue, however, in view of the present attitude of the Watercraft Registration Section toward the existing use question. When asked if a demand for such information existed, the reply was that they had no idea why such a question was on the registration form and that there was no apparent need (for their purpose) for it.[1] Therefore, it was concluded that unless some liaison can be established between the Waterways Division and the Watercraft Registration Section, no additional information could be gained from the registration forms regarding the use of registered craft.

The RECSYS-SYMAP Technique

Program "RECSYS" is an abbreviated name for a computer planning technique developed by the State of Michigan. Those who have developed and worked with "RECSYS" consider it a major breakthrough in recreational planning technology. The technique has undergone a thorough testing for recreational boating in the last year and proved to be a very satisfactory technique for analyzing supply and demand relationships not only for boating, but for other recreational activities as well.[2]

Possible Uses of the Technique

The RECSYS-SYMAP technique attempts to predict the distribution of boating demand by simulating the movement of recreationists from origin nodes to destination nodes over a highway travel network. This simulation is based upon the

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[1] *Ibid*.

[2] M. Chubb, A Systems Analysis and Spatial Demand Approach to Statewide Recreation Planning: A Case Study of Boating in Michigan, *op. cit*., pp. 140-142.

concepts of "distance decay" and "destination attraction;" meaning that the participation at a destination node from any origin is some function of a time-distance factor and the amenities of the destination for the particular activity being sought.[1] The model thus allocates the demand spatially and relates this demand to the supply to determine needs. Capacity standards were developed and converted to "annual carrying capacity" values for each of the destinations in order for the model to relate demand with supply in the same quantitative units. Finally, a computer "SYMAP" technique was used to illustrate the spatial relationships of the three parameters, supply, demand, and needs. This procedure was used in the test to estimate the quantitative distribution of these three parameters for both 1965 and 1980.

The RECSYS-SYMAP technique is primarily an analysis technique which could be used most fruitfully in the problem at hand. It has the advantage of having already been tested for the boating system of Michigan and thus much of the fundamental groundwork has been laid. In addition, the technique takes into account not only the concept of demand, but also the concept of supply, more specifically the idea of capacity and capacity standards. Added attributes of this technique

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[1]For a more detailed description of the "RECSYS" model, see Jack B. Ellis, Outdoor Recreation Planning in Michigan by a Systems Analysis Approach: Part I - A Manual for "Program RECSYS" Technical Report No. 1, (Lansing, Michigan: State Resource Planning Program, Michigan Department of Commerce, May, 1966).

are its relative speed and flexibility. Once the data has been collected and the model calibrated, results from a computer run can be obtained in a matter of hours. Also, a number of different assumptions concerning demand factors, supply factors, or capacity standards can be tested with relative ease.

Difficulties with the RECSYS-SYMAP Technique

Although the computer systems analysis approach is a relatively new and promising technique, it has some difficulties which should not be overlooked. The first is that this technique, as tested, required a considerable amount of data on the county level. But as Chubb states: ". . . this is a problem common to all the really comprehensive statewide recreation planning processes."[1] If this factor is taken into account in the data gathering portion of the planning process, it should not prove to be a limiting factor.

The second difficulty is the fact that although demand, supply, and the relationship between the two are expressed in the same user units (boat-days), the system does not tell us what type of use that day represents. Although the system can tell us that "x" units of demand are expressed at a destination, it can not tell us whether this is a demand for launching facilities, marina facilities or other types of developments. This type of data would have to be developed separately and

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[1]Chubb, A Systems Analysis and Spatial Demand Approach to Statewide Recreational Planning: A Case Study of Boating in Michigan, *op. cit.*, p. 18.

related to the destination demand. However, this may be asking too much of any analysis technique considering the "state of the art."

Another possible shortcoming is that the program requires the development of "attraction indices" for each of the destination areas. These indices are in essence a measure of the destination's relative assets for boating as compared with the other destination areas. In order to obtain accuracy for such factors, it is necessary to determine which attributes are most influential from a user's standpoint, in his selection of a boating site. In the absence of such information, the indices used in the test run of the model were developed intuitively.[1] These were refined in the "tuning" processes, and proved usable in the actual test runs as indicated by the low standard deviations of the estimates.

One final observation should be made concerning the accuracy of the future demand distribution simulation. The model as designed is only as accurate as the demand and supply estimations used in it. This principle holds true for any process involving computer calculations, and is best stated by the computer technologists' maxim, "garbage in equals garbage out."

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[1] Ibid., pp. 47-52.

The Michigan Outdoor Recreation Demand Study

The MORDS[1] study is a major research effort in the general field of recreation planning methodology. It was produced by the Department of Resource Development at Michigan State University under the auspices of the State Resource Planning Program.

Volume I of the MORDS report deals with the methodological problems of formulating adequate planning techniques for analyzing the demand for recreational facilities. For reasons indicated in Chapters I and II of the study, its orientation is toward the systems analysis and mathematical modeling techniques. Chapter II of the MORDS study discusses the application of systems analysis techniques to recreation planning and the components of a systems model. Each of the following three chapters is then devoted to a discussion of different types of mathematical models. The final chapter of Volume I proceeds to develop and run a systems model for state park camping.

Of particular interest in this study are Chapters III and X. Chapter III is entitled "Origin Models" and deals specifically with the development of demand projections at origin areas. A theory of general consumer demand is developed

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[1]MORDS is an abbreviated name for the _Michigan Outdoor Recreation Demand Study_. Michigan State University, Department of Resource Development, Michigan Outdoor Recreation Demand Study, _op. cit._, Vol. I and II.

from microeconomic theory and the variables are discussed. It is hypothesized that such variables as the cost of participation, cost of competitive or complementary leisure time pursuits, income of the participant, time cost to participate at the site, "inherent" time required to participate in alternative pursuits, travel times enroute to and from the activity site, travel times to and from alternative pursuit sites, the leisure or discretionary time budget available to the individual for participation in recreational pursuits, and the individuals preferences for the different alternatives are all variables which are functionally related to the demand by an individual for recreational opportunities.[1]

The authors then attempt to reduce the problem to manageable size by aggregating the individuals into homogeneous population groups and combining the alternatives into groups of activities. Next, the authors proceed to develop a simple "multivariate model" to project participation in the three activities of boating, swimming and water skiing for the years 1965, 1970, and 1980 on the basis of four socio-economic variables; income, sex, age and sex, and education.[2]

The model, as presented, is admittedly very crude and useful only for broad generalizations. However, it is

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[1] Ibid., pp. 3.3-3.4.

[2] Ibid., pp. 3.17-3.19, tables 3.2, 3.3, 3.4.

a beginning at a determination of demand and it attempts to recognize possible interaction between the variables. Its shortcoming is that it uses participation rates from the Outdoor Recreation Resources Review Commission reports which are considered by some as being inapplicable to spatial areas other than those sampled in that report. Also, it does not make allowances for "intercorrelation of the variables such as income and education."[1]

Volume II of the MORDS report contains the "activity reports" for a variety of outdoor recreation pursuits among which is a report on boating (Chapter X). This report is essentially an attempt to generate some basic socio-economic and participation data on the boaters of the State through the use of a mailed questionnaire technique. Of particular significance is the fact that many socio-economic variables have been investigated and tabulated with reference to boating which could be particularly helpful in making demand projections. Characteristics such as the age distribution of the boaters, occupations of boaters, and distribution of respondents by family income as well as other variables such as frequency of use, amount of time boats are used per outing and types of activity are all tabulated from the survey. Also some interesting cross-relationships are indicated between boating activities and preferences and the socio-economic characteristics of the boaters.[2]

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[1] Ibid., p. 3.

[2] Ibid., p. 10.8-10.24.

However, there are some problems in using the data gathered in this portion of the MORDS boating survey. One problem, as pointed out in the study, was the inability of the researchers to calculate an appropriate sample size for the survey because there were no previous studies and no variance of the population thus known. As many questionnaires as funds permitted were mailed. Also the selection of the recipients of the questionnaire was done by using the Department of State's boater registration records. No stratification procedure for sampling was undertaken, however, which could have detracted from the study but in some unmeasurable way.

California Small Craft Harbors and Facilities Plan

The California Small Craft Harbors and Facilities Plan[1] was produced for the Division of Small Craft Harbors of California. It is an example of the use of a general planning process to arrive at needs for boating facilities quantitatively and a plan to meet the needs. It is a lengthy and detailed study and thus it shall not be reviewed here in its entirety. Much of its information would not be applicable to the Michigan situation. However, certain portions of the study will be observed for their methodological contributions.

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[1]Leeds, Hill, and Jewett, Inc., California Small Craft Harbors and Facilities Plan (Sacramento, California: Division of Small Craft Harbors, California Department of Parks and Recreation, March, 1964).

The study begins by delineating planning regions and subregions and by describing and classifying the boating waters of the state. It then attempts to predict the future size of the recreational fleet to the year 1980 using income and population density factors. In order to determine the need for facilities a statistical sample of registered boaters was selected for a mailed questionnaire survey. The results from this questionnaire were then analyzed in detail and the results expanded to the entire fleet. Patterns of storage, launching and usage are analyzed as well as comments made by respondents concerning their use of these facilities. Future size distribution and usage projections are then formulated and equated with an inventory of facilities to determine present and future needs.

Uses of the Study

The significance of this planning report lies not so much in what was discovered in the study but rather how the information was gathered. As was mentioned, this study uses a mailed questionnaire technique to gather information on use and boating habits, as does the MORDS boating survey and the Michigan Waterways Division study. In the case of the latter two studies, the authors were unable to arrive at even a minimum sample required to achieve any desirable confidence levels. They resorted to sending out as many questionnaires as time and budget considerations would allow. Thus no estimates of the error variance could be prepared. Therefore, one is unable to determine how much confidence could be placed in the results of these two questionnaires.

In the California Small Craft Harbors and Facilities Plan the boats of the fleet were stratified by size, and the required number of responses for each size classification were calculated based on given confidence requirements. Estimates of error variations were calculated for each of the size classifications.[1] The reason why such calculations were possible in the California study was because of the unique construction of the questionnaire. Each of the major variables being estimated was measured by means of a question which permitted only a "yes" or "no" response. Thus, these variables can be classified as "binomial" variables. Because of the unique characteristics of binomial distributions, a maximum sample size was able to be calculated even though the probabilities of the two possible choices are unknown. Once the questionnaires were returned and the binomial variables tabulated, estimates of error variation were then able to be calculated from the responses to the binomial variables.

Of course all of the variables which the investigators were interested in were not capable of being answered with a two partite response. Therefore, a "lead in" binomial question was used and the respondent was requested to answer each of the subquestions below it if he answered "yes" to the

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[1] Ibid., pp. 4.1-4.8.

binomial question.[1] Although such a technique does not allow calculations of adequate sample size for each of the subvariables (or subquestions), it does permit such calculations on the major variables of interest, thus providing an idea of the confidence which can be placed on the results of the questionnaire.

Inadequacies of the Study

One apparent shortcoming of this study is its cursory consideration of the resource base. Needs for facilities were determined by comparing existing facilities with present and projected future demand. Thus there seems to be no allowance for the ability of the resource to withstand the use of the calculated magnitude. This would seem a major oversight since the production of more boating opportunities through construction of additional facilities could conceivably create situations of overcrowding and user conflict, especially on smaller bodies of water.[2]

A second criticism of the California Plan is the method used to project fleet size. Projections to the planning target date (1975) were accomplished by applying two

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[1]Ibid., see Appendix B, pp. B9-B13.

[2]For a more complete discussion of user conflict, see Carlton S. Van Doren, Recreational Boating in Michigan, (Paper presented to the Geography Section, Michigan Academy of Science, Arts and Letters, Wayne State University, March, 1961).

socio-economic multipliers (income and population density) to the 1962 boats per thousand population figure in each of the planning areas. The method involves simply multiplying the expected 1975 values of the two factors together to estimate their total effect and then applying this to the 1962 boats per thousand population to obtain the 1975 projections. This method excludes the possible effects of other variables which may be related to boating demand (such factors as the age group of the individual, sex, proximity to boatable waters, etc.).

