AN EXPLORATORY STUDY OF USE PATTERNS AND USER CHARACTERISTICS OF MICHIGAN SNOWMOBILE OWNERS

By

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ABSTRACT

AN EXPLORATORY STUDY OF USE PATTERNS
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The tremendous increase in number of snowmobiles, from 1962 to 1970, was cause for some concern to planners and managers of public land in Michigan. The problem selected for investigation was the question of whether or not significant differences in use patterns and socio-economic characteristics exist between various groups of snowmobilers and, if so, of what significance are these differences in managing resources for snowmobiling. Since Michigan is composed of three rather distinct geographic regions (Upper Peninsula, northern Lower Peninsula, and southern Lower Peninsula), it was of particular interest to determine if there are differences between the snow-mobilers in these three regions, and if so, in what way are they different. An additional aspect of the problem was that of examining methods used to collect data.

A survey of registered snowmobile owners was conducted in June and July of 1970 in cooperation with the

Michigan Department of Natural Resources. A four-page self-administered questionnaire was designed requesting information about: (1) socio-economic characteristics of the household; (2) opinions of respondents concerning regulations governing snowmobile activity; (3) patterns of snowmobile use in terms of number of snowmobiling days during the 1969-70 season, counties used, ownership of land used, kinds of snowmobile activities, other recreational activities associated with snowmobiling, and length and duration of overnight trips; and (4) information related to the snowmobiles owned by the household.

A random sample of 5,133 registered snowmobile owners, stratified by region, was drawn from the statewide listing of 127,769 registrations. The questionnaires were mailed on May 26, 1970; a reminder card followed by a second questionnaire were sent to nonrespondents on June 16 and 26 respectively. By the cut-off date, July 14, 3,527 usable responses were received: a response of 70 percent. Sub-samples of both respondents and nonrespondents were interviewed by telephone to determine if differences existed between these two groups. No statistically significant differences were found.

Contingency tables were developed for each variable across regions. If the analysis of variance and F test were significant (.05 level), then Scheffé post-hoc comparisons were made to determine which pair or pairs of means contributed to this significant difference. In

the case of qualitative variables, an overall chi-square was calculated; if it was significant then the chi-square was partitioned to determine where significant differences lay.

The Automatic Interaction Detector (AID) technique was employed to determine the presence of interaction effects between "predictor" variables and to determine the relative importance of these predictor variables in accounting for the variation in the dependent variable (number of snowmobiling days).[1]

Small regional differences were observed in the age and educational level of the head of snowmobile-owning households and in the number of children, 18 years old and under, in the household. However, substantial differences existed between regions in the combined household incomes: the more urban the region the higher the average income. There were differences from one region to another in the occupation of the head of the household.

Attitudes of snowmobile owners toward regulations governing snowmobiling activity varied little between regions, except for attitudes concerning the use of town and village streets for snowmobiling. In general, snowmobile owners favored stricter regulations and greater enforcement of them.

Snowmobile owners in the southern Lower Peninsula went snowmobiling fewer days than those in the other two regions. The more rural the region the more snowmobile

owners tended to go snowmobiling in their county of residence. Snowmobilers in the southern Lower Peninsula spent a large portion of time outside of that region while snowmobilers from the rest of the state confined snowmobiling activity almost exclusively to their own region. In general, respondents spent a greater proportion of their time snowmobiling on privately owned land than on publicly owned land. It was, also, noted that snowmobiling was more than just a sport by itself, but, was frequently associated with a number of other activities.

The results of this study lead to a number of recommendations. The main ones were that: (1) spacial units used for collecting and analyzing data should be more homogeneous, (2) a predictive model of snowmobile use be developed, (3) high priority be given to investigating user from the urban areas in the Lower Peninsula, and (4) in order to understand the behavior of the resource user it is necessary to examine their life style, rather than just their behavior in one activity.

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[1] "Predictor" is used in this phase of the analysis in terms of explaining the amount of variation in the dependent variable; not in terms of developing a functional equation.

ACKNOWLEDGMENTS

The completion of this study was made possible by the assistance and cooperation of many people. I am particularly indebted to Mr. Norman F. Smith, Office of Planning Services, Michigan Department of Natural Resources; Mr. Paul Rearich, Parks Division, Michigan Department of Natural Resources; Professor Louis F. Twardzik, Department of Park and Recreation Resources, Michigan State University; Dr. Michael Chubb, formerly the Director of the Recreation Research and Planning Unit, Michigan State University, for making this study financially possible.

Dr. Philip M. Marcus, Department of Sociology, Michigan State University, not only offered counsel and encouragement but arranged for the Urban Survey Research Unit to carry out the questionnaire coding and the transfer of data to computer tape. Mr. William H. Colburn, Office of Planning Services, Michigan Department of Natural Resources, offered assistance throughout, in particular, with the printing and distribution of the questionnaires.

I am grateful to the untiring assistance provided by the staff of the Recreation Research and Planning Unit, Michigan State University, in carrying out many of the routine, but necessary, tasks connected with conducting the survey.

To Dr. Daniel E. Chappelle and Dr. Milton H. Steinmueller, Department of Resource Development, Michigan State University, I am appreciative of the constructive criticism and encouragement they provided. Dr. Dennis Gilliland, Department of Statistics and Probability, Michigan State University, gave generously of his time and advice. I am most grateful to J. Paul Johnston, Department of Political Science, University of Alberta, for his invaluable assistance with the last phase of the analysis.

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STATEMENT OF PROBLEM

Introduction

Snowmobiling was one of the fastest growing recreation activities in the United States and Canada during the period 1962 to 1970. Sales increased from 4,000 in 1962 to approximately 350,000 in the 1969-1970 season, when this study was conducted. The snowmobile industry expected one million snowmobiles to be in operation by the 1969-70 season.[1] Sales figures for 1969-70 represented a threefold increase compared to the 1967-68 season. This growth appeared even more spectacular when it is realized that 75 to 80 percent of these sales were in the states of Maine, Michigan, Minnesota, New York, and Wisconsin.[2] The state of Michigan had the largest

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[1]Harold K. Howe, "Industry's View of Problems that Face Snowmobiles," Proceedings of the International Snowmobile Conference (Albany, N.Y.: New York State Conservation Commission, May 1969), p. 48.

[2]Steve F. Briggs II, "A Look at Where Industry Is Going," Proceedings of the International Snowmobile Conference (Albany, N.Y.: New York State Conservation Commission, May 1969), p. 51.

number of snowmobiles at the end of the 1969-70 season, with over 130,000 registered with the state. This rapid growth placed increased pressure on public and private resources suitable for this leisure time pursuit, particularly on the southern fringe of the "snowbelt" where large urban centres such as Chicago, Detroit, and Toronto have been located.[1]

This pressure on space and facilities, resulting from the pursuit of the wide variety of activities desired by snowmobilers, was felt at all levels of the public sector: city, county, state, and federal. Conflicts between snowmobilers and other recreationalists, such as skiers, ice fishermen, and cottage owners, have made it increasingly difficult to plan for multiple use of the resources. The problem has been particularly acute near urban centres where frequently the lack of adequate snowcover and comparative scarcity of public open space accentuated the problem. However, despite rapidly growing snowmobile usage, and many associated problems, very little research has been carried out to determine the basic characteristics of snowmobiling and

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[1]The "snowbelt" refers to that area of northern U.S. which has an average annual snow cover of 100 days or more, i.e., snow of a depth of one inch or more. The northern portion of these five states is in this snowbelt.

snowmobilers. Such research would be most useful to planners in allocating resources and in developing management techniques.[1]

In Michigan, the problems presented by and confronting snowmobilers have been accentuated by the distribution of the population and certain environmental factors. Nearly 90 percent of its almost 9 million people live in the southern third of the state while only some 3 1/2 percent live in the Upper Peninsula.[2] As might be expected, the proportion of open space and

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[1]Only two completed studies existed at the time this project was started. They were: (1) "Evenrude Snowmobile Trail Survey, 1967," Outboard Marine Corporation, a mail survey of Evinrude Snowmobile owners to determine the trail designs most desired by the respondents, and (2) "1970 Snow Goer Consumer Survey," Snow Goer Magazine, Minnesota, which mailed questionnaires to a sample of Snow Goer subscribers, primarily to determine the economic impact of snowmobiling.

At the time this study was conducted there were three related studies in progress: (1) the, Minnesota Snowmobile Survey - 1970, Minnesota Department of Conservation, which employed a mailed questionnaire to a sample of snowmobile owners to determine the amount and distribution of snowmobile use on public and private lands; (2) 1970 Snowmobile Survey, Directional Marketing Company, Grand Rapids, which involved a telephone survey of 500 randomly sampled registered snowmobile owners in order to examine travel patterns and economic factors of snowmobiling in Michigan; and, (3) An Analysis of Snowmobiling in Ontario, 1969-70, Department of Tourism and Information, Province of Ontario, which mailed questionnaires to a sample of registered snowmobile owners to determine the socio-economic characteristics, activity patterns, and economic aspects of snowmobiling in Ontario.

[2]U.S. Department of Commerce, Bureau of the Census, 1970 Census of Population, Michigan (Washington, D.C.: Government Printing Office, 1971), p. 3.

publicly owned land increases as one moves north and then west through the state. The topography is primarily rolling sandy and gravelly hills with some rocky uplands located in the western part of the Upper Peninsula. The state contains dozens of sizable river systems with a multitude of small streams and lakes.[1]

In terms of climate, the most important factors for snowmobilers has been the amount of snowfall and winter temperature patterns. In the highly urbanized areas around Detroit the snowfall was between thirty and forty inches in the 1969-70 season whereas in the upper part of the Lower Peninsula and in the Upper Peninsula many areas received well over 100 inches.[2] This difference in the supply of snow was further accentuated by the fact that the snowfall frequently melted soon after falling in the southern regions while in the north it tended to accumulate providing a more suitable base for snowmobiling.

Because of the abundance of natural resources for recreation, especially in its northern areas, Michigan has become a "recreation state" and tourism is a major

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[1]Department of Natural Resources, Michigan Recreation Plan, 1970 (East Lansing: Michigan Department of Natural Resources, 1970), p. 2.

[2]Michigan Department of State Highways, "Snowfall Contour Map, Winter of 1969-70" (East Lansing: Department of State Highways, Local Government Division, 1970).

part of the economy. To facilitate access to these resources by both Michigan residents and out-of-state recreationalists, an extensive highway system has been developed which has made it easy for most Mid-West residents.

The Problem

The topic upon which this dissertation focused was that of investigating the use patterns and characteristics of registered snowmobile owners in Michigan. Since no previous studies of this kind had been done concerning snowmobiling, the question of what were the most appropriate methods to use was an integral aspect of the problem.

As Michigan is composed of three rather distinct geographic regions (the Upper Peninsula, the northern Lower Peninsula, and the southern Lower Peninsula), it was of particular interest to determine if there were differences between the snowmobilers in these three regions, and if so, in what ways they differed. This was particularly true in a state such as Michigan since much of the planning of resources and resource management done by the Department of Natural Resources was conducted on a regional basis, using these three geographic divisions.

Not only was it of concern to be able to describe snowmobilers in the state with greater accuracy, but it

was also important to examine the relationships between their socio-economic attributes and the extent and manner in which they used their snowmobiles; as Van Doren and Lentnek point out: "In order to plan outdoor recreational facilities to meet future requirements of a large urbanized population . . . it is desirable to know the social and economic characteristics of persons engaging in specific activities."[1] If meaningful relationships did exist between user characteristics and use patterns, then it would be useful to determine to what extent use could be predicted from a knowledge of these relationships. This kind of information would be useful to planners who have been faced with making decisions regarding the allocation of natural resources for recreational purposes. Also those persons and agencies concerned with developing policies regulating the use and management of public lands for recreation were in need of this kind of information to provide them with a better understanding of the clientele served.