In addition, this method implies that there is no relationship between the multipliers themselves (i.e. there is no intercorrelation or interaction between the variables) which may or may not be the fact. Finally, the income component was obtained by applying statewide projections of income (the source is not indicated) uniformly to each planning unit. Even though the statewide projection may be very accurate, the variation from planning unit to planning unit will be masked by applying a uniform increase factor to each. The result will be that the estimates of fleet size for each planning unit will be inaccurate in proportion to the difference between the actual income factor for each planning unit and the projected average for the state. Despite the shortcomings of this study, the sampling methodology is a significant advance over the other studies reviewed.

Other Sources of Information

During the investigation for this study the author reviewed other technical reports and planning studies concerning recreational boating. One such study was prepared for six counties of the State of Oregon.[1] This study attempts to determine the feasibility of developing small boat harbors in those counties and attempts to deal with questions of demand and supply. This study was not considered applicable, however, to the problems of boating in Michigan, primarily because there was little or no discussion of methodology in the report. Therefore, there was no possibility of evaluating its methodology and its applicability to other situations. Further discussion of this source is thus unwarranted.

A statewide survey of recreation participation habits prepared by the Department of Agricultural Economics of North Dakota State University was reviewed.[2] Like the preceding study, this was also considered inapplicable to the present problem. It analyzes the responses from a sample of 6,500 household units. Various recreational pursuits were investigated in the study including boating, swimming,

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[1]Cornell, Howland, Hayes and Merryfield, Developing Small Boat Harbors in Six Oregon Counties, A Report Prepared for U.S. Department of Commerce, Area Redevelopment Administration (Washington, D.C.: U.S., Government Printing Office, February, 1965).

[2]R. W. Cox and E. C. Vangsness, "Demand for Outdoor Recreation by North Dakota Residents" (Fargo, North Dakota: Department of Agricultural Economics, North Dakota State University, mimeographed, 1966).

fishing, camping and hunting. Participation rates for each of the activities were tabulated by selected socio-economic characteristics of the population. However, there was no discussion concerning sampling methodology thus preventing any evaluation of such questions as the adequacy or precision of the sample. In addition, the report consists mainly of tables of raw participation rates. In the absence of any more detailed analysis no conclusions could be drawn from the data presented other than to say that the data seemed to lend support to the already known fact that participation depends upon such factors as the family income, age and education of the participant.[1] One additional factor was of interest. It was discovered in the survey that the major deterrent to participation in recreation activities was the lack of "time" followed closely by "finances" and "distance."[2] This leads to the conclusion that perhaps such variables as the amount of vacation time or the number of paid vacation days may be factors which significantly influence demand. Measurement of such variables would, however, present many problems.

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[1] Ibid., table S-13.

[2] Ibid., see table 2-8.

CHAPTER V

A CRITIQUE OF THE WATERWAYS DIVISION BOATING STUDY

General Methodology

The Waterways Division's boating study, entitled Recreational Boating and Commercial Shipping, is divided into essentially three parts. The first portion concerns itself chiefly with determining the number of registered recreational craft in the State and the projection of this figure into the future. The second portion of the study analyzes the "Boating Needs Survey" conducted by means of mailed questionnaires. The final portion of the report attempts to project certain boating trends discovered in the questionnaire analysis to the year 1980. Based on these trends and the projected boat population, a brief analysis is made of possible shortages of facilities and services which may exist if the trends continue.

The Waterways Division's study projects the boat population to the year 1980 in two different ways. A preliminary estimate is made on the basis of boat registration records available from the Department of State's Watercraft Registration Section. Straight line projections were made in graphical form from the plotted values of the preceding five registration periods. This projection is used primarily as a check on a second method of projection based on socio-economic data.[1]

The second and most authoritative projection of the study utilizes data reported from the Outdoor Recreation Resources Review Commission's Study Report No. 19, National Recreation Survey and the California Small Craft Harbors and Facilities Plan prepared by Leeds, Hill, and Jewett, Inc. These two studies indicate that a relationship exists between recreational boat ownership and certain socio-economic factors. The former study indicates that a direct relationship exists between income and boat ownership, and the latter suggests that an inverse relationship exists between boat ownership and population density. The Waterways Division checked these factors and found them to hold true for Michigan according to their data.

A forecast of population density was prepared by the Division for each county. These values were then multiplied by a population increase factor for each county and a state-wide income factor to obtain a forecast factor for the individual counties of the State. In the case of income, disposable income was used in place of family income because of the availability of data. The final conversion factor

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[1]Michigan Department of Conservation, Waterways Division, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping, op. cit., p. 6.

obtained for each county was then multiplied by the number of boats registered in that county in the base year (1965) and the projected boat population thus determined.[1] (See Table 1.)

The second part of the study analyzes in some detail the returns from the mailed questionnaires of the "Boating Needs Survey." The questionnaire attempts to identify the boaters' county of residence, counties where boating is done, and the type of facilities required, i.e., whether a seasonal mooring is used or whether the boater transported and launched his craft for each use period. A stratified random sample of boaters was taken from the Michigan Department of State's boater registration records. The sample was stratified both by size of boat and by county of residence. Size strata consisted of boats of twenty feet or less and boats larger than twenty feet. County strata consisted of boats registered in the various counties.

The return consisted of 38.6 percent of boats twenty feet or less and 37.3 percent of boats over twenty feet. The returns were reclassified by size of boat into five categories beginning with twelve feet or less and progressing on up to forty feet and over. An expansion factor was then obtained for each of the five size classifications. This was done by determining the number of boats in the total registered fleet of that particular size classification that one return represented. For instance, in the twelve feet and

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[1] *Ibid.*, pp. 10-22.

TABLE 1.--Extract From Table Used In Waterways Division Report To Forecast 1980 Fleet Size[a]

	FORECAST FACTOR				FORECAST
County	Population Factor	X Population Density Factor	X Income Factor	= Forecast Factor	Number of Craft in 1980
Alcona	0.98	1.01	1.72	1.71	1,161
Alger	0.88	1.03	1.72	1.56	1,045
Allegan	1.12	0.97	1.72	1.87	7,461
Alpena	1.11	0.97	1.72	1.85	4,936
Antrim	0.99	1.01	1.72	1.72	3,486
Arenac	1.04	0.99	1.72	1.77	975
Baraga	1.01	0.99	1.72	1.72	819
Barry	1.02	0.99	1.72	1.73	6,420
Bay	1.09	0.98	1.72	1.84	8,116
Benzie	0.95	1.01	1.72	1.65	2,223
Berrien	1.21	0.96	1.72	2.00	16,058
Branch	1.15	0.97	1.72	1.92	10,664
Calhoun	1.05	0.98	1.72	1.77	14,063
Cass	1.19	0.96	1.72	1.96	12,097
Charlevoix	1.06	0.98	1.72	1.79	3,032
Cheboygan	0.97	1.01	1.72	1.69	4,049
Chippewa	1.08	0.98	1.72	1.83	5,194
Clare	1.12	0.97	1.72	1.87	2,184
Clinton	1.31	0.94	1.72	2.12	4,725
Crawford	1.15	0.97	1.72	1.92	891
Delta	1.00	1.00	1.72	1.72	2,726
Dickinson	0.96	1.01	1.72	1.67	2,518
Eaton	1.28	0.95	1.72	2.09	6,765
Emmet	1.02	0.99	1.72	1.73	3,633
Genesee	1.32	0.95	1.72	2.15	45,649
Gladwin	1.04	0.99	1.72	1.77	1,696
Gogebic	0.82	1.04	1.72	1.47	2,615
Grand Traverse	1.18	0.96	1.72	1.95	8,330
Gratiot	1.09	0.98	1.72	1.84	3,676
Hillsdale	1.03	0.99	1.72	1.75	4,897
Houghton	0.95	1.01	1.72	1.65	2,929
Huron	1.05	0.99	1.72	1.79	2,490
Ingham	1.28	0.95	1.72	2.09	26,075

[a]Source: Michigan Department of Conservation, Waterways Division, Recreational Boating and Commercial Shipping, *op. cit.*, p. 20.

under class there were 784 usable returns and 75,966 boats registered falling within this classification. Therefore, 75,966 divided by 784 equals 96.9 boats of the entire fleet represented by each return in this class.[1] The development of all five classes is shown in Table 2.

TABLE 2.--Waterways Division's Method of Obtaining Fleet Expansion Factors.[a]

Size	No. of Registered Boats	No. of Usable Returns	Expansion Factor
12' or less	75,966	784	96.9
12' to 20'	301,797	2,859	105.6
20' to 30'	17,455	1,190	14.7
30' to 40'	3,103	328	9.5
40' or greater	581	57	10.2
TOTAL	398,902	5,218	

[a]Source: Michigan Department of Conservation, Waterways Division, op. cit., p. 26.

The responses were then tabulated on the basis of this five partite length classification for each of the items on the questionnaire. This data is then expanded to the entire fleet using the expansion factors described above. Estimates of the distribution of use of various types of facilities are arrived at using this technique.[2]

[1]Ibid., pp. 23-28.

[2]Ibid., pp. 30-35.

The final portion of the study is devoted to the 1980 projections of use of facilities. The methodology used here is essentially the same as that employed throughout the study. Forecasts of the fleet size in the first part of the study indicate an increase of 191 percent in fleet size. On the assumption that present trends and relationships will hold into the future, 1.91 is used as an expansion factor and applied to the survey results to obtain an idea of demands on and needs for facilities in the year 1980.[1]

The Waterways Division Study as a Planning Document

There are essentially two points which must be examined when reviewing the planning study produced by the Waterways Division. First, how does the study compare with what is conceptualized as the ideal planning process? Secondly, how accurate is the representation of the boating system illustrated in the report? The latter of these two points will be discussed in detail in the sections which follow. The purpose here is to examine the former.

To answer the question posed above one must first look at what was theorized in Chapter II as the essential elements of the planning process. Comparing the Waterways Division study with those elements reveals that this document deals primarily with the demand aspects of a data inventory

[1] *Ibid.*, pp. 56-65.

and analysis phase. It attempts to formulate no planning objectives once needs are determined through the data analysis process. These objectives are essential since they provide a standard of comparison for the various plan alternatives. Further, the Waterways Division study makes no attempt at designing or recommending alternative plans to meet the needs which are determined. Finally, the data analysis of the document ignores two essential elements of the recreational boating system, the supply of boating waters and the location of facilities. An analysis of the carrying capacities of boatable waters is an essential part of designing a plan for needed facilities. Location is important since an adequate number of facilities, if poorly distributed, will not meet the needs.

Although this document is considered an interim effort prior to setting up a complete planning process, it is necessary to compare it with an ideal data inventory and analysis phase.

Critique of the Boat Projections

There appear to be several difficulties with both the methodology and the data used in the projections of 1980 fleet size of the Waterways Division's study. There also appear to be difficulties with the "Boating Needs Survey" which will be examined. The latter of these two problems will be reserved until later. The concern at this point is with methodology and the data used in the boat registration projections.

In order to assure expert guidance in examining the statistical portions of the study, professional assistance was sought from the Department of Statistics and Probability at Michigan State University. The Waterways Division's boating study was submitted to Professor T. V. Hanurav along with working memorandum KKM-1 from Arthur D. Little, Inc. concerning the sampling plan for review and analysis. A subsequent interview was arranged with Professor Hanurav during which the above subjects were discussed in detail. Later, brief written comments were received from Professor Hanurav summarizing the major points covered during the interview. This information, along with what applicable literature could be found and the author's personal knowledge of the subject areas, form the basis of the following critique of the boat projections and the "Boating Needs Survey."

The Check Projections

Two methods were used in the Waterways Division's study to estimate the size of the 1980 fleet. First a straight line projection of boat registrations for the years 1958, 1962, 1963, 1964, and 1965 was extended to 1980. Next, a direct projection using conversion factors for each county obtained from socio-economic data was obtained. The study indicates that the former estimate is not to be interpreted as definitive but rather as a check on the second method. However, the reliability of the former projection is questionable, even as a check on other methods, primarily because of the data used and because of the method itself.

The Method of Projection.--Straight line projections are used in many areas of endeavor as a quick check on an estimate, primarily because of the simplicity of the method. It has some serious limitations, however, which should not be overlooked. Isard, in speaking of population projections of a region, states the difficulties with this method quite succinctly. Although he is speaking here in the context of the use of the method for population projection, his criticisms are applicable to the general method.

> Graphic extrapolation has serious limitations, especially when linear curves are applied uncritically. The procedure assumes that relationships which have existed in the past will continue to exist in the future and with the same intensity. Only where it is possible to demonstrate the continuing relationships of the social, economic and political determinants of population growth is the method valid.[1]

Thus the particular method used has limited value and only under certain conditions.

The straight line projection used in the Waterways Division's study seems further limited by the fact that the projection is made twenty years into the future on the basis

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[1]Walter Isard, Methods of Regional Analyses: An Introduction to Regional Science, Vol. IV of The Regional Science Studies Series, ed. Walter Isard (Cambridge, Massachusetts: The M.I.T. Press, 1960), p. 8.

only five years of data. This fact would leave the projected fleet size figure especially susceptible to the criticism of Ishard indicated above in that not enough data is available to indicate whether or not long term relationships remain constant. Twenty years is a comparatively long period over which to predict the actions of a variable. Without some indication of the trends which take place between the dependent and independent variable, a projection so far into the future is very risky.

The Data Base for the Projection.--In addition to the above difficulties, there seems to be some doubt about the accuracy of the data used. Possible inaccuracies in the boat registration figures supplied by the Department of State Watercraft Registration Section appear to have their origin in the administration and the enforcement of the watercraft registration law. The straight line projection of expected 1980 fleet size depends not at all on the registration figures for 1962 through 1964. In actuality, only two figures were used to make the projection, those for 1958 and 1965 since these were considered to be the most accurate estimates. There are apparently two reasons why even the 1958 and 1965 boat registration figures may lack some accuracy. First, boats already registered under the 1958 registration law may have been sold and re-registered by the new owner when the three year registration law became effective.[1]

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[1]The original law requiring registration of all

Secondly, some boat owners (the number is unknown) fail to comply with the regiation law and even though continuing to operate their boats on the waters of the State have neglected to register them.[2]

With the combined sources of possible error indicated above, it seems highly unlikely that the 1980 fleet size projection using the straight line extrapolation method is a reliable estimate of future fleet size, even as a check on a second method of projection.

The Final Projections of Fleet Size

The method of deriving the final projection of the 1980 fleet size has already been described and illustrated in an earlier section. The general method as well as the derivation of the factors used to obtain the "forecast factors" will be examined more closely in an effort to draw some conclusions concerning the validity of this model for determining future fleet size.

Description of the Methodology.--The method employed to make the final 1980 fleet projections uses the three factors of population, population density and disposable income,

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powered craft was put into effect in 1958 and was intended to be permanent. In 1959, however, the law was changed to include a new numbering system and a three year registration period. Thus boats now have to be re-registered every three years.

[2]Michigan Department of Conservation, Waterways, Division, *op. cit.*, pp. 3-5.

all of which are multiplied to arrive at a "forecast factor" for each county of the State. The forecast factor is then multiplied by the registered boats in each county for the base year (1965).

The population factor was obtained by dividing the projected 1980 population of the county by the 1965 population. The population density factor was discovered to have the following relationship:

$$\text{Density Factor} - \left(\frac{(1965 \text{ pop/sq. mi.})}{(1980 \text{ pop/sq. mi.})}\right)^{1/5}$$

This relationship means that boat ownership (in boats per thousand population in a given county) varies inversely with the fifth root of population density. Therefore, the relationship given above was used to calculate the population density factor for the forecast factor. Finally, the income factor was obtained by projecting statewide disposable income to the year 1980 on the basis of data obtained from 1950 through 1965. According to the projections, disposable income would increase by 172 percent. Therefore, 1.72 was used as a uniform county income factor for all counties in obtaining the final forecast factor.[1]

<u>Derivation of the Income Factor</u>.--There are several difficulties with both the procedures and the derivation of the factors which should be mentioned. Although a proven

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[1] <u>Ibid</u>.

relationship exists between boat ownership and income, the projection of this factor into the distant future is, according to Dr. Hanurav, statistically unreliable.[1] The wide fluctuations of income and its dependence on other economic conditions, does not enable accurate prediction over long periods of time. Complicating the situation is the fact that income for Michigan, according to Ishard, fluctuates more than does income for other regions because of the specialized nature of the economy of the State.[2]

Another problem with the income factor as used in the Waterways Division study is that the projection for 1980 is a straight line or linear extrapolation from previous data. Although more extensive data for the past is used in making this extrapolation, the method is still open to the same criticisms suggested above for the straight line projections of boat registrations.

Finally, the disposable income was derived on a statewide basis, then applied uniformly to each county. A uniform application such as this would tend to overstate the effects of income in economically poor areas of the State and understate the effect in more prosperous areas, although its effects on the statewide total may be represented accurately.

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[1]Interview with Dr. T. V. Hanurav, Department of Statistics and Probability, Michigan State University, July, 1967.

[2]Ishard, <u>op. cit</u>., pp. 216-217.

The Derivation of the Population Density Factor.--The Waterways Division's boating study indicates that a test was performed of the proposition that boats per thousand population in a county varied inversely with population density of the county. The Waterways Division report concludes that boats per thousand population varied inversely with the fifth root of population density.

The point to be noticed here is that the data to test the relationship was plotted on log-log paper, i.e. the logarithms of the data values were plotted rather than absolute values. Such a relationship tends to be less accurate and thus less predictive than a linear relationship using absolute values of the dependent and independent variables.

Derivation of the Forecast Factor.--The process used in the Waterways Division study to obtain the forecast factor is one which involves simple multiplication. What has been done, in effect, is to formulate a simple product model to represent the relationships between three variables and their effects on a fourth. However, in order for a product model to be valid, it must be assumed that the elements or factors are independent or mutually exclusive, that is, they have no elements in common or that there exists no interaction between the three factors. Whether or not the Waterways Division model correctly represents the relationships between the variables seems to be a moot point. It is reasonable to suggest that there would be definite interaction between the two variables of population and population density. If this is in fact the case, the mathematical relationship of the predictive variables and the dependent variable (registered boats) would be other than that used by the Waterways Division.

Professor Hanurav indicated that a better method could have been used to predict registered boats on the basis of the same socio-economic data. This would involve a multiple regression analysis of the three socio-economic variables and the dependent variable, boat registrations.[1] However, this technique does require the services of a professional mathematician, which budgetary considerations did not allow.

Critique of the Boating Needs Survey

"The Boating Needs Survey" of the Waterways Division attempts to determine the adequacy of facilities provided for recreational boating through the use of a mailed questionnaire. In particular, it is said to be designed to determine "where and to what extent the boats of the fleet are used" and "where facilities are used or demanded." The Division felt that an attempt to question the entire boating population was beyond its capabilities and therefore a selected sample of boat owners would receive the questionnaire. The sample was selected from a list of registered boat owners

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[1]Interview with Professor T. V. Hanurav, *op. cit*.

provided by the Watercraft Registration Section of the Department of State. It was stratified by county of residence of the owner and by size of boat. The Division felt this was necessary in order that all counties might be adequately represented in the sample and that a sufficiently large sample of boats over twenty feet would be obtained. It was decided to include 2.5 percent of the boats under twenty feet and 20 percent of the boats over twenty feet in the sample.[1]

The conclusions of the report concerning the need for facilities are based to a large degree on this sample of boat owners. Since the reliability of these conclusions depends to a large degree on the reliability of the survey, the sampling techniques should be closely scrutinized. The purpose here is not to question the mechanics of sample selection, that is, which registered boat owner is selected, but rather to scrutinize larger questions such as the adequacy of the sample size, its precision and its representativeness.

Representativeness of the Sample

The first question which must be addressed is how representative of the boating population is the sample?

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[1]Michigan Department of Conservation, Waterways Division, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping, *op. cit.*, p. 24.

To answer this question it is necessary to look at possible sources of bias in the sample. One qualification should be stated here however before attempting to answer this question. This qualification is that although possible sources of bias can be pointed out, assessing the magnitude of such sources presents a very difficult and probably impossible problem. However, since the reliability of a survey depends on its representativeness, any identifiable bias should be noted so that in any further studies of the same nature, measures may be taken to minimize it.

There appear to be at least two possible sources of bias in the sample, both of which originate from the stratification procedure. This possibility is pointed out in a memorandum from Arthur D. Little, Inc.,[1] the statistical consultant to the survey. A bias of unknown magnitude may have been introduced by the fact that the sample was stratified by size of boat, those under twenty feet and those over twenty feet. The questionnaires were color coded for these two strata so that the Waterways Division could determine which strata was being sampled. However, the questionnaire does not indicate to the respondent which size classification he was selected for. It merely asks that the

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[1]Arthur D. Little, Inc., Memorandum KKM-1, February 18, 1966.

respondent answer the questionnaire only for the boat "used most often."[1] This factor could introduce a bias in the case of the multiple boat owner. In the words of Arthur D. Little, Inc.:

> For instance, suppose a sampling unit consisting of a 12 foot boat in Cheboygan County is selected. If the owner of this boat also owns a 25 foot boat which he uses more often he would answer the questionnaire for the 25 foot boat. However, he was selected for a different stratum from the one he put himself in. This change would influence the results of our sample in a way we could not measure.[2]

Since approximately 35 percent of the respondents owned more than one boat,[3] some of those selected as part of either size strata were probably multiple boat owners with boats in both size strata. Further, an unknown percentage probably answered the questionnaire for a different boat than that for which he was sampled. Although this bias would be evident because of the color coding of the questionnaire, this type of response would still be invalid and thus unusable in the tabulation of responses. To eliminate this source of bias, the questionnaire should have indicated which boat the respondent had been selected for.

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[1]Michigan Department of Conservation, Waterways Division, op. cit. Appendix C, Boating Needs Survey.

[2]Arthur D. Little, Inc., op. cit., pp. 3-4.

[3]Michigan Department of Conservation, Waterways Division, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping, op. cit., p. 27.

Another source of possible error in the sample arises from the stratification by counties. The purpose of stratifying by county of residence was to ensure that each county of the State was represented in the sample.

Although the precision of a sample can be increased by proper stratification, the strata selected must be related to the information which is sought in the sample. Slonim states the problem as follows:

> When the universe can be divided into two or more homogeneous groups it is often possible to increase the precision of the estimate by taking a sample from each stratum instead of using a simple random sample of the same total size. . . . To be sure, the better one's judgment in defining the strata, the higher the precision for a given total size of sample. One should bear in mind that regardless of how homogeneous the elements of each stratum are and how nicely the strata differ from one another, this is not enough. The expected benefits of stratification will not accrue unless the basis of stratification is logically related to the item or items of information sought. Thus, one would probably achieve little or no gain in precision in stratifying a group of ladies according to shoe size if one were attempting to estimate their average annual expenditures for Sen-Sen.[1]

It would seem then, that the county strata are not logically related to any of the items tabulated in the analysis of the survey. Most of the data is in fact tabulated on the basis of size classification of the boat owned by the respondent rather than on the basis of the county of residence of the respondent.

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[1]M. J. Slonim, Sampling (New York, New York: Simon and Schuster, 1960), pp. 52-53.

Precision of the Estimates

The next query is the precision of the estimates of variables measured in the survey. Precision of the sample estimates is used here to mean the accuracy with which the values obtained for a parameter approximate the actual value of the parameter in the entire population. Hodges and Lehmann illustrate this concept as follows:

> In terms of the analogy of target shooting, it is not enough that the pattern of fire be centered at the bull's-eye, the pattern should also be tightly concentrated. If both of these conditions hold, most of the shots will land close to the bull's-eye. Similarly, an estimate which is unbiased and has a tightly concentrated distribution will usually give values that are close to the true value being estimated.[1]

Hodges and Lehmann adopt the "variance" of the estimate as a measure of its accuracy. Variance is defined simply as the "squared deviation of T (the estimate) from the parameter value being estimated.[2]

How precise are the estimates of the parameters being measured in the Boating Needs Survey? According to Professor Hanurav there is no way to judge the precision of the estimates of the sample, at least from the data provided in the analysis of the survey.[3] The reason is that there are no actual measurements of these parameters. Therefore, one has

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[1]J. L. Hodges, Jr., and E. L. Lehmann, Basic Concepts of Probability and Statistics (San Francisco, California: Holden-Day, Inc., 1964), pp. 218-219.