The problem selected for investigation in this dissertation is the question whether or not significant differences in use patterns and socio-economic characteristics existed between snowmobilers from Michigan's

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[1]Carlton S. Van Doren and Barry Lentnek, "Activity Specialization Among Ohio's Recreation Boaters," Journal of Leisure Research, 1 (Autumn 1969): 296-315.

three regions, and if so, of what significance were these differences in managing resources for snowmobiling.

Objectives

The following objectives were established based on the problem outlined above:

1. To determine and compare socio-economic and snowmobile ownership characteristics and attitudes toward snowmobiling regulations of snowmobile owners resident in each of the three regions and the state as a whole.
2. To determine and compare use patterns of snowmobile owners for each of the regions and the state as a whole.
3. To establish ratios between total amount of use and amount of use in the county of residence for each region.
4. To examine relationships between the total amount of snowmobile use in each of the three regions and socio-economic characteristics and other selected factors of snowmobile owners resident in each of these three regions.

Significance of the Study

The tremendous increase in the number of snowmobiles in the short space of eight years just prior to

the conduct of this study has been cause for some concern to planners and managers of public recreation land. As Dodge, of the Parks Division, Michigan Department of Natural Resources, pointed out: "Among current problems concerning State Park administrators has been increased pressure from recreation vehicle owners."[1]

The fact that two International Snowmobile Conferences (at Albany, New York in May 1969 and at Duluth, Minnesota in February 1970) have been held and that a third (at Portland, Maine in October 1970) was being planned at the time this study was conducted, indicated the desire on the part of planning agencies, management agencies, manufacturers, dealers, and participants to resolve some of the problems that had arisen. Snowmobiling was not a fad that would disappear in the near future but rather as Koenings, of the Bureau of Outdoor Recreation, pointed out at the first of these conferences, " . . . snowmobiling is a legitimate use of peoples' leisure time in the winter, and, therefore, should be provided for."[2]

Providing for snowmobiling is not simply a matter of permitting snowmobilers to use public land, for aside

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[1]Robert O. Dodge, "Michigan," Parks and Recreation, December 1970, p. 45.

[2]Roman H. Koenings, "Introduction," Proceedings, International Snowmobile Conference (Albany, New York: May 1969), p. 2.

from the impact these vehicles have on the physical environment, there are also problems with conflicts. As Baldwin indicated, such conflicts are:

> . . . inevitable between off-road vehicle proponents and more traditional outdoorsmen. Left alone, however, vehicles quickly dominate the scene, since competition of uses is inherently unequal. The same unequal competition holds true for snowmobiles.[1]

As well as resolving conflicts with other recreationists, recreation managers have another task according to Glasgow, former Assistant Secretary of the Interior, namely: " . . . to learn how to so regulate and conduct the use of snowmobiles that the advantages of this type of transportation may be employed and engaged but without degrading the landscape and the natural resources which make up the environment. . . . "[2]

Much has been said and written about snowmobiles and snowmobile operators, but little research has been carried out to examine the many aspects of this recent leisure phenomenon. The Michigan Department of Natural Resources has begun to experiment with several schemes for coping with the snowmobile onslaught, by setting up "snowmobile demonstration areas" to test types of trails

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[1]Malcolm F. Baldwin, The Off-Road Vehicle and Environmental Quality (Washington, D.C.: The Conservation Foundation, 1970), p. 26.

[2]Leslie L. Glasgow, "Snowmobiles Today," Trends in Parks and Recreation, 6 (October 1969): 3.

and facilities and through the zoning of areas in the state parks, in an attempt to improve their ability to provide for all winter recreationists who wish to use the state parks.[1] These have been important and necessary steps but more knowledge of snowmobilers and their behavior was needed if planners were to plan effectively. In discussing the changing nature of planning, Burton and Cherry emphasized that planners must develop a better understanding of the total situation and in so doing need to rely on the social sciences as well as the physical sciences to develop these insights.[2] In order to understand a situation, or a behavioral phenomenon, it is necessary to examine the relationships which exist. It was not useful enough to merely measure participation, for as Driver and Tocher pointed out in their discussion on planning in recreation: "We make estimates of short run participation rates and selected recreational activities, and these are too frequently taken as demand projections."[3]

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[1]Dodge, "Michigan," p. 45; Michigan Department of Conservation, Snowmobile Demonstration Areas, February 15, 1968, p. 2.

[2]T. L. Burton and G. E. Cherry, Social Research Techniques for Planners (London: George Allan and Unwin Ltd. 1970), pp. 6-7.

[3]B. L. Driver and S. Ross Tocher, "Toward a Behavioral Interpretation of Recreational Engagements, with Implications for Planning," Elements of Outdoor Recreation Planning, ed. B. L. Driver (Ann Arbor: University Microfilms 1970), p. 27.

In order to plan and develop areas for snowmobiling and also to manage the resources used, it was necessary to develop a deeper insight into the nature of this leisure pastime. This study will provide some of the basic data needed for snowmobile facility and resource planning. It will also provide a data base upon which future studies can be founded, resulting in a greater understanding of snowmobilers and also the trends that have been taking place in the pursuit of this activity.

Definitions

The following terms and definitions were used in this dissertation:

Snowmobile.--"Snowmobile means any motorized vehicle designed for travel primarily on snow or ice, steered by wheels, skiis, or runners."[1]

Owner.--"'Owner' means any person, other than a lienholder, having the property in or title to a snowmobile entitled to the use or possession thereof."[2]

Registered Owner.--A "registered owner" was defined as the owner of a snowmobile who had registered his vehicle with the Secretary of State.

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[1]Michigan, An Act to Register and Regulate Snowmobiles, H.B. 3575, Regular Session, 74, Legislature, 1968, Section 1(e).

[2]Ibid., Section 1(b).

Day.--Respondents to the questionnaire were asked to count each day or part of the day spent snowmobiling as ONE day. This meant that if use of their snowmobile involved several different activities in one day then they would count their time spent on each activity as one "day" for that activity.

Head of Household.--"Head of the household" was considered to be the principal wage earner or the person who was considered by the household in question to be head of that household.

Members of the Household.--Members of the household were those persons living in the dwelling unit in question and was usually comprised of members of the "heads" family.

Socio-economic Characteristics.--The socio-economic characteristics selected for this study were as follows: age, educational level, and occupation of household head; combined household income, number of children in household, membership in snowmobile clubs and snowmobile groups preferred.

Predictor Variable.--The term "predictor" variable was used in terms of accounting for some portion of the variation in the dependent variable and not in terms of being part of a functional relationship.

Limitations and Assumptions

The main limitation encountered in conducting the study was one of gaining sufficient financial support to obtain an adequate sample size on a county-by-county basis. The funds available limited sample size to a maximum of 5,000 registered snowmobile owners. Therefore, the state was stratified into only three geographic regions when designing the survey. The universe from which the sample was selected was limited to those snowmobile owners who had registered a machine with the Secretary of State's office by April, 1970. It was assumed that a high percentage of the state's snowmobile owners (other than those who used their snowmobiles exclusively on their own land) would have registered their machines by this date. The Act requiring registration went into effect on January 1, 1969, providing up to fifteen months during which registration could have taken place.

Another limitation was the recall problem resulting from asking questions concerning snowmobiling done during the season. Some respondents probably overestimated use while others may have underestimated it. Whether or not statistical results were biased in one direction or the other is not known. However, it was assumed that the statistical results were not affected

to any great extent; that is, the plus or minus discrepancies in estimating the amount of use added to zero or close to it.

Having defined the problem and stated the objectives the next task was to determine the most appropriate methods and procedures to use to investigate the problem, within the limitations outlined.

Outline

Chapter II is divided into two sections: the first discusses and describes the methods that were used to collect data, and the second describes the methods of analysis. In the first section of Chapter III the results of the contingency tables are presented and analyzed; in the second portion the interaction between the variables is examined. Chapter IV contains the conclusions and recommendations.

CHAPTER II

METHODS AND PROCEDURES

This study was undertaken in cooperation with the Recreation Resource Planning Division,[1] Michigan Department of Natural Resources and the Recreation Research and Planning Unit, Department of Park and Recreation Resources, Michigan State University. It was begun in the fall of 1969 but the actual mail survey was conducted in the spring of 1970.

In selecting a design for this study, a number of major constraints were taken into consideration. Various possible methods were examined in order to determine their relative suitability under these constraints.

Data Collection

Techniques

In this study, limited financial resources was one of the chief constraints. Its main influence was on sampling procedure and the method of collecting data.

[1]Now, Office of Planning Services.

In examining the various possible approaches, the importance of keeping survey bias and errors to a minimum had to be kept in mind.

Several methods of data collection that warranted consideration were: direct observation, personal interviews, telephone interviews, self-administered questionnaires, and examination of existing records.

Direct observation as a method did not offer the scope desired. As Burton and Cherry pointed out: "It is usually suitable for only a small fraction of the subjects the researcher wants to study, since it is confined in time and space."[1] Snowmobiling activity usually takes place over a wide geographical area and often has undetermined starting and ending points, thus making objective and comprehensive observation very difficult to achieve.[2] In addition, observation would require a considerable field staff and could not provide data on socio-economic characteristics.

Collecting information through personal interviews had a number of advantages that made this approach worth consideration. Some of the more pertinent ones

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[1]Burton and Cherry, Social Research Techniques, p. 126.

[2]L. L. Lanier, "Snowmobile Survey of Selected State Parks" (unpublished mimeographed material, Recreation Research and Planning Unit, Michigan State University, 1970).

which have been discussed by Lininger and Warwick are that this method: (1) tends to reduce the problem of nonresponse common to other survey techniques, (2) is more readily administered to persons of all education levels, (3) allows the interviewer to correct misinterpretation of questions, (4) facilitates exploration of areas in which little information existed, and (5) makes it easier to obtain information about emotionally charged subjects.[1] However, a number of problems would arise in using the personal interview approach on a state-wide basis, the most important of which would be the high cost of conducting interviews throughout the state, especially if numerous "call-backs" were required in order to make contact with the potential respondents. The administrative structure to carry out interviews in different portions of the state would have added considerably to the cost.

According to Seltiz et al., telephone interviews offered some advantages compared to the mailed questionnaire, primarily, that they were usually less costly per unit. However, this technique also had serious limitations for this study, such as: (1) having to be brief and superficial in order to gain the cooperation

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[1]Charles A. Lininger and Donald P. Warwick, "Introduction to Survey Research" (Ann Arbor: Survey Research Center, Institute for Social Research, University of Michigan, mimeographed material, 1967), pp. IV - 2 and 3.

of the respondent, (2) not being able to reach a random sample of the desired population, since not all people had telephones, and (3) the difficulty in contacting persons who work away from home by telephone.[1]

Burton and Cherry noted that with the mailed self-administered questionnaire: " . . . it is possible to cover a wider geographical area and to reach a larger sample of the population (with given financial resources) than is possible by the use of an interview survey."[2] According to Lininger and Warwick, the self-administered questionnaire had several other advantages compared to the interview method, such as: a feeling on the part of the correspondent that his statements would be treated confidentially making it easier to express his true views, and that he had greater opportunity to search out information which he may not have had at his fingertips.[3] Against these advantages there were some limitations that needed evaluating. As Moser pointed out: "The vital limitation of mail survey is the difficulty of

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[1]Claire Selltiz, et al., Research Methods in Social Relations (New York: Holt, Rinehart and Winston, 1959), p. 239.

[2]Burton and Cherry, Social Research Techniques, p. 38.

[3]Lininger and Warwick, Survey Research, pp. IV - 1 and 2.

getting an adequate response."[1] He also indicated that questions must be kept simple in order to be understood with the help of printed instructions, that the answers obtained must usually be accepted as final, and that no opportunity was available to supplement the respondent's answers by observational data.

The advantage of using existing records as a source of information is that the data have already been collected. However, since such records have usually been produced for some other purpose they may not be in an appropriate form.

After carefully considering the above methods, while keeping the objectives of the study in mind, it was decided to use a combination of several methods. The self-administered questionnaire was thought to be the most appropriate method for collecting the main body of information about snowmobilers. In order to determine if, in selected counties, there was a difference in the characteristics of the respondents compared to non-respondents, a telephone survey of a sub-sample of both nonrespondents and respondents in those counties was conducted. Registration records from the Secretary of State Office were used to select the survey sample, and snowfall data collected by the Michigan Department of

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[1] C. A. Moser, Survey Methods in Social Investigation (London: Heinemann Education Books Ltd., 1958), pp. 177-78.

State Highways was used to estimate the snowfall received in each county. The rationale underlining these selections will be discussed more fully in the following sections.

Self-Administered Questionnaire

The chief reason for selecting this method of data collection was because it enabled the researcher to contact a larger sample than would have been possible with the same amount of funds if the personal interview method had been chosen. Due to the larger sample it would be possible to make more precise statements about snowmobilers throughout the state. Also, data of a more comprehensive nature could be gathered than if a telephone survey was used. Having made that decision, the problem of developing a suitable survey instrument had to be tackled. Oppenheim identified three other types of decisions, that are pertinent to the study, which had to be made before writing the actual questions, namely:

> (1) The method of approach to the respondents (after selection through sampling procedures), including sponsorship, stated purpose of the research, confidentiality, anonymity. (2) The build-up of question sequences in the order of questions and other techniques was in the framework of the questionnaire. (3) The use of precoded versus free-response questions.[1]

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[1] A. N. Oppenheim, Questionnaire Design and Attitude Measurements (New York: Basic Books, Inc., 1966), pp. 24-25.

Personnel from the Recreation Resource Planning Division were of the opinion that it would be better to mention Michigan State University as the sponsoring agency since it was said to have a better image of impartiality than the Department of Natural Resources at that time.[1] According to Burton and Cherry: "The initial response to a self-administered survey depends upon . . . the degree of interest in the subject of the survey that can be aroused in this population. . . . "[2] Hence, a covering letter for inclusion with the questionnaire was drawn up which asked for the respondent's cooperation. It said that the survey was being conducted in cooperation with the Department of Natural Resources, briefly explained the purpose of the study, stated that the respondents' replies would be treated confidentially, and indicated that it would only take fifteen to twenty minutes of their time (see Appendix A). By assuring confidentiality rather than guaranteeing anonymity, it was possible to place each respondent's registration number on the questionnaire so that it could be checked off on a duplicate set of address labels if the

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[1]A series of discussions were held with Mr. William Colburn and other members of the Recreation Resources Planning Division in early March 1970 regarding the forms that the covering letter and questionnaire should take.

[2]Burton and Cherry, Social Research Techniques, p. 39.

questionnaire was returned. This procedure reduced the number of reminder cards and second questionnaires which had to be mailed out subsequently.

In developing the overall plan for a questionnaire, Oppenheim suggested that the first part should begin with: " . . . some easy impersonal questions and not ask for details like age, family, occupation and so forth until rapport has been established."[1]

In deciding on the type of questions to use (i.e., open-ended versus closed question), it was decided to use closed questions where the respondent was either asked to check off the appropriate category or he was asked to fill in a blank with a name or a quantity. As Burton and Cherry stated: "Open questions are easy to ask, difficult to answer and more difficult to analyze."[2] In some cases the category "other" was included and the respondent asked to specify the particular activity, etc. This was done to ensure that, at least in a sense, the categories listed were exhaustive in nature.

Special efforts were made to ensure that the wording of the question was simple and straight forward. In order to reduce the length of the questionnaire, charts were constructed that enabled the respondent to put down

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[1]Oppenheim, Questionnaire Design, p. 37.

[2]Burton and Cherry, Social Research Techniques, p. 57.

a considerable amount of information in a small space. This technique gave the questionnaire the appearance of being shorter than if several questions had been asked to obtain the same amount of information, for as Crapo and Chubb concluded: "The amount of material contained in a questionnaire does not seem to affect response as much as the appearance of being brief."[1]

The questionnaire was pretested in early April on thirty-six snowmobile owners who either worked in a nearby manufacturing plant or were civil servants. As a result of the pretest, minor but significant changes were made in the wording of the questions and also in the categorization in some cases. The average time required to complete the questionnaire was less than twenty minutes. The revised questionnaire requested the following information:

(1) Information describing the snowmobile make, year of manufacture, horse-power, number of years owned, county in which it was registered, and the member of the household who was the registered owner (see question 1, Figure 1).

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[1]Douglas Crapo and Michael Chubb, Recreation Area Day-Use Investigation Techniques: Part 1 A Study of Survey Methodology, Technical Report Number 6 (East Lansing, Mich.: Recreation Research and Planning Unit, Michigan State University, 1969), p. 97.

21 DO YOU FEEL THAT REGULATIONS SHOULD BE ESTABLISHED TO CONTROL SNOWMOBILE ACTIVITY ON FROZEN LAKES WHERE ICE-FISHING IS BEING DONE? Yes ☐ No ☐

22 DO YOU THINK SNOWMOBILERS SHOULD BE ALLOWED TO DRIVE ON A:

(a) main highway (other than expressways)? Yes ☐ No ☐
(b) secondary highways? Yes ☐ No ☐
(c) highway shoulders (unplowed portions)? Yes ☐ No ☐
(d) street of a town or village? Yes ☐ No ☐

23 IN THE SPACE BELOW, PLEASE INDICATE ANY SPECIAL SNOWMOBILING PROBLEMS YOU MAY HAVE HAD DURING THE PAST SEASON.

THANKS FOR YOUR HELP!

If you accidently misplaced the return envelope provided, please mail to:

Recreation Research and Planning Unit
Room 131 Natural Resources Building
Michigan State University
East Lansing, Michigan 48823

MICHIGAN SNOWMOBILE USE STUDY

PLEASE FILL OUT THIS QUESTIONNAIRE AND RETURN IT IN THE ENCLOSED PREPAID REPLY ENVELOPE

1 DESCRIBE THE SNOWMOBILES OWNED BY MEMBERS OF YOUR HOUSEHOLD, BY COMPLETING THE TABLE BELOW. (Head of household means the main wage earner.)

Make	Year	Horse-power	No. of years owned	County of registration	Registered owner, eg., head, wife, son, etc..
EXAMPLE Sno-jet	1967	25	2	Alpena	Head

2 PLEASE CHECK THE FOLLOWING ITEMS THAT ARE OWNED BY MEMBERS OF YOUR HOUSEHOLD.

Motorcycle or trail bike ☐
All terrain vehicle ☐
Truck camper ☐
Power boat ☐
Snowmobile conversion kit (for summer use) ☐
Snowmobile trailer (to carry snowmobile) ☐
Camping or house trailer (that you tow with your car) ☐

3 WHICH COUNTIES DID YOU USE THE MOST FOR SNOWMOBILING DURING THE PAST WINTER? (Write in the number of days on each line. NOTE: Count each day or part day spent snowmobiling in a county as ONE day.)

	County of most use	County of 2nd most use	County of 3rd most use	All other county use	Out of State use; name state or Prov.
County name				X	
No. of days of use					
EXAMPLE					
County name	Kent	Lake	Alpena	X	Ontario
No. of days of use	27	12	2		1

4 IN WHAT YEAR DID YOU BUY YOUR FIRST SNOWMOBILE? _____.

5 (a) IS THERE A SNOWMOBILE CLUB IN YOUR AREA? Yes ☐ No ☐ Don't know ☐
(b) DO YOU BELONG TO A SNOWMOBILE CLUB? Yes ☐ No ☐

Fig. 1. The snowmobile questionnaire. A view of the front and back pages of the questionnaire in the unfolded condition. Actual size of each page was 8 1/2 x 11 in.

6 INDICATE BELOW THE KINDS OF AREAS THAT YOU USED FOR SNOWMOBILING DURING THE PAST SNOWMOBILE SEASON, BY WRITING IN THE NUMBER OF DAYS FOR EACH OF THE AREAS BELOW. (NOTE: Count each day or part day spent in an area as ONE day. Therefore the total days may add to more than the actual number of days you used your snowmobile.)

On your own land	____ days	On private land after paying a fee	____ days
On Federal land	____ days	On local public roads not plowed	____ days
On State owned land	____ days	On City park land (including City golf courses)	____ days
On county owned land	____ days		
On private land, at no charge	____ days	Other _____ (specify)	____ days

IN ORDER TO FORECAST FUTURE DEMAND FOR SNOWMOBILE AREAS IN MICHIGAN, IT IS NECESSARY FOR US TO BE ABLE TO RELATE FAMILY CHARACTERISTICS TO USE PATTERNS OF SNOWMOBILERS. PLEASE ASSIST US BY ANSWERING THE FOLLOWING QUESTIONS.

7 WHERE IS YOUR PERMANENT RESIDENCE? _____ county _____ state _____ zip code

8 WHAT IS THE AGE AND SEX OF THE HEAD OF YOUR HOUSEHOLD? Age ____ years Male ☐ Female ☐

9 WHAT IS THE OCCUPATION OF THE HEAD OF YOUR HOUSEHOLD? _____ occupation (not organization)

10 WHAT IS THE AGE AND SEX OF EACH FAMILY MEMBER LIVING IN YOUR HOUSEHOLD?(Not head of household)

Male - ages ___ : ___ ; ___ : ___ ; ___ . Female - ages ___ ; ___ ; ___ : ___ ; ___ .

11 WHICH OF THE ANSWERS BELOW BEST INDICATES THE TOTAL YEARS OF EDUCATION COMPLETED BY THE HEAD OF THE HOUSEHOLD? (Check one)

☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12 ☐ 13 ☐ 14 ☐ 15 ☐ 16 ☐ 17 or more

12 WHICH OF THE FOLLOWING BEST DESCRIBES THE COMBINED GROSS INCOME OF YOUR HOUSEHOLD IN 1969? (Check one)

under $3,000 ☐	$8,000 - $9,999 ☐	$20,000 - $24,999 ☐
$3,000 - $5,999 ☐	$10,000 - $14,999 ☐	$25,000 - $29,999 ☐
$6,000 - $7,999 ☐	$15,000 - $19,999 ☐	$30,000 and over ☐

13 CHECK THE FOLLOWING PEOPLE OR GROUPS OF PEOPLE THAT YOU WENT SNOWMOBILING WITH MOST OF THE TIME DURING THE PAST SNOWMOBILE SEASON. (Check only one)

I went alone ☐	A group of friends ☐	Family (with children) ☐
Wife (or husband) ☐	An organized group ☐	Girlfriend (or boyfriend) ☐
My children ☐		Other _____ (specify) ☐

14 ON HOW MANY DAYS DID YOU OR MEMBERS OF YOUR HOUSEHOLD TAKE PART IN THE FOLLOWING ACTIVITIES WHILE USING YOUR SNOWMOBILE(S) DURING THE PAST SNOWMOBILE SEASON? (Write in the number of days on each line. Use a "0" for no activity. NOTE: Count each day or part day spent on an activity as ONE day.)

Scrambling in open areas and on lakes	____ days	Competive racing	____ days
Snowmobiling to work or during your work	____ days	Trail riding and forest cruising	____ days
		Other _____ (specify)	____ days

15 ON HOW MANY DAYS DID YOU OR MEMBERS OF YOUR HOUSEHOLD ENGAGE IN THE FOLLOWING ACTIVITIES WHILE ON A SNOWMOBILE TRIP THE PAST SNOWMOBILE SEASON? (Write in the number of days.)