[2]*Ibid.*, p. 219.

[3]Interview with Professor T. V. Hanurav, *op. cit.*

no idea of what the variance of the estimates might be. Nor does the Waterways Division, in their analysis, give any idea of the standard errors of their estimates.

In the absence of any actual counts, one must resort to other surveys in an attempt to determine whether estimates of the same nature have been produced and, if so, are they comparable with the Waterways Division's Boating Needs Survey. One other study, the boating chapter of the Michigan Outdoor Recreation Demand Study,[1] attempted to generate some basic data on boating through the use of a mailed questionnaire technique. However, the parameters this study attempts to measure are, in most instances, dissimilar to those of the Boating Needs Survey of the Waterways Division and thus cannot be compared. Also, since the two studies were done at different times, (the MORDS in 1964 and the Waterways Division study in 1965), it would be difficult to determine whether variations between the two studies were due to the differences over time or the precision of the two estimates. Thus it is impossible to arrive at any positive conclusions about the precision of the Waterways Division's estimates by comparisons to the Michigan Outdoor Recreation Demand Study.

A better assessment of the precision of the Waterways Division's estimates could have been made if more

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[1]Michigan State University, Department of Resource Development, Michigan Outdoor Recreation Demand Study, op. cit., pp. 10.1-10.38.

comparable statistics had been available. If several estimates of a parameter are available one can calculate a mean of these estimates which, provided the estimates are representative or unbiased, can be assumed to equal the mean of the population. Then by comparing the Waterways Division's estimates with the mean of other sample estimates, one could determine a level of variance and thus a more accurate assessment of the estimate's precision. In the absence of other data, however, Professor Hanurav's conclusion is justifiable.

Size of the Sample

Sample size is important in any survey since it bears directly on the other questions of representativeness and precision of the sample estimates. As was mentioned earlier, the variance of an estimate is often used as a measure of its accuracy. Further, the variance of an estimate can be controlled by the size of the sample. Hodges and Lehmann state that:

> The variance (of an estimate) becomes small as the number of observations becomes large and can be made arbitrarily small by taking sufficiently many observations. Unfortunately, the formulas show that the variances depend not only on the sample size but also on the parameters of the model, which of course are unknown. Does this mean that the sample size cannot be rationally determined? Usually, one has some idea in advance of the experiment as to the possible or likely values of the unknown quantities, and this permits at least a rough calculation of the appropriate sample size. . .[1]

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[1]Hodges and Lehmann, op. cit., p. 223.

In its Boating Needs Survey, the Waterways Division sampled 2.5 percent of the boats under twenty feet in length and twenty percent of the boats over twenty feet in length. The question to be answered then is, was this sample size sufficiently large to permit an accurate measure of the parameters being estimated?

According to Professor Hanurav, the question of the adequacy of the sample size for the Boating Needs Survey cannot be answered from the report.[1] The 2.5 and 20 percent figures for sample sizes were selected quite arbitrarily. It is known that the Waterways Division wanted a larger sample for the larger craft since there are fewer of them and thus a larger sample would ensure a more reliable return. The statistical consultant to the Waterways Division attempted to make a determination of the required sample size. However, because of the difficulties caused by the necessity to stratify by counties as well as boat size, they were unable to arrive at an accurate sample size estimate.[2] Under these conditions, the sample size had to be determined arbitrarily, and thus the results of the survey qualified accordingly. If such situations are to be avoided in the future and a reliable sampling technique designed, it will be necessary for the Waterways Division to simplify the stratification requirements. However, which type of strata (by counties or

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[1]Interview with Professor Hanurav, *op. cit*.

[2]Arthur D. Little, Inc., Memorandum KKM-1, *op. cit*. pp. 2-3.

boat size) to use is a question which needs more investigation. The basis for stratifying by counties rests upon the premise that there are significant differences in participation patterns between rural and urban residents. However, there is no conclusive evidence to indicate that this premise is necessarily true for boaters in Michigan. The Waterways Division could provide some circumstantial evidence in this regard by investigating the results of the 1965 survey from selected urban and rural counties. If significantly different response patterns are apparent, stratification by counties or other geographical areas may be necessary.

Critique of the Questionnaire

Until this point, the discussion of the Boating Needs Survey has been limited to questions dealing with the adequacy of the projection and sampling techniques rather than with the problems involved with using this particular technique. An examination of these problems is now in order.

One of the goals of the Boating Needs Survey is to determine the demand for seasonal mooring facilities and launching sites.[1] To accomplish this, the questionnaire divides the respondents into two groups by determining whether the respondent transports his boat or uses a seasonal mooring.

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[1]Michigan Department of Conservation, Waterways Division, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping, *op. cit.*, p. 2.

This gives an initial idea of the overall demand for the two types of facilities. The questionnaire then attempts to determine where these facilities are located and how adequate (in terms of capacity) the existing facilities are compared to demand. Determining where demand is exerted is accomplished by having the respondent name the counties and the waters in which his boating is done (this question to determine which waters are used is asked only of those who transport their boats. Those who use mooring facilities are asked where that facility is located). The survey then attempts to determine the ability of existing facilities to handle this demand by asking the respondents of each group (those who use seasonal moorings and those who transport and launch their craft) if they were unable to use the facility desired because it was overcrowded, or in the case of a seasonal mooring, if the facility desired was unavailable.[1]

Professor Hanurav revealed some difficulties in using the mailed questionnaire technique for estimating a demand of the type exerted by recreational boating. The Waterways Division's questionnaire in effect, measures the boaters personal satisfaction with the facilities he uses. It therefore compels a qualitative judgment on the part of the respondent and thus leaves the response susceptible to certain psychological effects. One such effect is that it is the dissatisfied

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[1]Ibid., Appendix C.

person who is more highly motivated to answer a questionnaire of this type. For example, a boater who could not use a launching site because it was overcrowded or one who could not find a seasonal berth because none were available would be more likely to respond. Another such effect is that the answers to certain types of questions are unreliable because people tend to inflate their prejudices. Thus, if a person is dissatisfied because he was unable to use a launching site, he may inflate the number of times he was unable to launch his boat.[1] A further problem of this nature is the fact that the respondent is called upon to remember such occasions for an entire boating season, and thus his estimate may be affected by time lag.

Finally, although the Waterways Division considered the sample return quite good, the amount of non-response was in fact quite high.[2] The number of usable returns amounted to slightly under 40 percent of the number of mailings for both boat size strata. However, the total returns represent only slightly more than one percent of the total boat population of the State. In addition, no attempt was made to follow up on those mailings which produced no response. This is considered poor sampling practice. It is conceivable that the response to the questionnaire could have been improved

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[1] Interview with Professor Hanurav, op. cit.

[2] Ibid.

considerably if a follow-up letter had been sent to non-respondents.

Summary and Conclusions

Although the Waterways Division's study was a preliminary effort which produced much useful information, the discussion points out several deficiencies. First, the document, in its present form, cannot be considered a plan for the allocation of boating resources to the areas of need. It merely provides certain background information and it may be considered a portion of a data gathering and analysis phase of a planning program.

Secondly, the predictions of the 1980 fleet size made by the study lack a sound methodological base. The use of the straight line projection of total boat registrations, even to check the accuracy of other methods of projection, appears in this case to be unreliable because the accuracy of the registration figures used in the projection is questionable, and the projection of boat registrations twenty years into the future on the basis of only five years of data is a statistically unsound practice.

There is also reason to doubt the accuracy of the final predictions of fleet size because of the methodology used and because predictions of income and population density tend to be quite unreliable. Because the extrapolation of these factors tends to be unreliable, their use as predictive elements lends an element of uncertainty to the final forecasts.

Also, the method of combining the three variables (population, population density and income) by multiplication to arrive at a conversion factor ignores the possibility of interaction between the variables.

Finally, the Boating Needs Survey has several deficiencies. There are two apparent sources of bias in the sampling plan which originate with the stratification of the plan. The amount of bias is unknown, but the bias does exist. The adequacy of the sample size and the precision of the estimates are moot problems, primarily because a probability sampling design was not used. In addition, there are psychological effects which may have affected the reliability of the responses to the questionnaire. Finally, a large amount of non-response coupled with a lack of follow-up on the non-response make the results of the survey dubious.

CHAPTER VI

A TEST SIMULATION OF THE WATERWAYS FLEET PROJECTION TECHNIQUE

Introduction

In the previous chapter, questions were raised concerning the methodology used in both the projections of 1980 fleet size and the "Boating Needs Survey" of the Waterways Division's boating study. In the case of the survey, there is little basis for making any conclusive judgments concerning the accuracy of the variables estimated by the survey or the adequacy of its sample size. Further, the possible sources of bias in the sample can only be pointed out, but it cannot be definitely shown that these possible biases affected the results of the survey. To test the adequacy of the Division's survey would require repeating their technique for a future year while at the same time providing a "control" by sampling 100 percent of the boating population in a number of counties.

However, a research methodology course in the School of Urban Planning and Landscape Architecture offered the author an excellent opportunity to test the methodology used by the Waterways Division in making its 1980 fleet size projections. To avoid the necessity of numerous long hand calculations as well as the loss of time and accuracy which could result, the author attended a non-credit computer programming course so that the problem could be run on the IBM 1130 computer used in the Urban Research Institute.

Methodology Used for the Test

The method used to test the Waterways Division projection technique was a past projection type of technique. It was determined at the outset that repeating the Waterways Division projections for 1980 would serve no other purpose than to check the arithmetic of the technique. Therefore, it was decided to apply this technique to some previous data on boat registrations and make a projection to some more recent year for which actual boat registration figures existed. Then, by comparing the projected boat registration figures for the target year with the actual registration figures, one could obtain an idea of the magnitude of the discrepancies for each of the counties and for the total boat registration of the State. It should not be concluded that this test would necessarily resemble the same patterns and magnitudes of errors which would occur in the Division's 1980 projection. However, the results should provide an indication of the reliability of the method.

Once the problem and the basic method had been formulated, a projection period had to be decided upon. The Waterways Division study uses a 15 year projection period, the base year being 1965 and the projection target year being 1980. Ideally, in order to simulate the predictive procedure exactly, the same projection period should be used. Problems in acquiring data, however, prevented this. For instance, if the year 1965 was selected as the projection target year, data for the factors would have to be gathered for 1950. Gathering data on population, population density, and income for this period would have presented no difficulty. Boat registration figures, however, were not available since the boat registration law did not go into effect until 1958. The range of time for which actual registration figures by counties were available was from 1950 through September of 1967.[1] This would not allow a 15 year test projection period needed to simulate the Waterways Division's projections.

Because of this data limitation it was necessary to contract the projection period so that the time between the base year and the projection target year would fall between 1958 and 1967. The year 1960 was finally selected as the base year since this was the earliest date at which boat registration figures, tabulated by counties, were available. Also, this was the first year in which the three year registration cycle was in effect. The year 1965 was chosen as the final projection target year. The reduction of the projection period of 15 to five years was not considered a serious defect since the method used in the Waterways Division

[1]Interview with Mr. Howard Swanson, Michigan Department of State, Watercraft Registration Section, Sept. 28, 1967.

study was applicable for any length of time period. If anything, the simulation for only a five year period should increase precision since the further a projection is made into the future the less accurate it tends to be.

Formulation of the Socio-Economic Factors

The accuracy of the simulation depended, to a large degree, on the similarity between the predictive factors used. In an effort to ensure a true representation of the Division's predictive technique, the following steps were taken. First, the same socio-economic factors were used to arrive at forecast factors. Secondly, the sources for the computation of the actual values of the factors were the same, except for the dates of the population estimates. Finally, the same method for computing the socio-economic factors was employed. A description of the derivation of each of the three socio-economic factors for the simulation follows.