Tobogganing, sledding or skiing (not being towed)	____ days	Cook-outs	____ days
Hunting	____ days	Overnight camping	____ days
Ice fishing	____ days	Other _____ (specify)	____ days

16 HOW MANY NIGHTS DID YOU STAY OVERNIGHT AWAY FROM HOME WHILE ON A SNOWMOBILE TRIP DURING THE PAST SNOWMOBILE SEASON? (Complete the table below by writing the number of trips opposite the distance travelled.)

Distance from home to area	Number of ONE night trips	Number of TWO night trips	Number of THREE or more night trips
Up to 50 miles			
50 to 100 miles			
100 to 200 miles			
200 to 300 miles			
Over 300 miles			

17 DO YOU FEEL THAT THE PRESENT REGULATIONS SHOULD BE:

☐ much more strict ☐ more strict ☐ unchanged ☐ less strict ☐ much less strict

18 DO YOU FEEL THAT THE ENFORCEMENT OF THE PRESENT REGULATIONS SHOULD BE:

☐ much more strict ☐ more strict ☐ unchanged ☐ less strict ☐ much less strict

19 SHOULD CHILDREN UNDER 14 YEARS OF AGE BE ALLOWED TO OPERATE A SNOWMOBILE?

(a) by themselves without adult supervision? Yes ☐ No ☐

(b) only under the supervision (within sight) of an adult? Yes ☐ No ☐

20 DO YOU THINK THAT REGULATIONS SHOULD BE ESTABLISHED TO GOVERN THE AMOUNT OF NOISE THAT A SNOWMOBILE IS ALLOWED TO MAKE? Yes ☐ No ☐

Fig. 1. Continued. The inside pages.

(2) Ownership of selected types of recreation equipment, particularly items that were motorized or related to motorized vehicles (see question 2, Figure 1).

(3) The amount of snowmobiling done in the 1969-70 season, measured in "days." The respondents were asked to specify the three most frequently used counties plus the number of days of all other county use (see question 3, Figure 1).

(4) The number of years the registered owner had owned a snowmobile and whether or not they belonged to an organized snowmobile club (see questions 4 and 5, Figure 1).

(5) The type of land used, classified according to ownership, and the number of days used, in each case, for snowmobiling (see question 6, Figure 1).

(6) The socio-economic characteristics of the household (see questions 7-12, Figure 1).

(7) The kinds of groups with whom snowmobile owners most preferred to go snowmobiling (see question 13, Figure 1).

(8) The kinds of activities pursued by the owner or members of the household while using the snowmobile(s) and also those activities

associated with a snowmobile trip. In each case the number of days involved was requested (see questions 14 and 15, Figure 1).

(9) The number of one-, two-, and three-night snowmobile-oriented trips taken during the season and the distance travelled from the place of residence (see question 16, Figure 1).

(10) The attitude of owners towards selected regulations related to the operation of a snowmobile (see questions 17-22, Figure 1).

(11) The last question was the one open-ended question in the questionnaire and it provided space for the snowmobiler to mention any special snowmobile problems he may have had during the past season (see question 23, Figure 1).

Sample Design

Moser stated that: "Two major principles underlie all sample design. The first is a desire to avoid bias in the selection procedure, the second broadly to achieve the maximum percision for a given outlay of resources."[1] In order to avoid selection bias it was necessary to use a probability sampling method of choosing the sample and to make sure the sampling frame adequately covered the

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[1]Moser, Survey Methods, p. 73.

population to be studied. Moser went on to say that: "Stratification is a means of using knowledge of the population to increase the representativeness and the precision of the sample."[1] In Michigan there is a transition from very densely populated areas in the southern portion of the state (and particularly in the southeastern section) to very sparsely populated areas in the north and northwest portions. In this continuum from a very urban population to a very rural one it was known that there were also changes in the characteristics of the population in terms of income, education, occupation, and other socio-economic characteristics. Whether differences in the characteristics of snowmobile owners occurred from one area to another in a similar manner was of interest in this study. It was also apparent that variation in snowfall and open space availability could result in quite different use patterns among snowmobilers residing in different areas. Therefore, it appeared that some additional precision could probably be gained by stratifying the sample on a geographical basis.

The problem now became one of determining appropriate strata. Data on a county basis rather than on a broader regional basis would be more useful to planners. This was particularly true in the case of Michigan since it varies considerably in terms of population distribution,

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[1]Ibid., p. 78.

topography, climate, snowfall, accessibility, etc. Therefore, reliable data on a county-by-county basis would more clearly indicate how the characteristics in use patterns of snowmobilers varied. In other words it would give planners more detailed and complete information upon which to make policy decisions.

To obtain data of this type, a sample of approximately 24,000 snowmobilers would be required in order to insure a return of some 200 responses per county for each of Michigan's 83 counties.[1] However, available funds only allowed for a sample of approximately 5,000. It was, therefore, decided to stratify the state into three regions corresponding to the regional division established by the Parks Division, Department of Natural Resources: Region I, the Upper Peninsula; Region II, the Upper Lower Peninsula; Region III, the Lower Lower Peninsula (see Figure 2).

According to Burton and Cherry in their discussion of sample size: "A variable sampling fraction can greatly increase the accuracy when the sampling units vary greatly in size, or more generally in the variability

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[1]In discussions with Dennis Gilliland, Associate Professor, Department of Statistics and Probability, it was estimated that in most cases a minimum of 200 returns would be necessary in order to make inferences about the snowmobile population of a county. A sample size of 24,000 assumed a response rate of 65 percent.

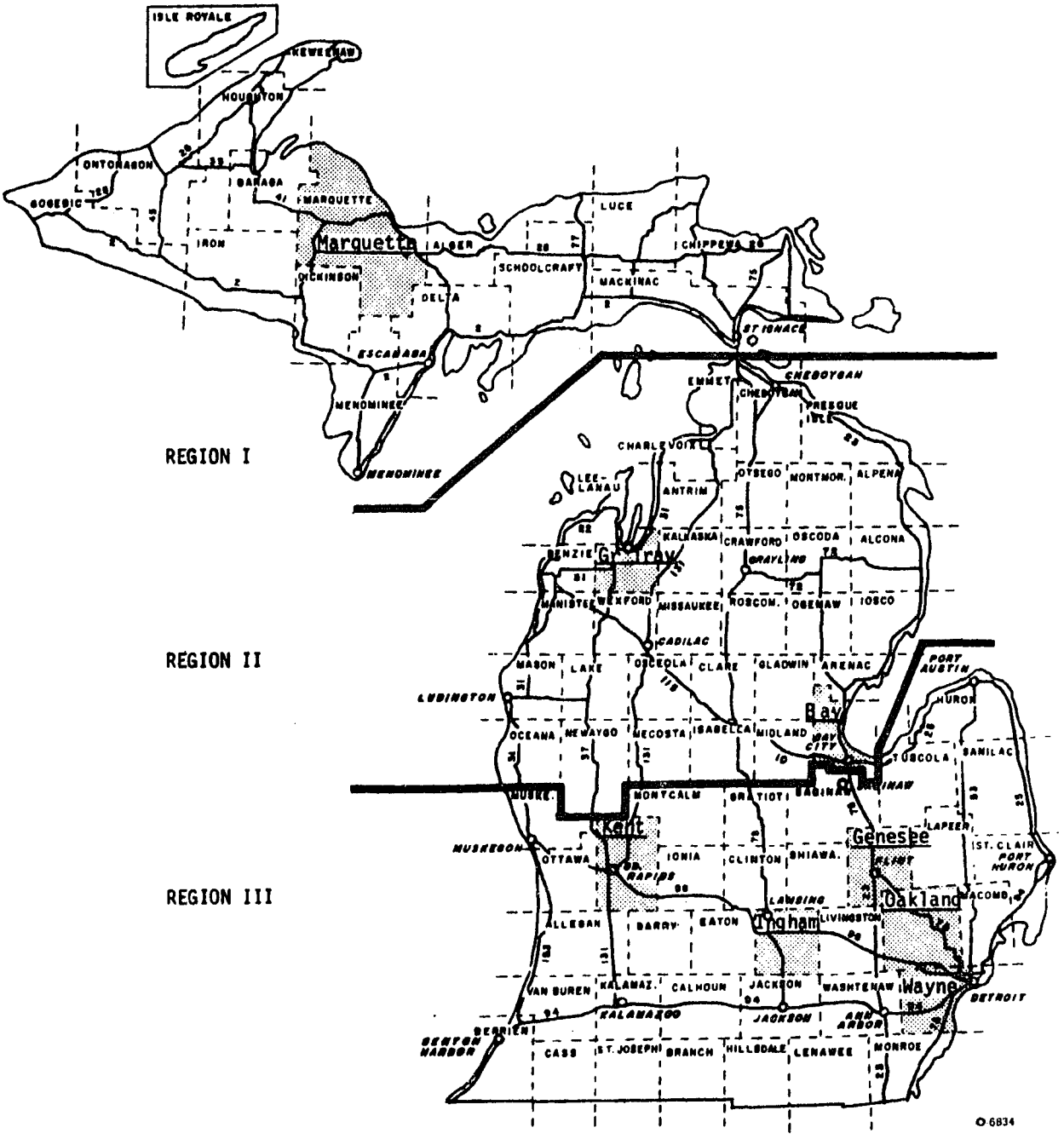

Fig. 2. Regions and selected counties used in the sample stratification and analysis.

from stratum to stratum."[1] Kish stated that: "Generally, the variance decreases as n increases. . . . "[2] Since the size of the snowmobile population varied considerably between each of the three regions, samples from each region based on the same percentage of registered snowmobiles in each case would result in a very small sample being selected from the Upper Peninsula and a rather large sample from the southern Lower Peninsula. Therefore, it was decided to use a disproportionate sampling method which would result in a larger than average sampling fraction from the less densely populated areas.[3] This approach closely approximated what Kish refers to as "optimum allocation" criteria as opposed to proportionate sampling.[4] Since little was known about the characteristics of snowmobilers in Michigan, it was necessary to arbitrarily set the sample size for each region, as: 1,000 from Region I, 1,500 from Region II, and 2,500 from Region III.

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[1]Burton and Cherry, Social Research Techniques, pp. 104-05.

[2]Leslie Kish, Survey Sampling (New York: John Wiley and Sons Inc., 1965), p. 92.

[3]Gilliland. Further discussion.

[4]Kish, Survey Sampling, pp. 92-93. Kish uses "optimum allocation" to refer to the process of obtaining the most meaningful sample sizes under given set of circumstances rather than the "best" sample size, per se.

To insure that some reliable data were obtained on a county basis in each region (in order to permit analysis at this level, if desired), eight counties were selected from which a larger proportion of registrations would be selected: Marquette County from Region I; Bay and Grand Traverse counties from Region II; and Genesee, Ingham, Kent, Oakland, and Wayne counties from Region III. The criteria used in the selection of these counties were snowmobile population, geographic location, and available socio-economic data on a comparable basis (primarily from boating studies conducted by the Recreation Research and Planning Unit). In each case, the sample size was set at 300 registrations per county, assuming that approximately 200 questionnaires would be returned in each case. The remainder of each region was then to be sampled on a set proportion within that region.

The sampling frame was a listing of registered snowmobiles on magnetic computer tape which was obtained from Michigan Secretary of State Office in April, 1970. The Michigan State University CDC 6500 computer was programmed to select a specified size random sample from each county.[1] Based on the number of registered snowmobiles in each county and the above criteria, the

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[1]In the selection of each observation, the computer was programmed to call on its "random number generator." This meant that each observation in the sample frame had an equal chance of being selected.

computer was instructed to calculate the fraction required to obtain the desired sample size for each of the eight selected counties and the remainder from each of the three regions. The number of registered snowmobiles, the number of registrations drawn by the sampling process, and the percentage of the registrations drawn for each county were shown in Table 1.

Distribution and Returns

As mentioned above, a common limitation of self-administered questionnaires has been the likelihood of a low response rate. Therefore, every attempt needed to be made to ensure a high rate of return. This study had an advantage in dealing with a population that had a common interest in snowmobiling, a pastime that was relatively new and also had created some concern particularly among nonsnowmobilers, all of which was speculated by the researcher to motivate the recipients of questionnaires to complete and return them. Also included with the questionnaire was an explanatory letter, a map of the state showing the counties and major roads (see Appendix A), and a prepaid return envelope. These items were all expected to aid response.

In addition to the above measures intended to increase the initial response, methods aimed at securing

TABLE 1

SAMPLING STATISTICS

County	Code No.	No. of Reg. SM[a]	% of Total Requested	Sample Drawn	Usable Responses	% of Total[b]
			Region I - Upper Peninsula			
Marquette	52	3,762	8.0	319	221	5.9
Alger	02	970	4.4	47	30	3.1
Baraga	07	565	"	25	16	2.8
Chippewa	17	2,725	"	118	63	2.3
Delta	21	2,238	"	101	70	3.1
Dickinson	22	1,321	"	48	39	3.0
Gogebic	27	1,052	"	45	30	2.9
Houghton	31	1,343	"	57	35	2.6
Iron	36	1,012	"	41	29	2.9
Keweenaw	42	91	"	3	2	2.2
Luce	48	778	"	34	22	2.8
Mackinac	49	979	"	48	32	3.3
Menominee	55	1,049	"	34	22	2.1
Ontonagon	66	1,075	"	41	25	2.3
Schoolcraft	75	805	"	38	29	3.6
Total		19,765		999	665	3.4
			Region II - Upper Lower Peninsula			
Bay	09	3,978	7.5	276	184	4.6
Grand Trav.	28	2,700	11.2	292	168	6.2
Alcona	01	505	3.2	18	14	2.8
Alpena	04	1,741	"	62	43	2.5
Antrim	05	1,038	"	42	31	3.0

TABLE 1--Continued

County	Code No.	No. of Reg. SM[a]	% of Total Requested	Sample Drawn	Usable Responses	% of Total[b]
Arenac	06	976	"	40	31	3.2
Benzie	10	545	"	12	7	1.3
Charlevoix	15	1,307	"	33	25	1.9
Cheboygan	16	1,509	"	51	47	3.1
Clare	18	1,126	"	31	23	2.1
Crawford	20	424	"	13	11	2.6
Emmet	24	1,073	"	37	26	2.4
Gladwin	26	723	"	24	19	2.6
Iosco	35	1,168	"	51	36	3.1
Isabella	37	1,366	"	52	40	2.9
Kalkaska	40	578	"	20	20	3.5
Lake	43	222	"	2	1	0.5
Leelanau	45	622	"	14	23	3.7
Manistee	51	687	"	18	15	2.2
Mason	53	818	"	24	13	1.6
Mecosta	54	1,042	"	32	22	2.1
Midland	56	1,487	"	53	38	2.6
Missaukee	57	546	3.2	16	12	2.2
Montmorency	60	481	"	7	5	1.0
Newaygo	62	1,264	"	30	20	1.6
Oceana	64	1,112	"	39	27	2.4
Ogemaw	65	1,065	"	38	17	1.6
Osceola	67	816	"	27	21	2.6
Oscoda	68	223	"	6	7	3.1
Otsego	69	1,137	"	45	28	2.5
Presque Isle	71	915	"	30	21	2.3
Roscommon	72	1,314	"	46	36	2.7
Wexford	83	1,198	"	41	29	2.4
Total		35,706		1,522	1,060	3.0

TABLE 1--Continued

County	Code No.	No. of Reg. SM[a]	% of Total Requested	Sample Drawn	Usable Responses	% of Total[b]
		Region III - Lower Lower Peninsula				
Genesee	25	8,098	3.8	340	224	2.8
Ingham	33	3,448	8.8	294	172	5.0
Kent	41	4,704	6.4	310	207	4.4
Oakland	63	7,107	4.3	298	219	3.1
Wayne	82	4,810	6.3	309	189	3.9
Allegan	03	1,379	2.3	37	26	1.9
Barry	08	911	2.3	23	22	2.4
Berrien	11	1,051	"	39	27	2.6
Branch	12	470	"	12	6	1.3
Calhoun	13	1,122	"	24	15	1.3
Cass	14	398	"	9	3	0.8
Clinton	19	1,124	"	31	39	3.5
Eaton	23	1,332	"	24	27	2.0
Gratiot	29	1,171	"	34	21	1.8
Hillsdale	30	346	"	11	10	2.9
Huron	32	1,056	"	30	21	2.0
Ionia	34	1,074	"	14	10	0.9
Jackson	38	1,714	"	36	26	1.5
Kalamazoo	39	1,790	"	48	28	1.6
Lapeer	44	1,879	"	41	31	1.7
Lenawee	46	452	"	13	9	2.0
Livingston	47	749	"	20	15	2.0
Macomb	50	3,820	"	86	63	1.7
Monroe	58	593	"	8	5	0.9
Montcalm	59	1,970	"	53	37	1.9
Muskegon	61	2,868	"	66	44	1.5
Ottawa	70	1,623	"	37	34	2.1

TABLE 1--Continued

County	Code No.	No. of Reg. SM[a]	% of Total Requested	Sample Drawn	Usable Responses	% of Total[b]
Saginaw	73	5,751	"	136	92	1.6
Sanilac	74	1,848	"	43	31	1.9
Shiawasee	76	1,476	"	31	27	1.8
St. Clair	77	1,761	2.3	46	33	1.9
St. Joseph	78	299	"	10	9	3.0
Tuscola	79	2,133	"	57	50	2.4
Van Buren	80	778	"	18	14	1.8
Washtenaw	81	1,193	"	24	16	1.4
Total		72,298		2,612	1,802	2.5
TOTAL		127,769		5,133	3,527	2.8

[a]Total number of registrations on the magnetic tape obtained from the Secretary of State's Office.

[b]Usable responses as a percentage of the total number of registrations in that county.

additional responses were considered. As Burton noted: "The most well known of these is the follow-up letter, or reminder."[1] Moser pointed out that another approach was to send: "Follow-up requests, enclosing a copy of the questionnaire and covering letter. . . . "[2] The factors of cost and time had also needed to be considered, in terms of how many reminders or follow-up requests should be sent out before the point of diminishing returns was reached or the survey unduly delayed.

The snowmobile questionnaires, plus enclosures, were mailed to the selected samples of registrants on May 26th and June 1st (see Table 2). The number of questionnaires returned per day rapidly built to 475 by June 4th and then began to decline. As the questionnaires were returned, they were checked off on a duplicate set of labels. On June 12th, the number of returns had decreased to 49 per day and the reminder card (see Appendix B) should have been sent out at this time; however, since only 3,500 cards had been printed, their mailing had to be delayed until June 16th. Returns increased substantially. On June 26th, when returns

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[1]Burton and Cherry, Social Research Techniques, p. 40. Results of fish and game surveys conducted by the Michigan Department of Natural Resources indicated that reminder cards produced substantial increases in the number of returned questionnaires.

[2]Moser, Survey Methods, p. 182.

TABLE 2

DISTRIBUTION OF AND RESPONSE TO MAILED QUESTIONNAIRE

Date	Day	Number Mailed	Returns	Date	Day	Number Mailed	Returns
May 28		3335		June 23			101
June 1	Mon	1798	26	24			92
2				25			83
3			241	26		2616	67
4			475	29	Mon	(2nd Q)	230
5			184	30			227
8	Mon		365	July 1			103
9			102	2			114
10			85	6	Mon		170
11			64	7			33
12			49	8			66
15	Mon		78	9			36
16		3500	37	10			27
17		(cards)	46	13	Mon		0
18			58	14			32
19			206				3705
22	Mon		308				

Note: Net sample = 5133 - 129 = 5004

Net returns = 3705 - 178 = 3527

Response rate = 70%

per day had dropped to 67, a second questionnaire with a revised explanatory letter (see Appendix C) was mailed to those who had not yet returned their questionnaires, resulting in a further increase in returns. July 14th was set as a cut-off date by which time 3,705 questionnaires had been received.

From the original sample of 5,133 registrations, 129 were deleted due to: unknown addresses, snowmobiles not being used, snowmobiles no longer being owned, because the snowmobiles were demonstrators owned by retailers, or because the owners resided outside Michigan. This resulted in a net sample of 5,004 registrations. Of the total 3,705 returned questionnaires, 178 were rejected due to respondents' refusal to fill out the questionnaire, duplicate returns, and residence in another state. This resulted in a net response of 3,527, or a response rate of 70 percent.

Data Coding

According to Selltiz: " . . . categorization of complex data is usually done by coders after the data have been collected."[1] He went on to discuss the importance of training the coders to improve the reliability

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[1]Selltiz, Research Methods, p. 402.

of the coding and also checking the accuracy and consistency of the coding throughout the procedure.[1]

The questionnaires were coded by staff members of the Urban Survey Research Unit, Michigan State University. Data from the questionnaires were transferred to optical scan sheets which were over-printed to facilitate the coding process in this study. Every fifth questionnaire was checked-coded, a process in which the data were transferred to another optical scan sheet by a check-coder and the results compared. If errors were discovered, they were corrected and the error was brought to the attention of the initial coder. In cases where the error rate of a coder was found to be excessive (over 4%) all of his questionnaires were recoded. The final error rate for the complete coding operation was estimated to be less than 1.5 percent.[2] Data were then transferred to computer cards. Finally a computer program, "Try-Hard," was used to transfer data to magnetic computer tape. In the transfer process the program

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[1]Ibid., p. 405.

[2]The error rate was calculated by multiplying the total number of detected errors by five (since only every fifth questionnaire was checked) and dividing this product by five times the number of questionnaires times the total number of columns (229).

rejected any responses that were outside a set range of acceptability for each question (in other words eliminating gross errors).[1]

Nonresponse

The importance of obtaining a high response rate in order that more precise inferences concerning the snowmobile population can be made has been pointed out in preceding sections. However, since 30 percent did not respond there was still the question of whether or not nonrespondents differed from respondents. As Cochran points out, the most important consequence of nonresponse is that estimates can become biased.[2]

There may have been any number of reasons why people did not complete and return questionnaires, such as: having moved to a new address, being away on vacation at survey time, too busy to be bothered, refusal to cooperate for one reason or another, etc. Burton and Cherry suggest: " . . . that interviewers be sent to nonrespondents, . . . to obtain some data about their

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[1]Paul Emmery, "Try-Hard" (East Lansing: Urban Survey Research Unit, Michigan State University, Mimeographed material, 1970). This computer program was primarily designed to clean large amounts of punched card data for analysis.

[2]William G. Cochran, Sampling Techniques (New York: John Wiley and Sons, Inc., 1963), p. 389.

characteristics so that these may be compared with the characteristics of the respondents."[1]

It was decided to use a telephone interview to gather a limited amount of data concerning nonrespondents at a reasonable cost. In pursuing this approach, an abbreviated questionnaire was developed which requested the following data: details concerning the snowmobile, the amount of use by county, what kind of land they used for snowmobiling and how much, socio-economic data, and kinds of activity pursued while snowmobiling (see Appendix D). Random samples were drawn of both respondents and nonrespondents from the counties of Ingham and Kent. Two interviewers were trained to carry out this survey. This procedure enabled interviewers to telephone sample respondents in the early part of July and concluded with sample nonrespondents following the cut-off date on July 14.