The Population Factor.--The Waterways Division obtained population estimates for the years 1965 and 1980 from *Michigan Population, 1960 to 1980: Working Paper No. 1* of the State Resource Planning Program produced in January of 1966. The Division arrived at a population increase factor by simply dividing the 1980 estimated population by the 1965 population as indicated by the above mentioned source.[1] For the test

[1]Michigan Department of Conservation, Waterways Division, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping, *op. cit.*, pp. 20-22.

simulation, population data was also sought from the Michigan Department of Commerce. The source used was a "fact sheet" prepared by the Research Division of the Office of Economic Expansion. This document presents 1965 population estimates based on the 1960 census.[1] The factor itself was derived in the same way for the simulation as it was in the Waterways Division boating study. That is, the 1965 population estimate for each county was divided by the 1960 population of that county to obtain the increase.

Population Density Factor.--The Waterways Division boating study postulates a relationship between the number of boat registrations in a county and its population density. Boat registrations were found to vary inversely with the fifth root of population density. Population density factors are then derived for each county for both the base year (1965) and the target year 1980 on the basis of population estimates for those years and the square mile area of the counties. The density factor for each county is then derived by the dividing of the 1965 population density by the 1980 population density and raising the quotient to the one fifth power.[2]

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[1]Michigan Department of Commerce, Office of Economic Expansion, Research Division, "Estimated Michigan Population Changes by Counties, 1960-1965 and Projections to 1975," Fact Sheet No. 3.1, Population, July, 1966.

[2]Michigan Department of Conservation, Waterways Division, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping, op. cit., p. 16, and Appendix B.

In the test simulation, the same process was again used, except that population density factors were used for the years 1960 and 1965 rather than 1965 and 1980. The process was also simplified somewhat, although not materially changed, by programming the computer to perform the computation rather than going through the laborious task of calculating this factor by hand for each of eighty-three counties.[1]

Income Factor.--The Waterways Division used a straight line projection of statewide income to the target year to determine the factor by which income was expected to increase. This factor was than applied uniformly to each county. Data on income for the State was gathered by the Division for the preceding 15 years (1950 to 1965) and plotted on a graph. Three projections were then made, one on a basis of average rate of increase over the period, the second on the basis of the higher rate of increase from the year 1961 to 1965, and a final projection on the average rate of increase from 1958 to 1965. The first was considered a conservative estimate, the second a very optimistic estimate, and the third a more realistic estimate. This final rate was found to be 1.72 and this value was applied as the income factor for each county.[2]

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[1]See Appendix A.

[2]Michigan Department of Conservation, Waterways Division, Transportation Predictive Procedures: Recreational Boating and Commercial Shipping, op. cit., pp. 13-15, and Appendix B.

The same process was used in determining the income factor used in the test simulation. Income data from Sales Management was plotted for the years 1955 to 1960[1] and three projections were made to the year 1965 based on the same assumptions used by the Waterways Division (See Figure 1). Five years of preceding data were used to maintain the same ratio of base data years to projection years. (Since the simulation was for a five year projection, five years of data were used. The Waterways Division projection was for 15 years and 15 years of preceding data were used.)

The first projection of income was based on the average rate of increase each year for the entire five year period. This was considered to be the most conservative estimate since it takes into account both upswings and downswings in the data. A second, and more optimistic projection was made on the basis of the average rate of increase from the years 1958 to 1960. This was considered to be optimistic because a significant drop in income occurred in 1958 followed by an upswing in 1959 and a tapering off in 1960. This projection thus reflects the higher average increase due to the upswing following the drop. A third projection was then made based on the average yearly rate of increase

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[1]"Annual Survey of Buying Power," Sales Management, Vol. LXXVI, May, 1956; Vol. LXXVIII, May, 1957; Vol. LXXX, May, 1958; Vol. LXXXII, May, 1959; Vol. LXXXV, July, 1960; Vol. LXXXVI, May, 1961.

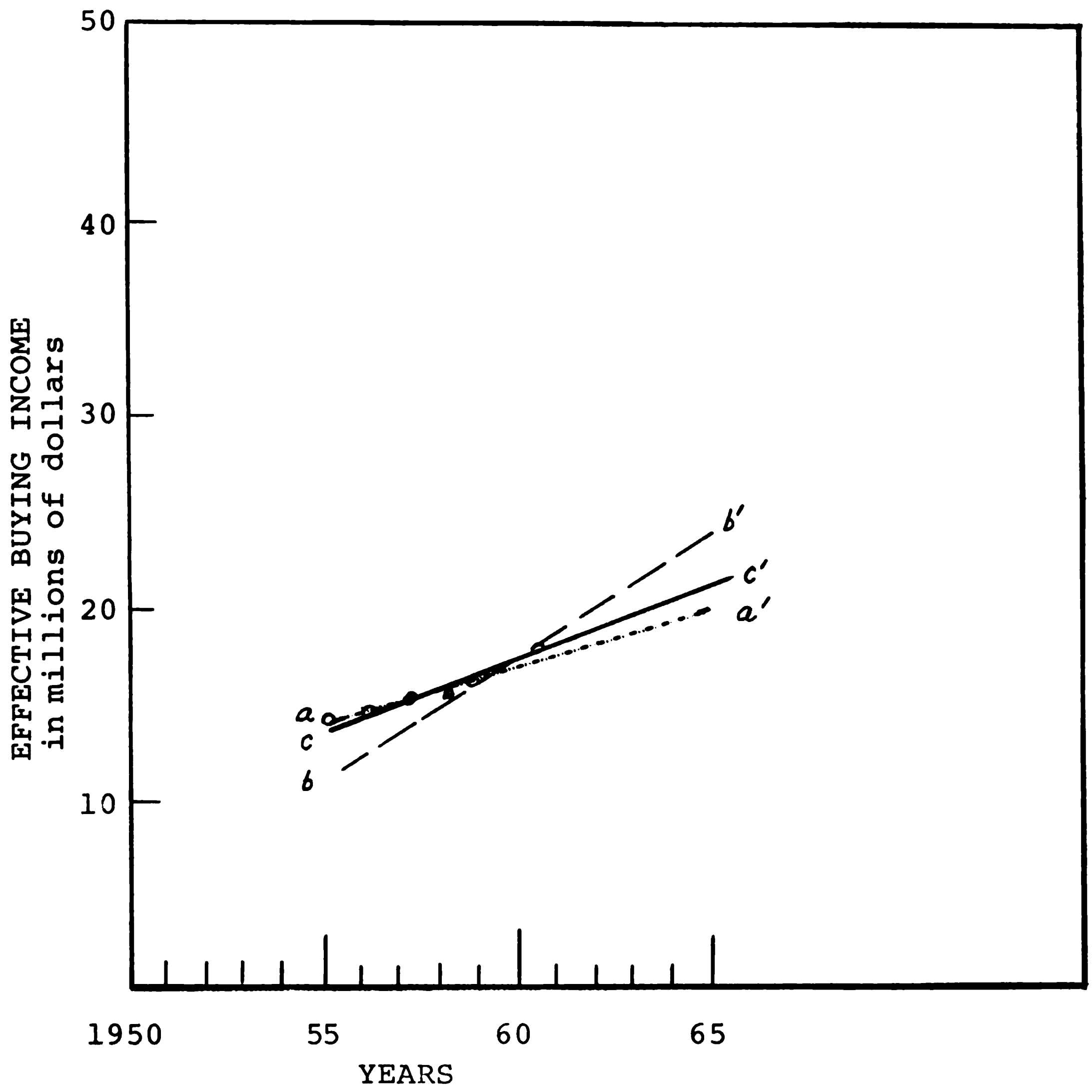

FIGURE 1.--Projection of effective buying income in order to develop income factor.

from 1957 to 1960. This projection fell between the two previously described projections. It was found that total state income could be expected to increase from 1957 through 1960 by a factor of 1.21. This value was then used as the income multiplier for each county in the test projection.[1]

Registered Boats in 1960

The final factor needed for the test simulation was the boat registrations for the base year 1960. The Michigan Department of State, Watercraft Registration Section provided a list of all boats registered with the State as of December 31, 1960. Total statewide boat registrations were provided as well as totals for each county. These values were used as the boat registrations for each county in the test simulation.

The Simulation

The population data and boat registration figures assembled were punched on data processing cards. Each card in the data deck represented one county and contained the following information; a county code number, the 1960 to 1965 population factor, the 1960 population density, the 1965 population factor, the income factor, and the 1960 registered boat factor (See Table 3). A simple computer program was then prepared which read the data from the cards and carried

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[1]For more detailed information, see Appendix B.

TABLE 3.--Factors and Results For The Test Simulation

County	Population Factor	1960 Popn. Density	1965 Popn. Density	Income Factor	1960 Boats Registered	1965 Boats Forecast	1965 Boats Registered	Percent Error
Alcona	0.960	9.2	8.8	1.21	703	817	679	+20.3
Alger	0.930	9.9	9.2	1.21	766	862	670	+29.4
Allegan	1.015	69.0	70.0	1.21	3757	4614	3990	+15.6
Alpena	1.030	48.4	49.8	1.21	2327	2900	2688	+ 7.9
Antrim	1.041	19.9	20.8	1.21	1823	2296	2027	+13.3
Arenac	0.953	26.7	25.5	1.21	454	524	551	+ 4.9
Baraga	1.049	7.7	8.1	1.21	294	373	476	-21.6
Barry	0.939	55.6	52.2	1.21	3741	4250	3711	+14.5
Bay	0.997	237.3	236.6	1.21	3369	4064	4421	- 8.1
Benzie	1.008	22.9	23.1	1.21	1189	1450	1347	+ 7.7
Berrien	1.057	256.6	271.2	1.21	6878	8797	8029	+ 9.6
Branch	1.020	67.5	68.9	1.21	5114	6312	5554	+13.7
Calhoun	1.004	193.9	194.7	1.21	7685	9336	7945	+17.5
Cass	1.045	73.1	76.4	1.21	5895	7454	6172	+20.8
Charlevois	1.051	29.8	31.3	1.21	1489	1894	1694	+11.8
Cheboygan	0.948	18.2	17.3	1.21	2446	2806	2396	+17.1
Chippewa	1.038	19.8	20.5	1.21	2171	2727	2838	- 3.9
Clare	1.039	20.2	21.0	1.21	1101	1384	1168	+18.5
Clinton	1.130	66.3	74.9	1.21	1710	2338	2229	+ 4.9
Crawford	1.046	8.8	9.2	1.21	447	566	464	+22.0
Delta	0.980	28.5	28.0	1.21	1513	1794	1585	+13.2
Dickinson	0.987	31.3	30.9	1.21	1282	1531	1508	+ 1.5
Eaton	1.099	86.9	95.5	1.21	2753	3661	3237	+13.1
Emmet	1.044	33.3	34.8	1.21	1812	2289	2100	+ 9.0
Genesee	1.114	576.8	642.4	1.21	16799	22644	21232	+ 6.7
Gladwin	0.966	21.0	20.3	1.21	864	1010	958	+ 5.4
Gogebic	0.854	21.3	18.2	1.21	1608	1662	1779	- 6.6
Grand Traverse	1.081	68.3	73.9	1.21	3610	4722	4272	+10.5
Gratiot	1.035	65.4	67.7	1.21	1694	2121	1998	+ 6.2
Hillsdale	0.976	57.5	56.1	1.21	2507	2961	2798	+ 5.8
Houghton	0.970	34.1	33.0	1.21	1293	1518	1775	-14.5

TABLE 3.--Continued.