Snow Depth

The amount of snow an area received probably had considerable influence on the amount of snowmobiling done in that area, particularly in those counties of the southeastern portion of the state, which received little snow. The Parks Division was under pressure, especially from residents of Region III, to open public land to

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[1]Burton and Cherry, Social Research Techniques, p. 41.

snowmobiling. In response to this pressure and in an effort to minimize environmental damage resulting from snowmobile traffic, the Division set four inches as the minimum snow depth required before snowmobiling would be permitted in selected state parks and recreation areas.[1]

Therefore, if the number of days that a given depth of snow was available in each area was known, then a meaningful index of the number of possible snowmobiling days could be established. The U.S. Department of Commerce records the number of days that there is a one-inch or more and three inches or more snow on the ground throughout the state.[2] However, data for 1969-70 had numerous gaps, that is, depth of snow was not always recorded every month and further, it was not collected for every county. The Michigan Department of State Highways gathered data on the average amount of snowfall for each county in order to establish the amount of financial aid each county should receive for snow removal.[3] This

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[1]Paul Rearick, Parks Division, Michigan Department of Natural Resources, Discussions held in November 1969.

[2]U.S. Department of Commerce, Environmental Data Service, "Climatological Data - Michigan, October 1969 - July 1970" (Washington, D.C.: Department of Commerce, 1970).

[3]Michigan Department of State Highways, Local Government Division, "Snowfall data for 1970" (Lansing, Mich.: Department of State Highways, 1970).

information appeared to be consistent in its recording methods and calculations. Therefore, it was decided to use the Department of State Highways data to develop an index of relative availability of snow for snowmobiling in each county (see Appendix E).

Methods of Analysis

Phase I

Contingency tables were developed using G9 MSU ACT Program designed for the CDC 3600 computer. These tables are comprised of the frequencies and percentages for each variable for each of the three regions and the state. Wherever it was appropriate means and standard deviations were also calculated. These tables were used to compare: (1) socio-economic characteristics, (2) snowmobile ownership characteristics, (3) attitudes toward regulations governing snowmobiling, and (4) patterns of use of snowmobile owners resident in each region.

A one-way analysis of variance was carried out on the quantitative variables that were suitable for this type of analysis (see Appendix F). If the overall F test was found to be significant at the .05 level, then Scheffé post-hoc comparisons were conducted to determine which pair or pairs of means (for each of the regions) contributed to this significance. As

Hays pointed out, this method was applicable to groups of unequal size and suitable for any comparison.[1]

An overall chi-square test was carried out on the qualitative nominal and ordinal variables. Maxwell, in discussing contingency tables having more than one degree of freedom, stated, " . . . though a significant overall χ^2 would tell us that these proportions were heterogenous a more detailed analysis would be required to decide just where the significant differences lay."[2] The contingency tables that were of interest, here, had from two to eight degrees of freedom, therefore, the

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[1]William L. Hays, Statistics (Toronto: Holt, Rinehart and Winston, Inc., 1963), pp. 483-85.

In discussions with Howard Teitelbaum, Research Methodology and Evaluation Specialist, Office of Medical Education, Michigan State University, July, 1972, the following formula was derived from Hays:

$$\hat{\psi} \pm \sqrt{(J-1)\ F\alpha\ (MS\omega)\ \Sigma\ \frac{c_j^2}{n_j}}$$

in which $\hat{\psi}$ was the difference between the sample means to be compared; J was the number of groups (3) in the study; $F\alpha$ was the value required for significance at the α level (.05) with J-1 and N-J degrees of freedom; $MS\omega$ was the mean square within groups; c_j were the weights assigned to each group in the comparison, such that the sum of the weights equalled zero, in this case weights of 1 and (-1) were assigned; n_j was the number in each group being compared.

In order for the comparison to be significant the interval could not include zero.

[2]A. E. Maxwell, Analyzing Qualitative Data (London: Methuen and Co. Ltd., 1961), p. 52.

overall chi-square was subdivided into additive components. In other words, the degrees of freedom were partitioned.[1] If the probability level was greater than .05, it was not considered to be significant.

In order to examine the patterns of use more closely, the "amount of use" data (as measured by the number of snowmobiling days in the county of first, second, and third most use) were expanded to produce an estimate of the total number of snowmobiling days for all of the registered snowmobile owners in each county. The expansion was carried out by using weights which were based on the response rates from the eleven subregions (see Appendix G).[2] This process provided estimates of the amount of movement into and out of each county by snowmobilers in pursuing their sport.

Phase II

Analysis problems.--Data from cross-section surveys, because they were usually of a complex nature, frequently presented problems of analysis. Morgan and Sonquist identify the major problems as being: (1) the

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[1]The NONP11 Program was used: "Lancaster's Partitioning of Chi-square," designed for the IBM 360/67 computer at the University of Alberta, Canada, 1971.

[2]The weights used were the reciprocal of the proportion that the number of usable responses was of the total number of registered snowmobiles in that subregion.

wide variety of information about each of the units in a survey; (2) many of the data items collected are classifications rather than continuous variables; (3) the difficulty in estimating the errors which are usually present in all the measures, not just the dependent variable; (4) complex probability samples, which presented problems in applying statistical techniques; (5) that among many of the explanatory variables used in the analysis, intercorrelations have existed that have made it difficult to access the relative importance of the different factors; and (6) the problem of handling the effects of interaction among the independent variables. They claimed it was a mistake to assume that their various influences on the dependent variable were additive, for two reasons. First, there were many known instances of strong interactions effects, where the effect of one variable on the dependent variable was dependent upon the value or presence of one or more other variables. Second, measured classifications were often proxies for more complex constructs. For example, age, marital status, number and age distribution of children were all components of a life cycle construct.[1]

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[1]James N. Morgan and John A. Sonquist, "Problems in the Analysis of Survey Data, and a Proposal," Journal of the American Statistical Association, 58 (June 1963): 415-16.

In an attempt to improve the methods of analyzing survey data, Morgan and Sonquist developed a new technique for predicting[1] social behavior from personal characteristics called the Automatic Interaction Detector (AID) technique.[2] According to Sonquist it is:

> . . . a step-wise application of a one-way analysis of variance model. Its objective is to partition the sample into a series of non-overlapping subgroups whose means explain more of the variation in the dependent variable than any other such set of sub-groups.[3]

Analysis procedures.--The organization of the input data from this study and the operation of the algorithm used by the AID program were as follows. The data from each region were entered and analyzed separately. In each case the dependent variable was the number of snowmobiling days (reported in question 3, see Figure 1). The distribution of this variable was markedly skewed to the right. Sonquist and Morgan suggest that the extreme cases should be removed,

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[1]The term "predictor" as used in this discussion only pertains to the amount of variation in the dependent variable that is explained by the independent variable and not in terms of a functional relationship.

[2]John A. Sonquist and James N. Morgan, The Detection of Interaction Effects (Ann Arbor: Institute for Social Research, University of Michigan, 1964), pp. 180-217.

[3]John A. Sonquist, Multivariate Model Building (Ann Arbor: Institute for Social Research, University of Michigan, 1970), p. 20.

therefore this skewness was reduced by deleting from the input data all values of 130 days or more.[1] This procedure reduced the sample size in each region by approximately 10 percent. Weights, which summed to 1,000, were established for each region to take into account the different sampling fractions used (see Appendix J).

The AID program collapsed the classes of the sixteen independent variables into that dichotomous grouping which produced the greatest reduction in error variance in the sum of squares. Nominal variables were treated as free predictors, that is, the classes were monotonically reordered according to the mean values of the dependent variable. With ordinal or interval type variables, however, the collapsing procedure required that the original order among classes be maintained. The optimal dichotomization on the independent variables was then treated as the "split" on that variable. This resorting process, of the "free" predictors, was repeated after each split.

The total number of observations from each region treated separately was considered as the first parent group to be partitioned. The between-classes sum of squares (BSS_p) was examined across the reordered

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[1]Sonquist and Morgan, Detection of Interaction Effects, p. 120.

predictor variable. A cutting point was placed between contiguous groups of classes, for example, a versus b and c or a and b versus c, and the BSS_p calculated for each dichotomous grouping. That grouping which contained the largest BSS_p indicated where the split would be made on that predictor, if it was chosen. This split took place between the two contiguous classes (after reordering) that had the largest BSS_p such that the parent group was reorganized according to the resulting dichotomous class grouping of that predictor. In other words the two created groups contained c-r classes and r classes of the predictor.

In the next and succeeding steps, all created unsplit groups were examined and the group i containing the largest total sum of squares (TSS_i) around its own mean was identified. This group i was then considered for splitting, if it satisfied the eligibility criteria of: (1) possessing a TSS_i that was equal to or exceeded a specified minimum proportion (.015) of the total sum of squares for all input observations (TSS_T) and (2) contained a minimum number of observations (50), to provide some sampling stability.

The group thus selected became the new parent group. Each predictor variable was tested, over group i, to locate the predictor j that contained the largest BSS_p between two contiguous classes. Group i was then split

into two new groups, if the BSS_p satisfied a reducibility criterion requiring that it be equal to or greater than the specified proportion of the TSS_T.[1] This reducibility criterion was set in relationship to the size of the samples, which resulted in the following proportions: (1) .010 for Region I, (2) .009 for Region II, and (3) .006 for Region III.

The above iteration process was terminated when one of the following conditions occurred: (1) no group contained a large enough TSS_i to satisfy that eligibility criterion; (2) no group contained 50 or more observations; (3) the reducibility criterion was not satisfied or; (4) the maximum number of unsplit groups allowable under the program limitations (50) was reached. Of the above conditions, only the second and third were actually invoked in this application to terminate the iteration process; the other two remained, however, as safeguards.[2]

The purpose in using the AID program was to identify the interactions that existed between the selected independent variables and not to develop a functional relationship, for as Herrmann states:

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[1]The reducibility criteria were not discussed for the initial parent group as Sonquist and Morgan implied that it was not relevant to the first split (see Appendix I).

[2]Sonquist and Morgan, Detection of Interaction Effects, pp. 5-6 and 158-61. These descriptions of the algorithm were placed in Appendix I.

> The program does not, however, provide any estimates of the functional relationships between the predictor variables and the dependent variable. The technique is a useful preliminary to regression analysis but is not a substitute for it.[1]

It was also of interest to determine the relative usefulness of each predictor variable in explaining the variation in the dependent variable.

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[1]Robert O. Herrmann, "Interaction Effects and the Analysis of Household Food Expenditures," Journal of Farm Economics, 49 (November 1967): 831.

CHAPTER III

RESULTS AND ANALYSIS

Phase I

The purpose of Phase I was to determine and compare, on a regional basis, the following: (1) socio-economic characteristics, (2) ownership characteristics, (3) attitudes toward snowmobile regulations, and (4) patterns of snowmobile use.

Contingency tables were developed which comprised the frequencies and percentages for each variable, for each of the three regions. Where there were appropriate population parameters available, these were included in the tables.[1] In some cases, statistics from two other snowmobile studies were included in the tables to facilitate comparisons.[2]

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[1]Bureau of the Census, 1970 Census, Michigan.

[2]Peter Klopchic, An Analysis of Snowmobiling in Ontario, Winter 1969-1970 (Toronto: The Department of Tourism and Information, 1971); Directional Marketing Company, 1970 Snowmobiler Survey (Duluth: Upper Great Lakes Regional Commission, 1971).

Wherever it was appropriate, tests of significance were applied. In the case of the quantitative variables, the Scheffé comparison of means was applied. An overall chi-square was calculated for the qualitative variables and then partioned by region.

Socio-economic Characteristics

Age characteristics.--The results of this study indicated that heads of snowmobile-owning households in Region I (the Upper Peninsula) were significantly older (statistically) than those from Regions II and III.. The mean age in Region I was 44.4 years compared to 42.6 years and 41.7 years in Regions II and III respectively (see Table 3). There appeared to be a similar pattern in the age ranges of the general population.

Compared to the percentage of those 20-24 years in the general population, the proportion of heads of snowmobile-owning households who were 25 years and under was much smaller. In the 25-34 year age group the proportion of respondent household heads and persons in the general population were similar. However, 59 percent of the heads of snowmobile-owning households compared to 34 percent of the general population were between 35 and 54 years of age. There was little difference between the proportion of heads of snowmobile-owning households and members of the general population that

TABLE 3

AGE OF THE HEAD OF SNOWMOBILE-OWNING HOUSEHOLDS

Age	Region I			Region II			Region III			State			
	No.	Percent		No.	Percent		No.	Percent		No.	Percent		
		SMO	GP[a]		SMO	GP		SMO	GP		SMO	GP	DMS
Under 25[b]	13	2	13	40	4	12	79	4	16	132	4	15	5
25 - 34	118	18	16	240	23	19	422	24	20	780	22	19	22
35 - 44	205	31	16	311	30	17	580	32	21	1096	31	21	31
45 - 54	199	30	18	293	28	18	469	26	12	961	28	13	28
55 - 64	105	16	18	133	13	16	207	12	16	445	13	16	] 15
65 & over	21	3	19	28	3	18	31	2	16	80	2	16	
Total	661	100	100	1045	101	100	1788	100	101	3494	100	100	101
Mean	44.4			42.6			41.7			42.5			
SD	10.9			11.1			10.7			10.9			
Comparison of Means	Region I differed from Region II and from Region III (.05 level).												

Key: SMO - Heads of "snowmobile-owning" households.
GP - General population of region
DMS - Directional Marketing Survey statistics

[a]Calculated from: Bureau of the Census, 1970 Census, Michigan, Table 35. Age by Race and Sex for Counties: 1970.

[b]For the general population, the number of 20-24 year olds was used to provide a comparative estimate. Calculation of percentages was based on the general population 20 years and over.

were 55-64 years of age. Only a small percentage of the general population in the 65 years and over category owned snowmobiles.

In the Directional Marketing Survey (DMS), age distributions were almost identical to the results of this study.[1]

However, in Ontario, Klopchic estimated the average age of Ontario snowmobilers to be 38 years old as compared to 42.5 years in this study.[2]

Education characteristics.--The average education level attained by respondent household heads in this study was 12.1 years, with those in Region III reaching a higher level than those in the other two regions (see Table 4).

Heads of snowmobile-owning households with less than nine years of education comprised a smaller proportion of the respondents to this study (particularly in Region II), than in the general population. Respondent household heads in Region I who had completed some high school education appeared in the sample in the same proportion as in the general population; in Region II and III the proportion in the sample was lower than that of

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[1]Directional Marketing Survey, p. 58. Hereafter DMS will be used to refer to this survey.

[2]Klopchic, Snowmobiling in Ontario, p. 8.

TABLE 4

EDUCATION LEVEL OF HEAD OF SNOWMOBILE-OWNING HOUSEHOLDS

Years of Education Completed	Region I			Region II			Region III			State			
	No.	Percent		No.	Percent		No.	Percent		No.	Percent		
		SMO	GP[a]		SMO	GP		SMO	GP		SMO	GP	ONT[b]
8 or Less	84	13	17	139	14	23	169	10	16	392	12	17	20
9 - 11	128	20	20	161	16	25	317	18	28	606	18	28	40
12	248	38	56	422	42	41	663	38	43	1333	39	43	20
1 - 4 Univ.	126	20	] 7	235	23	] 10	482	27	] 12	843	25	] 12	17
Graduate	60	9		58	6		126	7		244	7		3
Total	646	100	100	1016	101	99	1758	100	99	3420	101	100	100
Mean		12.0			11.9			12.2			12.1		
SD		2.7			2.5			2.5			2.5		
Comparison of Means	Region III differed from Region I and from Region II (.05 level).												

Key: SMO - Heads of "snowmobile-owning" households.
GP - General population of region
ONT - Ontario snowmobilers

[a]Bureau of the Census, 1970 Census, Michigan, Table 120. Educational and Family Characteristics for Counties: 1970.

[b]Klopchic, Snowmobiling in Ontario, p. 11.

the general population. Those that completed high school made up the largest category in all regions. In Region II, 42 percent of the heads of snowmobile-owning households had completed grade twelve, which was similar to the percentage in the general population; however, in Region III, and particularly in Region I, the proportions were much less than in the general population of those regions.

The proportion of respondent household heads that went beyond high school was three times as great in one sample from Regions II and III as it was in the general population; in Region I the proportion was four times as large.

Klopchic's data show that snowmobilers in Ontario were not as well educated as their Michigan counterparts.[1] Only 40 percent had completed high school, or better, compared to 71 percent of the snowmobilers in Michigan.

Occupational characteristics.--The occupational characteristics of the heads of snowmobile-owning households varied between regions and also differed from the working population in the state (see Table 5). For Regions I and III, professional people were represented in the sample in similar proportion to that in the general population. In Region II, the percentage of

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[1]Ibid., p. 11. In comparisons between these two educational systems, it should have been noted that in Ontario, grade thirteen was required for high school completion.

TABLE 5

OCCUPATIONS OF HEAD OF SNOWMOBILE-OWNING HOUSEHOLDS

Occupation	Region I			Region II			Region III			State			
	No.	Percent		No.	Percent		No.	Percent		No.	Percent		
		SMO	GP[a]		SMO	GP		SMO	GP		SMO	GP	DMS
Profession	84	13	13	95	9	13	200	12	12	379	11	12	9
Self-Emp/ Manager	108	17	8	168	16	7	306	18	6	582	17	6	20
Cler/Sales	42	6	20	76	7	20	162	9	20	280	8	20	9
Skilled	140	22	15	270	26	15	457	26	32	867	25	31	30
Semi-Skilled	152	23	19	192	19	22	400	22	16	744	22	17	9
Service	60	9	17	72	7	15	66	4	10	198	6	11	
Unskilled	10	2	6	21	2	6	23	1	4	54	2	4	] 10
Farm Oper.	12	2	2	60	6	2	78	5	1	150	4	1	8
Unemp/Stu.[b]	3	1	-	4	-	-	7	-	-	14	-	-	-
Retired[b]	32	5	-	69	7	-	43	3	-	144	4	-	6
Housewife[b]	4	1	-	1	-	-	2	-	-	7	-	-	-
Total	647	101	100	1029	99	100	1744	100	101	3419	99	102	101

Key: SMO - Heads of "snowmobile-owning" households
GP - General population of region
DMS - Directional Marketing Survey

[a]Bureau of the Census, 1970 Census, Michigan, Table 122, Occupation and Earnings for Counties: 1970.

[b]These classifications were not included in Table 122.

professionals that were heads of snowmobile-owning households was less than the percentage of professionals in the general population.

There was little difference between the percentage of respondent household heads in each region who were classified as self-employed or managers. However, representation of this group in the sample for each region was two to three times as great as it was in the general population.

Similarly, there was not much difference between the percentage of heads of snowmobile-owning households who were clerical or sales persons in each region. However, in the sample, clerical and sales personnel attained only one-third to one-half the representation that they actually had in the general work force.

Even though the proportion of skilled workers in the general population of Region III was twice as great as in the other regions, the distribution in the sample was very similar for each region. In other words, a smaller proportion of skilled workers in the general population of Region III were heads of snowmobile-owning households than in the other two regions.

The proportion of semi-skilled workers who were heads of snowmobile-owning households was greatest in Region I and least in Region II. By comparison to the general population, the percentage of semi-skilled

workers who were respondent household heads in Regions I and III was greater in the sample than in the general population, while in Region II the percentage was a little less.

For service and unskilled workers the proportion found in the sample as heads of snowmobile-owning households was much less in Region III than in the other two regions. In all regions both groups were underrepresented by one-quarter to one-half in the sample, compared to the percentage of these workers in the general population.

In Region I, farm households owning snowmobiles appeared in the sample in the same proportions as they did in the general population. However, for the other regions their representation in this survey was much higher. For example, snowmobile ownership by farm households appeared to be five times greater in Region III than their general population numbers would indicate. It should be noted that since land owners were not required to register their machine if it was only operated on the owner's property, then it was quite possible that farm operators who were heads of snowmobile-owning households were not as accurately represented in this study as were persons with other occupations. Therefore, the percentage of farm households who owned snowmobiles could be much greater than this study indicated.

The DMS found similar distributions according to occupation, with two exceptions. The proportion of semi-skilled workers in their sample was less than one-half as large as in this study, while the percentage of farm operators was twice as large. In the DMS, the small sample of 500 could have resulted in a greater error in its estimates, especially when broken down into the eight occupational categories. Also, the basis on which respondents were assigned to the categories, skilled and semi-skilled, may have been different than the one used in this study.[1]

Income characteristics.--The mean incomes for snowmobile-owning households in Regions I, II, and III were estimated to be $10,900, $12,200, and $15,200 respectively (see Table 6). These differences were significant. The DMS and Klopchic study obtained state-wide and province-wide means of $10,700 and $10,900 respectively, compared to the overall mean of $13,500 in this study.[2] This discrepancy could have been due to differences in data collection techniques, as both studies established their highest category as $15,000 and over. In this study there were four

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[1]Directional Marketing Survey, p. 57.

[2]Ibid., p. 28; Klopchic, Snowmobiling in Ontario, p. 10.

TABLE 6

COMBINED GROSS INCOME OF SNOWMOBILE-OWNING HOUSEHOLDS

Income[a]	Region I			Region II			Region III			State			
	No.	Percent		No.	Percent		No.	Percent		No.	Percent		
		SMO	GP[b]		SMO	GP		SMO	GP		SMO	GP	DMS
Under $6,000	77	13	35	91	9	29	46	2	19	214	7	20	
$6,000 - $9,999	261	42	35	333	35	31	342	20	21	936	29	23	] 44
$10,000 - $14,999	186	30	22	315	33	27	614	37	29	1115	35	29	35
$15,000 - $24,999	74	12	8	159	17	11	448	28	24	681	21	23	
$25,000 & over	16	3	1	49	6	3	194	12	6	259	8	6	] 21
Total	614	100	101	947	100	101	1644	100	99	3205	100	101	100
Mean		4.2			4.6			5.4			5.0		
SD		1.5			1.6			1.6			1.7		
Comparison of Means	All regions differed from each other (.05 level).												
Mean in Dollars[c]	$10,900			$12,200			$15,200			$13,500			

Key: SMO - "Snowmobile-owning" households
GP - General population of region
DMS - Directional Marketing Survey

[a]For a description of the nine income categories see Figure 1.

[b]Bureau of the Census, 1970 Census, Michigan, Table 124, Income and Poverty Status in 1969 for Counties: 1970.

[c]These means were calculated using the mid-point of each category and using $3,000 and $30,000 to represent the lowest and highest category respectively.

categories over $14,999 and the highest category was "over $30,000" so it would reflect the higher income groups with greater precision.[1]

There was a distinct decrease from Region I to III in the percentage of households in the general population who earned under $10,000. This pattern was even more pronounced with snowmobile-owning households; it decreased from 56 percent in Region I to 22 percent in Region III. This indicated that it was probably more difficult, or less attractive, for households in Region III with incomes less than $10,000 to become involved in snowmobiling than it was in the other two regions. The DMS obtained a proportion of 44 percent for this category compared to the 36 percent estimated for the state in this study.[2]

Approximately a third of the snowmobile-owning households in the state earned between $10,000 and $14,999, which was the same proportion as that obtained by the DMS.[3]

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[1]The technique of collecting income data using categories may have had the advantage of obtaining a higher response, but it did present difficulties in calculating the means. In this study the categories were not in equal intervals (see Figure 1), therefore the means obtained by assigning the number 1 to 9 to each category, which assumed equal appearing intervals, produced relatively lower means than those resulting by using the dollar mid-point of each category, which assumed that mean of each interval coincides with the mid-point.