County	Population Factor	1960 Popn. Density	1965 Popn. Density	Income Factor	1960 Boats Registered	1965 Boats Forecast	1965 Boats Registered	Per-cent Error
Huron	1.003	41.3	41.4	1.21	1310	1590	1391	+14.3
Ingham	1.091	377.3	411.6	1.21	10341	13651	12476	+ 9.4
Ionia	1.039	74.6	77.5	1.21	2372	2982	2542	+17.3
Iosco	1.230	29.3	36.1	1.21	1716	2554	1947	+31.9
Iron	0.902	14.1	12.7	1.21	1848	2017	1936	+ 4.9
Isabella	1.030	61.7	63.5	1.21	1365	1701	1579	+ 7.7
Jackson	0.998	184.1	183.7	1.21	9703	11717	9782	+19.8
Kalamazoo	1.056	292.6	309.0	1.21	9531	12178	10520	+15.8
Kalkaska	1.073	7.6	8.2	1.21	598	776	610	+27.2
Kent	1.053	418.4	440.8	1.21	18431	23483	20851	+12.6
Keweenaw	0.910	4.1	3.7	1.21	223	246	198	+23.7
Lake	0.993	9.3	9.2	1.21	637	765	628	+21.8
Lapeer	1.064	63.3	67.4	1.21	1646	2119	1865	+13.6
Leelanau	0.998	24.9	24.9	1.21	1584	1913	1743	+ 9.7
Lenawee	0.983	102.4	100.7	1.21	5084	6047	5435	+11.3
Livingston	1.075	65.6	70.5	1.21	2860	3720	2975	+25.0
Luce	0.958	8.4	8.1	1.21	594	689	664	+ 3.6
Mackinac	0.931	10.0	9.3	1.21	2075	2338	2153	+ 8.6
Macomb	1.252	843.7	1056.5	1.21	12519	18965	18761	+ 1.1
Manistee	1.024	33.5	34.3	1.21	1433	1776	1624	+ 9.3
Marquette	1.076	29.9	32.2	1.21	2209	2876	2785	+ 3.3
Mason	0.994	43.4	43.2	1.21	1861	2238	2182	+ 2.6
Mecosta	1.050	36.9	38.8	1.21	1543	1960	1689	+16.0
Menominee	0.988	23.6	23.4	1.21	836	999	1111	-10.2
Midland	1.061	98.4	104.4	1.21	2958	3798	3777	+ 0.5
Missaukee	0.943	11.9	11.2	1.21	415	474	497	- 4.8
Monroe	1.062	179.3	190.4	1.21	4038	5202	4815	+ 8.0
Montcalm	1.048	49.7	49.3	1.21	2546	3229	2813	+14.8
Montmorency	0.927	7.8	7.2	1.21	801	898	716	+25.4

TABLE 3.--Continued.

County	Population Factor	1960 Popn. Density	1965 Popn. Density	Income Factor	1960 Boats Registered	1965 Boats Forecast	1965 Boats Registered	Percent Error
Muskegon	1.006	288.9	290.8	1.21	6899	8398	7762	+ 8.2
Newaygo	1.039	27.9	29.0	1.21	2054	2582	2146	+20.3
Oakland	1.094	767.8	839.6	1.21	27467	36359	33112	+ 9.8
Oceana	0.985	30.6	30.1	1.21	1016	1211	1088	+11.2
Ogemaw	0.961	16.7	16.0	1.21	899	1045	844	+23.8
Ontonagon	1.030	8.0	8.2	1.21	465	580	596	- 2.9
Osceola	1.015	23.2	23.6	1.21	668	820	786	+ 4.3
Oscoda	1.044	6.1	6.3	1.21	352	445	338	+31.4
Otsego	1.100	14.0	15.4	1.21	950	1264	977	+29.4
Ottawa	1.096	172.6	189.2	1.21	5524	7326	5873	+24.7
Presque Isle	0.991	19.3	19.2	1.21	1298	1556	1362	+14.2
Roscommon	1.042	12.6	13.1	1.21	2928	3692	2795	+32.6
Saginaw	1.069	234.3	250.5	1.21	6701	8668	8896	- 2.6
St. Clair	1.005	111.6	112.1	1.21	5646	6866	6423	+ 6.9
St. Joseph	1.028	34.4	35.4	1.21	6016	7483	5735	+30.5
Sanilac	1.043	59.8	62.4	1.21	720	909	819	+10.9
Schoolcraft	0.905	11.9	10.8	1.21	1179	1291	1142	+13.1
Shiawassee	1.057	103.2	109.1	1.21	2339	2992	3000	- 0.3
Tuscola	1.035	52.8	54.8	1.21	1341	1679	1681	- 0.1
Van Buren	1.050	78.7	82.6	1.21	3949	5017	4133	+21.4
Washtenaw	1.102	238.5	262.8	1.21	6238	8318	7347	+13.3
Wayne	0.994	4266.0	4241.3	1.21	54398	65427	65496	- 0.1
Wexford	1.024	32.4	33.2	1.21	1537	1904	1717	+10.9
Totals						420410	386424	+11.7

out the calculations in the same manner as had been done for the Waterways Division study. (See Appendix C.)

The final boat projections from the computer run were tabulated and compared with the actual figures for boat registrations in 1965 in Table 3. Column 7 indicates the test values, Column 8 the actual number of registrations, and Column 9 the percent deviation of the test projections.

Results of the Test Projection

A comparison of the actual total fleet size with the total projected fleet size indicates that the two totals are not too dissimilar. The projected total for 1965 was 420,408 boats whereas the actual total registered with the State was 398,902. This represents an overprediction of slightly over 5 percent. However, one adjustment should be made before comparisons are made. The tabulations of actual registered boats have one category called "other" which contains some 12,478 craft, indicating that the county of residence of the owners of these boats is not within the State of Michigan, or that it is unknown. The predictive method used by the Waterways Division and by the test simulation does not contain this classification since both are based only on boats registered for the 83 counties of Michigan. Therefore, the actual total should be adjusted downward by 12,478 boats, giving a total of 376,424 registrations. When comparing this total with the projected total it is apparent that the method overpredicted the fleet size by some 11.7 percent.

It should also be pointed out that this type of overprediction is a cumulative error. In the case of the simulation, the overprediction accumulated for only five years. If the same procedure is used to project for a 15 year period (as in the case of the Waterways Division study), the total overprediction could be expected to be in the order of 30 to 35 percent. Therefore, it is possible that the predictions of 1980 fleet size generated in the Waterways Division study may be substantially inflated.

An analysis of the individual county projections indicates that by far the majority of the county registrations were overpredicted (see Table 3). Only 13 of the 83 counties were underpredicted. As a result of the large number of counties being overpredicted, the total overprediction was widely distributed among the counties with no excessively high predictions for any particular county.

The geographic distribution of the underpredicted counties was approximately equally distributed between the Upper and Lower Peninsulas. For no readily apparent reason, five of the underpredicted areas were concentrated about the Bay City - Saginaw area. Wayne County was also underpredicted, but the fact that half of the underpredictions were in the Upper Peninsula suggests that there is probably no relationship between underprediction and either the population growth factor or the population density factor. The only noticeable relationship was that with the exception of three counties, all of the underpredictions bordered on the Great Lakes. This indicates the possibility that accessability to water should be considered.

The trend in the predictions was generally toward a moderate overprediction in most counties. This produced a fairly large overprediction in the total fleet size. A number of possible reasons for the discrepancies are noted earlier. Any one, any combination, or all of the shortcomings of the projection technique could have been the source of the error. To ascertain the precise causes would require a more extensive research effort. The purpose here was only to gain an idea of the precision which could be expected from this particular type of technique.

The results of the test indicate that the technique utilized by the Waterways Division produces relatively reliable results for short projection periods. For long periods, the method may substantially inflate total fleet size estimates. However, this analysis is based on the supposition that the effects of population growth and density as well as income continue to have the same effects. If future occurrences (such as a successful anadromous fish program or a stabilization of population) should result in changes in boat ownership patterns, the entire bases of this type of projection technique would be invalid.

CHAPTER VII

SUMMARY AND RECOMMENDATIONS

Summary

The preceding chapters have indicated what factors should be considered when assessing the current planning efforts of the Waterways Division and in formulating a systematic and permanent comprehensive planning process. The major points of those chapters will now be summarized. Following this summary, specific recommendations will be made.

Chapter II began the development of a systematic approach to the planning process. It outlined the general elements of an ideal planning process and attempted to begin the adaptation of these elements to the problems of recreational boating planning. It suggested that the process should consist of four elements. The first is the background information phase in which the planner attempts to identify the problems which should be studied and the relevant variables involved. The second phase is the data inventory and analysis phase in which a planner attempts to measure specific variables to establish functional relationships between them, and to project certain variables to the chosen planning target date. The goals formulation phase of the process involves the formulation of the goals, objectives, and standards for the plan itself. The fourth phase, the plan design phase, attempts to suggest alternative policies and programs and to provide feasible choices from which to select a final course of action.

Chapter III discussed the basic requirements of a planning program for the Waterways Division. It pointed out that the program should determine the number, type, and place of storage of Michigan boats, place of residence and characteristics of boat owners, the location of boat use, the method of moving from origin to destination, the inadequacies of facilities, and the patterns and influences of special programs. It is also pointed out that the program should have the following characteristics; it should be continuous, reliable, predictive, modern, and be manageable by a few staff members.

Chapter IV discusses possible sources of information which relate to the planning of recreational boating in Michigan. Several reports and sources were reviewed.

Having thus established the basic requirements of a sound planning process, Chapter V proceeds with reviewing the planning program of the Waterways Division, as outlined in the study of recreational boating. Chapter V points out that this document should be considered primarily as an attempt at a background or data inventory and analysis phase of a planning process in that it attempts to estimate and determine the needs for various types of boating facilities. It does not, however, attempt to set up any goals, standards, or policies for the final plan. Nor does it attempt to formulate any sort of plan to meet the determined needs. Finally, it does not include two very important components of the boating system which must be considered in the planning process. First, it does not consider the supply of available boating opportunities or any concept of resource capacity. It considers only the need for launching and mooring facilities as measured by the amount of unsatisfied demand. Secondly, although it attempts to determine these needs, it does not consider the important question of the location of needed facilities.

In addition, Chapter V discusses the methodological limitations of the Division's boating study. First, the number of registered craft within the State in the future appears to be dependent upon more variables than are used in the Waterways Division estimates of future fleet size. Second, the mathematical model used to determine future fleet size, is considered to be fairly crude in that it makes unwarranted assumptions concerning the relationships of the variables in the model. Third, the estimates of probable fleet size are determined only on the basis of the craft presently registered within the State of Michigan. No consideration is given to boats owned by non-residents of the State or boats not requiring registration. Finally, it is pointed out that the survey technique used in the Waterways Division study, had several limitations, the most important being that it is impossible to determine the adequacy of its sample size or its precision in terms of the variables being estimated.

Recommendations

To organize the following recommendations in a more logical order, they have been presented in the chronological sequence in which they should be considered. However, this is not necessarily the order in which these topics were discussed in the preceding chapters.

Basic Planning Procedure Policy

There are at least two different approaches which could be followed by the Waterways Division in establishing a planning program. The Division could continue to develop impressive but general demand estimates to be used in attempting to justify further increases in funds to develop more facilities. This approach does not relate demand to supply in a quantitative way, thus ignoring the important factors of resource capacity and location. Although this type of approach cannot be called a "planning process" in the modern sense, it has been successful in obtaining funds in many instances in the past.

This thesis suggested that a more sophisticated and comprehensive approach to recreational boating planning should be established in which the quantitative relationships of supply and demand are analyzed on the basis of geographical areas and several alternative courses of action can be tested. It is believed that the simple approach cannot provide the information needed for planning the Waterways Division programs.

Recommendation 1.--The Waterways Division should first decide the type of planning process which is to be used. If an approach which provides information concerning only statewide demand is acceptable then a technique similar to the 1965 boating study should be selected. If a more sophisticated approach is desired, then a more comprehensive process that relates supply to demand quantitatively and includes all the phases suggested in Chapter II should be selected.

Recommendation 2.--Since the more sophisticated process provides a better basis for allocating considerable monetary resources, it is recommended that the Waterways Division adopt a policy which institutes this planning process, including all the phases described in Chapter II and procedures for relating demand to supply quantitatively by specific geographic areas, as its permanent approach.

If the general demand approach is chosen, it will be necessary to simplify the questionnaire and to improve its statistical reliability. The sampling procedure, mailings, follow-up to non-response and the various compilations and analyses could be fitted into a standardized computer program requiring little modification from year to year. To improve the sampling reliability, confidence limits should be specified and appropriate sample sizes determined using principles of probability sampling. Error estimates should then be prepared to provide an estimate of reliability.

The remainder of the recommendations assumes that Recommendation 2 is adopted.

Division of Responsibility

Up to this point the discussion has centered around the needs and responsibilities of the Waterways Division. It should be pointed out that since the reorganization of Michigan State Government, the Waterways Division has become a part of the Conservation Department and is therefore not in as independent a position as it previously was. Also, a Recreation Resource Planning Division has been established within the Conservation Department and has responsibilities for the coordination of recreational planning efforts of the various agencies within the Department. Therefore, it is necessary to address the question of how responsibilities should be divided between the Recreation Resource Planning Division and the Waterways Division when implementing the recommended planning process.

Since the Recreation Resource Planning Division is charged with the overall planning for recreation in the State, and is developing the staff, data, and procedures to carry out this duty, the following division of responsibilities between the Waterways Division and the Recreation Resource Planning Division is recommended.

Recommendation 3.--A close liaison should be established between the Recreation Resource Planning Division and the Waterways Division and mutual agreement reached as to the appropriate responsibility of the two agencies in carrying out the complete planning process. It is recommended that the Background Information and the Data Inventory and Analysis Phases of the process be carried out by the Recreation Resource Planning Division with assistance from the Waterways

Division for information gathering. The Policy Formulation Phase should be the result of a joint effort and the Plan Design Phase largely the work of the Waterways Division.

This division of responsibilities should prevent overlapping and duplication of efforts, promote better coordination of statewide recreation planning, and increase efficiency. However, this will present some problems in that the Recreation Resource Planning Division is currently understaffed and overburdened. This situation can be eased if the Waterways Division can provide the necessary assistance in such areas as the gathering of data.

The Recommended Process

Background Information Phase.--This phase of the process should be set up so that information concerning the general characteristics and problems is gathered as a matter of routine. It should be pointed out that the recommendations concerning the boat registration procedure indicated in this section are significant for the next phase of the planning process as well.

It is evident that the boat registration procedure will remain the major source of data concerning fleet size and will provide the basis for expansion of other boating variables on a statewide basis. This procedure offers an excellent opportunity to make better use of data already being gathered by the Department of State and to add new sources of data.

Recommendation 4.--Because of the significance of the boat registration procedure to the Background phase of the planning process, it is recommended that a close liaison be established between the Waterways Division, the Recreation Resource Planning Division and the Watercraft Registration Section. This would enable:

a. periodic tabulations of new registrations in an effort to detect shifts in demand characteristics and,

b. obtaining data on use characteristics by distributing questionnaires at predetermined intervals with the registration forms.

The agencies involved should also examine the possibility of changing the registration interval from three years to one.

In addition to the above recommendations concerning the boat registration procedure, other facets of the Background Information Phase should be carried out to enable quantitative analysis of supply and demand relationships.

Recommendation 5.--It is apparent that boat ownership is affected by more factors than population, population density and income. Therefore it is recommended that the role of other variables be investigated and the fleet size projection procedure modified according to the findings.

Recommendation 6.--It is recommended that the significance of boating by craft not registered with the State as well as those not requiring registration should be investigated. If this use is found to be significant or approaching this point, procedures to measure the quantity and characteristics should be instituted.

Recommendation 7.--The Department of Conservation's investigations of water resources should include whenever possible a measurement of recreational boating carrying capacities. It is essential that the supply of boating opportunities be considered in the planning process as well as the demand for facilities.

Recommendation 8.--A periodic inventory of boating facilities, their capacities and locations, should be undertaken for both the public and private sectors. This would help eliminate duplication and overdevelopment when considering new facilities.

Data Inventory and Analysis Phase.--This portion of the planning process should be carried out by the Recreation Resource Planning Division.

Recommendation 9.--The Waterways Division should continue to gather information on the extent and nature of demand by use of a recreational boating questionnaire but with the following revisions:

a. The sample should continue to be stratified by boat size classification, but confidence levels and intervals should be specified by the Division for each of the strata.

b. An attempt should be made to shorten and simplify the questionnaire. Binomial types of questions should be used where possible.

c. Once such confidence assumptions are provided, computations of minimum sample size should be calculated based on the statistical laws of binomial distribution. Such calculations could be performed for questions such as 6, 6c, 6f, 6g, 7, 7d, and 8 of the Waterways questionnaire, thus providing an idea of the necessary sample size for some of the variables.

d. The return questionnaire should then be tabulated by size strata and the numbers of actual returns compared with the calculated sample size to determine whether the return was adequate.

e. An analysis of the responses to the questions mentioned in item b should be tabulated and error estimates prepared. This would provide an estimate of the actual confidence which could be placed in the questionnaire results.

f. Follow-up techniques should be employed to decrease the amount of non-response.

g. The questionnaire should indicate which boat the respondent was sampled for (in the case of multiple boat owners) to eliminate a possible bias caused by a multiple boat owner responding for the boat he used most rather than the one for which he was sampled.

h. Those additional socio-economic variables which may be determined in the Background Stage to be pertinent to the prediction of demand should be measured and relationships established. This may require the addition of these variables to the boating questionnaire or the use of a second questionnaire.

i. Every effort should be made to standardize the questionnaire so that it can be repeated each year and comparisons made between years.

j. The questionnaire should be mailed immediately following the end of the boating season to lessen the recall problems of respondents.

Recommendation 10.--More sophisticated statistical techniques should be employed in analyzing the data for the preparation of fleet projections. Less reliance should be placed upon such techniques as linear extrapolation and straight line projection and more emphasis placed on techniques such as regression and multiple regression analysis. Such techniques should establish the relationships between demand for facilities and the various socio-economic and other variables involved. The result should be a more statistically reliable prediction of future demand. Those developing the process should look toward the establishment of some form of multivariate model which could be usable in the future for the purpose of projection of future fleet demands. Because of the nature of the problem and complexities of the demand situation, the model may of necessity be a fairly simple one consisting mainly of additive types of relationships. More research should be considered in the future in terms of the development of more sophisticated types of models.

Recommendation 11.--It is recommended that the "RECSYS-SYMAP" technique be used in the analysis and projection of boating supply and demand relationships. All information should be gathered and processed in a manner which will be usable in the "RECSYS-SYMAP" process.

Recommendation 12.--If the "RECSYS-SYMAP" technique is used, studies should be carried out at the destinations and origins of users using appropriate techniques to determine use patterns and characters of demand as well as the types of facilities needed.

The Policy Formulation Phase.--Making decisions and establishing policies is the responsibility of those administrators who oversee the planning process and implement the final plan. Therefore, no attempt will be made to recommend policies other than those already mentioned concerning the establishment of an acceptable planning process. However, the following recommendations have been developed from the discussion of the desirable elements of a planning process.

Recommendation 13.--The Policy Formulation Phase should be founded on considerations of alternatives developed and tested in the previous phases of the planning process.

Recommendation 14.--It is apparent from the findings of the Waterways Division study and other sources of information that the recreational fleet of the State continues to grow every year. At the same time, the resource base upon which the demand is exerted remains relatively constant over time. As the demand for and use of these resources continues to increase, it is apparent that Michigan faces the possibility of greater use conflicts upon its water resource base. For these reasons it is essential that the Waterways Division attempt to formulate water resource capacity standards. These capacity standards could then be useful in determining supply and demand relationships.

BIBLIOGRAPHY

Public Documents and Reports

Chubb, Michael. Outdoor Recreation Planning in Michigan by a Systems Analysis Approach: Part III--The Practical Application of "Program RECSYS" and "SYMAP." Lansing, Michigan: State Resource Planning Program, Michigan Department of Commerce, December, 1967. Technical Report No. 12.

Cornell, Howland, Hayes, and Merryfield, Engineers and Planners. Developing Small Boat Harbors in Six Oregon Counties. Washington, D.C.: U.S. Government Printing Office, February, 1965. Report prepared for the Department of Commerce, Area Development Administration.

Ellis, Jack B. Outdoor Recreation Planning in Michian by a Systems Analysis Approach: Part I--A Manual for "Program RECSYS." Lansing, Michigan: State Resource Planning Program, Michigan Department of Commerce, May, 1966. Technical Report No. 1.

Green, Bernal L., and Wadsworth, H. A. Boaters, Fishermen, Hunters: What Affects Participation and What Do They Want? Lafayette, Indiana: Purdue University Agricultural Experiment Station, February, 1967. Bulletin No. 829.

Leeds, Hill, and Jewitt, Inc. California Small Craft Harbors and Facilities Plan. Sacramento, California: Division of Small Craft Harbors, Department of Parks and Recreation, March, 1964.

Michigan Department of Conservation, Waterways Division. Transportation Predictive Procedures: Recreational Boating and Commercial Shipping. Lansing, Michigan: State Resource Planning Program, Michigan Department of Commerce, December, 1966. Technical Report No. 9C.

________. Michigan State Waterways Commission: Biennial Report of the Waterways Commission. Lansing, Michigan: Michigan Department of Conservation, 1966.

Michigan Department of State. Michigan Law Relating to Registration and Operation of Vessels and Motorboats. Lansing, Michigan: Department of State, undated.

Michigan Legislature. Act No. 320 of the Public Acts of 1947. (Mimeographed.)

________. Act No. 257 of the Public Acts of 1947. (Mimeographed.)

Michigan State University, Department of Resource Development. Michigan Outdoor Recreation Demand Study. Lansing, Michigan: State Resource Planning Program, Michigan Department of Commerce, June, 1966. Technical Report No. 6, Vols. I and II.

Michigan Tourist Council. Boat Launching Guide to Michigan. Lansing, Michigan: Michigan Tourist Council, undated. (Reprinted from Outboard Magazine, January and February, 1961.)

U.S. Congress, Outdoor Recreation Resources Review Commission. Study Report No. 19, National Recreation Survey. Washington, D.C.: U.S. Government Printing Office, 1962.

________. Study Report No. 20, Participation in Outdoor Recreation: Factors Affecting Demand Among American Adults. Washington, D.C.: U.S. Government Printing Office, 1962.

Books and Periodicals

American Institute of Planners. "Urban Development Models: New Tools for Planning." Journal of the American Institute of Planners, Vol. XXXI, No. 2, May, 1965. Special issue edited by Britton Harris.

Hodges, J. L., Jr., and Lehmann, E. L. Basic Concepts of Probability and Statistics. San Francisco, California: Holden-Day, Inc., 1964.

Isard, Walter. Methods of Regional Analysis: An Introduction to Regional Science. (Vol. IV, The Regional Science Studies Series.) Cambridge, Massachusetts: The M.I.T. Press, 1960.

McCracken, Daniel D. A Guide to Fortran IV Programming. New York, New York: John Wiley and Sons, Inc., 1965.

Slonim, Morris James. Sampling. New York, New York: Simon and Schuster, 1960.

Unpublished Material

Chubb, Michael. "A Systems Analysis and Special Demand Approach to Statewide Recreation Planning: A Case Study of Boating in Michigan." Unpublished Ph.D. dissertation, Michigan State University, Department of Geography, 1967.

Cox, Rex, W., and Vangsness, Elmer C. "Demand for Outdoor Recreation by North Dakota Residents." Unpublished Report prepared for the North Dakota Outdoor Recreation Agency, January, 1967.

Michigan Department of Commerce, Office of Economic Expansion, Research Division. "Estimated Michigan Population Changes by Counties, 1960-65 and Projections to 1975." Fact Sheet No. 3, July, 1966. (Typewritten.)

Michigan Department of Conservation, Waterways Division. "Recreational Boating in Michigan." Initial draft, February, 1966. (Typewritten.)

Van Doren, Carlton S. "Recreational Boating in Michigan." Paper presented to the Geography Section, Michigan Academy of Science, Arts and Letters, Wayne State University, March, 1961.

Other Sources

Hanurav, T. V., Assistant Professor, Department of Statistics and Probability, Michigan State University, Personal interview and correspondence, June and July, 1967.

Honey, Keith, Associate Professor, School of Urban Planning and Landscape Architecture, Michigan State University. Class notes from U.P. 363, "The Comprehensive Planning Process," Spring term, 1967.

Smith, Norman F., Chief, and Colburn, William, Recreation Resource Planner, Recreation Resource Planning Division, Michigan Department of Conservation. Personal interview, October, 1967 and other personal contacts.

Swanson, Howard, Office Manager, Watercraft Registration Section, Michigan Department of State. Personal interview, September, 1967 and subsequent telephone inquiries.

Wilson, Keith, Director, Waterways Division, Michigan Department of Conservation. Personal correspondence, July, 1967 and other personal contacts.

APPENDICES

APPENDIX A

DERIVATION OF THE POPULATION AND POPULATION DENSITY FACTORS FOR THE TEST SIMULATION

	County	1960 Population	Projected 1965 Population	% Change	Popu-lation Factor	Area (sq. Miles)	1960 Popu-lation per Sq. Mi.	1965 Popu-lation per Sq. Mi.
01	Alcona	6,352	6,100	-4.0	.960	694	9.2	8.8
02	Alger	9,250	8,600	-7.0	.930	934	9.9	9.2
03	Allegan	57,729	58,600	1.5	1.015	837	69.0	70.0
04	Alpena	28,556	29,400	3.0	1.030	590	48.4	49.8
05	Antrim	10,372	10,800	4.1	1.041	520	19.9	20.8
06	Arenac	9,860	9,400	-4.7	.953	369	26.7	25.5
07	Baraga	7,151	7,500	4.9	1.049	925	7.7	8.1
08	Barry	31,738	29,800	-6.1	.939	571	55.6	52.2
09	Bay	107,042	106,700	-0.3	.997	451	237.3	236.6
10	Benzie	7,834	7,900	0.8	1.008	342	22.9	23.1
11	Berrien	149,865	158,400	5.7	1.057	584	256.6	271.2
12	Branch	34,903	35,600	2.0	1.020	517	67.5	68.9
13	Calhoun	138,858	139,400	0.4	1.004	716	193.9	194.7
14	Cass	36,932	38,600	4.5	1.045	505	73.1	76.4
15	Charlevoix	13,421	14,100	5.1	1.051	451	29.8	31.3
16	Cheboygan	14,550	13,800	-5.2	.948	798	18.2	17.3
17	Chippewa	32,655	33,900	3.8	1.038	1,651	19.8	20.5
18	Clare	11,647	12,100	3.9	1.039	577	20.2	21.0
19	Clinton	37,969	42,900	13.0	1.130	573	66.3	74.9
20	Crawford	4,971	5,200	4.6	1.046	566	8.8	9.2
21	Delta	34,298	33,600	-2.0	.980	1,202	28.5	28.0
22	Dickinson	23,917	23,600	-1.3	.987	763	31.3	30.9
23	Eaton	49,684	54,600	9.9	1.099	572	86.9	95.5
24	Emmet	15,904	16,600	4.4	1.044	477	33.3	34.8
25	Genesee	374,313	416,900	11.4	1.114	649	576.8	642.4
26	Gladwin	10,769	10,400	-3.4	.966	512	21.0	20.3

APPENDIX A--Continued

	County	1960 Population	Projected 1965 Population	% Change	Population Factor	Area (sq. Miles)	1960 Population per Sq. Mi.	1965 Population per Sq. Mi.
27	Gogebic	24,370	20,800	-14.6	.854	1,146	21.3	18.2
28	Gd. Traverse	33,490	36,200	8.1	1.081	490	68.3	73.9
29	Gratiot	37,012	38,300	3.5	1.035	566	65.4	67.7
30	Hillsdale	34,742	33,900	-2.4	.976	604	57.5	56.1
31	Houghton	35,654	34,600	-3.0	.970	1,047	34.1	33.0
32	Huron	34,006	34,100	0.3	1.003	824	41.3	41.4
33	Ingham	211,296	230,500	9.1	1.091	560	377.3	411.6
34	Ionia	43,132	44,800	3.9	1.039	578	74.6	77.5
35	Iosco	16,505	20,300	23.0	1.230	563	29.3	36.1
36	Iron	17,184	15,500	-9.8	.902	1,219	14.1	12.7
37	Isabella	35,348	36,400	3.0	1.030	573	61.7	63.5
38	Jackson	131,994	131,700	-0.2	.998	717	184.1	183.7
39	Kalamazoo	169,712	179,200	5.6	1.056	580	292.6	309.0
40	Kalkaska	4,382	4,700	7.3	1.073	573	7.6	8.2
41	Kent	363,187	382,600	5.3	1.053	868	418.4	440.8
42	Keweenaw	2,417	2,200	-9.0	.910	587	4.1	3.7
43	Lake	5,338	5,300	-0.7	.993	577	9.3	9.2
44	Lapeer	41,926	44,600	6.4	1.064	662	63.3	67.4
45	Leelanau	9,321	9,300	-0.2	.998	374	24.9	24.9
46	Lenawee	77,789	76,500	-1.7	.983	760	102.4	100.7
47	Livingston	38,233	41,100	7.5	1.075	583	65.6	70.5
48	Luce	7,827	7,500	-4.2	.958	929	8.4	8.1
49	Mackinac	10,853	10,100	-6.9	.931	1,081	10.0	9.3
50	Macomb	405,804	508,200	25.2	1,252	481	843.7	1,056.5
51	Manistee	19,042	19,500	2.4	1.024	568	33.5	34.3
52	Marquette	56,154	60,400	7.6	1.076	1,878	29.9	32.2
53	Mason	21,929	21,800	-0.6	.994	505	43.4	43.2
54	Mecosta	21,051	22,100	5.0	1.050	570	36.9	38.8
55	Menominee	24,685	24,400	-1.2	.988	1,044	23.6	23.4
56	Midland	51,450	54,600	6.1	1.061	523	98.4	104.4

APPENDIX A--Continued

	County	1960 Population	Projected 1965 Population	% Change	Population Factor	Area (sq. Miles)	1960 Population per Sq. Mi.	1965 Population per Sq. Mi.
57	Missaukee	6,784	6,400	-5.7	.943	572	11.9	11.2
58	Monroe	101,120	107,400	6.2	1.062	564	179.3	190.4
59	Montcalm	35,795	35,500	4.8	1.048	720	49.7	49.3
60	Montmorency	4,424	4,100	-7.3	.927	567	7.8	7.2
61	Muskegon	149,943	150,900	0.6	1.006	519	288.9	290.8
62	Newaygo	24,160	25,100	3.9	1.039	867	27.9	29.0
63	Oakland	690,259	754,800	9.4	1.094	899	767.8	839.6
64	Oceana	16,547	16,300	-1.5	.985	541	30.6	30.1
65	Ogemaw	9,680	9,300	-3.9	.961	580	16.7	16.0
66	Ontonagon	10,584	10,900	3.0	1.030	1,331	8.0	8.2
67	Osceola	13,595	13,800	1.5	1.015	585	23.2	23.6
68	Oscoda	3,447	3,600	4.4	1.044	568	6.1	6.3
69	Otsego	7,545	8,300	10.0	1.100	538	14.0	15.4
70	Ottawa	98,719	108,200	9.6	1.096	572	177.6	189.2
71	Presque Isle	13,117	13,000	-0.9	.991	678	19.3	19.2
72	Roscommon	7,200	7,500	4.2	1.042	573	12.6	13.1
73	Saginaw	190,752	203,900	6.9	1.069	814	234.3	250.5
74	St. Clair	107,201	107,700	0.5	1.005	961	111.6	112.1
75	St. Joseph	43,332	43,500	2.8	1.028	1,229	34.4	35.4
76	Sanilac	32,314	33,700	4.3	1.043	540	59.8	62.4
77	Schoolcraft	8,953	8,100	-9.5	.905	751	11.9	10.8
78	Shiawassee	53,446	56,500	5.7	1.057	518	103.2	109.1
79	Tuscola	43,305	44,900	3.5	1.035	820	52.8	54.8
80	Van Buren	48,395	50,800	5.0	1.050	615	78.7	82.6
81	Washtenaw	172,440	190,000	10.2	1.102	723	238.5	262.8
82	Wayne	2,666,297	2,650,800	-0.6	.994	625	4,266.0	4,241.3
83	Wexford	18,466	18,900	2.4	1.024	570	32.4	33.2
	TOTAL	7,823,194	8,162,000					

APPENDIX B

DERIVATION OF THE INCOME FACTOR FOR THE TEST SIMULATION

To derive the income factor for the computer run the author sought statistics on statewide income for each of the five years preceding the base year of the simulation (1960). The "Annual Survey of Buying Power" provided by Sales Management was the source of this information as it was for the Waterways Division's study. The following table was prepared from that report.

TABLE B-1.--Effective Buying Income In Net Dollars

Year	Amount
1955	13,169,455,000
1956	13,504,032,000
1957	14,441,651,000
1958	14,287,180,000
1959	15,843,746,000
1960	16,550,713,000

The Waterways Division used a fifteen year planning period and therefore fifteen years of previous data on income was used in their projection. In the case of the test simulation however, only a five year projection period was used and therefore only five years of data preceding the base year was used. Projections from 1960 to 1965 were then prepared as follows from this data.

In order to simulate the income Waterways Division projections as closely as possible three projections were made. First, a "pessimistic" projection was made on the basis of the average rate of increase from 1955 through 1960. Income was found to increase on the average by some $676,251,600 per year or a total of $3,381,258,000 for the entire five year projection period. On this basis, income could be expected to increase to $19,931,971,000 by 1965. This is a factor of 1.20 (19,931,971,000/16,550,713,000). This rate of increase is represented by a line a,a' in Figure I.

Next, a very "optimistic" projection was made on the basis of the average rate of increase from 1958 through 1960. This period of time represents a more rapid rate of increase following a slight decline in buying income from 1957 to 1958. If income were to increase at the same rate through 1965 it would total approximately $22,209,545,500 or an increase factor of 1.34 (line b,b' in Figure 1).

Finally, a more "realistic" estimate was prepared based on the rate of increase from 1957 through 1960. On the basis of the annual rate of increase during this period income could be expected to increase to a total of $20,065,816,500 or a factor of 1.21 (line c,c', Figure 1). This factor was then used as the income factor for each of the counties in the simulation run. This is considered a rather conservative estimate when one considers the fact that the most "pessimistic" projection (as interpreted from the Waterways technique) produced a factor of 1.20.

APPENDIX C

The Computer Program

The computer program is a series of cards which immediately precedes the data deck and tells the computer what data will be found on the data cards, where to find the data, what variable names are assigned to it, what to do with the data, and finally, how it should be printed out. The program consisted of one "do loop," three write statements, and a counter. For this program, the "do loop" asks the computer to read the data off the cards and to do the calculations to provide a projected 1965 boat registration figure for each county. The counter asks the computer to accumulate the total number of 1965 boat projections after the calculation has been made for each county. The write statement asks the computer to print column headings, print out all of the variables (including number of boats projected for each county), and to print out the cumulative total boat projections for each county.

THE COMPUTER PROGRAM FOR SIMULATING THE WATERWAYS DIVISION'S FLEET PROJECTION TECHNIQUE

```
// FOR
*IOCS(CARD,1132 PRINTER)
C      PROGRAM WATERWAYS
       WRITE (3,10)
    10 FORMAT ('CNTY CODE  POP. FACT 60 POP.  65 POP.   INCOME FAC 60 REG BT BOAT
      1PROJ')
       WRITE (3,15)
    15 FORMAT (23X,'DEN.',5X,'DEN.',27X,'1965')
       BBP=0
       DO 20 I=1,83
       READ (2,30) A,B,C,D,E,F
    30 FORMAT (6F10.2)
       BP = (B*((C/D)**(1/5))*E)*F
       BBP=BBP+BP
    20 WRITE (3,40) A,B,C,D,E,F,BP
    40 FORMAT  (7F10.3)
       WRITE (3,50) BBP
    50 FORMAT ('TOTAL BOAT PROJECTION=',F20.2)
       CALL EXIT
       END
```