[2]Directional Marketing Survey, p. 8.

[3]Ibid.

This proportion was 6 percent higher than that of the general population. However, this pattern was not constant for each of the regions with the percentage of snowmobilers in that income group, increasing from 30 percent in Region I to 37 percent in Region III.

Snowmobile-owning households in the higher income brackets also comprised a larger proportion of the sample population (particularly in Region III) than households in these groups did in the general population; the proportion in these higher groups ranged from 15 percent in Region I to 40 percent in Region III. However, the DMS estimated that there were 10 percent fewer snowmobilers in this category. The small sample that the DMS used or the fewer high income classes used may have contributed to the differences in the estimates obtained.[1]

Number of children.--The differences between regions in the mean family size appeared to be small (see Table 7). The DMS estimate of 2.2 children per family was much higher than the 1.8 calculated in this study. However, the mean calculated by the DMS included children 19 years to 21 years old, which would not only have contributed to a larger mean but also a smaller percentage

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[1]The DMS used a registration listing that did not include some 60,000 snowmobile owners who registered between June 1969 and April 1970.

TABLE 7

NUMBER OF CHILDREN 18 AND UNDER IN EACH SNOWMOBILE-OWNING HOUSEHOLD

No. of Children	Region I		Region II		Region III		State			
	No.	%	No.	%	No.	%	No.	%	DMS[a]	ONT[b]
None	181	28	269	26	549	31	999	29	18	-
One	144	22	183	18	304	17	631	18	19	16
Two	139	21	233	22	386	22	758	22	23	33
Three	81	12	154	15	284	16	519	15	18	26
Four	55	8	107	10	180	10	342	10	13	12
Five +	53	8	90	9	75	4	218	6	9	13
Total	653	99	1036	100	1778	100	3467	100	100	100
Mean	1.8		1.9		1.7		1.8		(2.2)	(1.9)
SD	1.7		1.7		1.6		1.6			
Comparison of Means	Region II differed from Region I and from Region III (.05 level).									

[a]Results of the Directional Marketing Survey. These figures included children up to and including 21 years of age.

[b]Results obtained by Klopchic in Ontario. Since the number of families without children was not reported the percentages given for the number of children per family provide only rough comparisons.

of owners who were classified as having no children.[1] In fact, if these two means had been calculated without including the zero children category when the means would have been almost identical. Klopchic produced an estimate of 1.9 children per family in Ontario.[2]

The relatively small percentage of owners in Region II who did not have children under 19 years of age may in part been due to the high proportion of retired snowmobilers in this region (see Table 5). In Region III only half the proportion of owners had families of five or more children, compared to the other regions.

Membership in snowmobile clubs.--Only one-eighth of the total sample joined snowmobile clubs (see Table 8). However, respondents in Region I became club members to a greater extent than those from the more urban regions.

Snowmobiling groups preferred.--There appeared to be little regional difference in the type of groups with whom snowmobile owners preferred to snowmobile, with the exception of "friends" and "family" (see Table 9). In Region I, friends were preferred for companions to a

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[1]Ibid., p. 21.

[2]Klopchic, Snowmobiling in Ontario, p. 9.

TABLE 8

SNOWMOBILE CLUB MEMBERSHIP BY SNOWMOBILE-OWNING HOUSEHOLDS

Membership	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
Yes	124	20	122	12	187	11	433	13
No	511	81	833	88	1515	89	2909	87
Total	635	101	1005	100	1702	100	3342	100

	Source	df	χ^2	p
Partition of Chi-square	I vs II & III	1	27.43	.001
	II vs III	1	.82	NS
	Total	2	28.25	.001

TABLE 9

TYPE OF SNOWMOBILING GROUPS PREFERRED

Group[a]	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
Alone	43	7	54	5	71	4	168	5
Wife	54	8	94	9	149	8	297	9
Children	39	6	83	8	147	8	269	8
Friends	300	46	398	38	609	34	1301	37
Org. Group	13	2	21	2	44	3	78	2
Family	52	8	128	12	305	17	495	14
Girl Friend/ Boy Friend	7	1	7	1	16	1	30	1
Other	148	23	265	25	451	25	864	25
Total	656	101	1044	100	1792	100	3492	101

[a]These groups were not mutually exclusive. Respondents were asked to indicate the group with which they snowmobiled most of the time.

greater extent than in the other regions. In the case of preference for family groups, the pattern was reversed. When these groups were combined, the regional differences tended to disappear.

Ownership Characteristics

Snowmobile horsepower.--There was a relationship between the region in which a snowmobiler lived and the horsepower of the machine he owned (see Table 10). As one went from Region I to Region III the machines became increasingly more powerful. Klopchic estimated that snowmobiles in Ontario were slightly less powerful: 18 horsepower compared to 20 horsepower in Michigan.

Years of snowmobiling.--The year in which present snowmobile owners bought their first machine was related to their region of residence (see Table 11). In other words, snowmobiling in Michigan tended to start in the north, in Region I, and gradually worked its way down to Region III. A larger proportion, 14 percent, of the sample in Region I bought their first snowmobile in the mid 1960's compared to only 3 percent in Region III. However, by the spring of 1970 this situation had reversed itself. Klopchic's data indicated that the mean purchase date in Ontario was August 1968 compared to January 1968 in this study.[1] One-third of the respondents reported

[1] Ibid., p. 39.

TABLE 10

SNOWMOBILE HORSEPOWER[a]

Horsepower	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
1 - 17	265	43	326	32	419	25	1021	30
18 - 22	185	30	340	34	605	36	1135	34
23 +	170	27	337	34	677	40	1199	36
Total	620	100	1005	100	1701	101	3356	100
Mean	18.8		20.0		21.0		20.3	
SD	6.7		6.3		6.4		6.5	
Comparison of Means	All regions differed from each other (.05 level)							

[a]The data were based on the first snowmobile reported. The means and SD were calculated before the data were grouped.

TABLE 11

YEAR OF FIRST SNOWMOBILE PURCHASE

Year of First Purchase	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
Before 1966	88	14	70	7	63	3	221	7
1966	17	13	72	7	79	5	230	7
1967	125	20	172	17	280	16	577	17
1968	133	21	259	26	450	26	842	25
1969	164	26	342	34	645	38	1151	34
1970	37	6	85	9	199	12	321	10
Total	626	100	1000	100	1716	100	3342	100
Mean	1967.4		1967.9		1968.2		1968.0	
SD	1.7		1.4		1.3		1.4	
Comparison of Means	All regions differed from each other (.05 level)							

that they made their first purchase in 1969 which emphasized the rapidly expanding nature of this outdoor activity.

Number of snowmobiles per household.--There appeared to be no particular relationship between the region in which a snowmobiler resided and the number of snowmobiles owned by that household (see Table 12). The mean number of machines owned was 1.4, which was very close to 1.45 machines owned that the DMS estimated.[1] In Ontario, Klopchic estimated that the average snowmobile household owned 1.2 machines, which may have reflected the lower mean income of snowmobilers in that Province.[2]

Other equipment owned by households.--Snowmobilers generally appeared to own a substantial number of motorized recreation vehicles (see Table 13). Twenty-four percent of the respondents owned truck campers or house trailers, with the regional proportions gradually increasing from 18 percent in Region I to 27 percent in Region III. Ownership of motorcycles followed the same pattern having almost identical proportions in each region. Snowmobile trailers (to transport snowmobiles) were owned by 60 percent of the respondents in the state.

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[1]Directional Marketing Survey, p. 16.

[2]Klopchic, Snowmobiling in Ontario, p. 35.

TABLE 12

NUMBER OF SNOWMOBILES PER HOUSEHOLD

Number	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
One	624	72	1006	71	1707	73	3337	72
Two	204	24	333	24	550	23	1087	24
Three	30	4	62	4	72	3	164	4
Four	4	1	15	1	17	1	36	1
Total	862	101	1416	100	2346	100	4624	101
Mean	1.4		1.4		1.4		1.4	
SD	0.65		0.65		0.60		0.61	
Comparison of Means	The F was not significant at the .05 level.							

TABLE 13

OWNERSHIP OF OTHER VEHICLES BY SNOWMOBILE-OWNING HOUSEHOLDS[a]

Type of Vehicle	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
Motorcycle	125	19	249	24	474	26	848	24
All Terrain Vehicle	20	3	27	3	52	3	99	3
SM Conv. Kit	5	1	18	2	22	1	45	1
Power Boat	240	36	360	34	664	37	1264	36
SM Trailer	369	56	522	49	1221	68	2112	60
House Trailer	68	10	110	10	243	14	421	12
Truck Camper	55	8	120	11	234	13	409	12
Total	882	133	1406	133	2910	162	5198	148
Number of Respondents	665		1060		1802		3527	

[a]Respondents were asked to check all equipment owned by the household, which resulted in multiple counting.

The regional proportions decreased from 56 percent in Region I to 49 percent in Region II and then increased to 68 percent in Region III. These figures did not necessarily provide a good estimate of the owners' capability to transport snowmobiles, as they did not take into account the possibility of trailer sharing by owners (many trailers can carry two machines), nor the number of respondents who had "pick-up" trucks which could be used for this purpose.

The overall proportion of respondents who owned power boats was 36 percent; this pattern was very similar for each region. However, in the general population of the state the percentage of households that owned power boats was only 16 percent. In Regions I and II, the percentage of households in the general population which owned power boats was 29 percent and 31 percent, respectively, whereas in Region III it was only 14 percent.[1] It appeared that households in the sample from the two northern regions owned power boats to slightly greater degree than those in the general population. However, ownership by snowmobilers in Region III was two and a half times as great as in the general population.[2]

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[1]The number of registered power boats (1971) was obtained from the Michigan Secretary of State's Office. These were: Region I, 30,670; Region II, 68,850, and Region III, 368,350.

[2]Bureau of the Census, 1970 Census, Michigan, Table 124 (Income and Poverty Status in 1969 for

Even though the above data indicate that snowmobilers tended to have a greater amount of motorized recreation vehicles than did the general population, it may have been more closely related to income than to snowmobile ownership.

Opinions About Selected Regulations

Present regulations.--The majority (60%) of all respondents felt that the present regulations should remain unchanged. Twenty-nine percent were of the opinion that they should be made stricter while 12 percent held the opposing view (see Table 14).

There was a relationship between the opinion held and the region of residence. Snowmobile owners in Region II were more in favor of making the present regulations more strict than were the respondents from Regions I or III.

Enforcement of regulations.--Though only 29 percent of all respondents felt that the present regulations should be made more restrictive (see Table 14), 44 percent were of the opinion that the enforcement of them should

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Counties.) This table contained the number of families and unrelated individuals by county, excluding inmates of institutions, members of the armed services, college students in dormitories, and unrelated individuals under 14 years.

TABLE 14

SHOULD THE PRESENT SNOWMOBILING REGULATIONS BE MORE STRICT

Opinion	Code	Region I		Region II		Region III		State	
		No.	%	No.	%	No.	%	No.	%
Much more strict	1	41	6	49	5	62	4	152	5
More strict	2	145	22	268	26	392	22	805	24
Unchanged	3	365	56	591	58	1067	62	2023	60
Less strict	4	89	14	100	10	179	10	368	11
Much less strict	5	8	1	8	1	29	2	45	1
Total		648	99	1016	100	1729	100	3393	101

	Source	df	χ^2	p
Partition of Chi-square	I & II vs III	4	29.96	.001
	I vs II	4	10.42	.05
	Total	8	37.38	.001

be stricter (see Table 15). Only 9 percent felt the enforcement of regulations should be relaxed.

The data indicated that there was an association between the region of residence and the opinion expressed. Region II respondents were more in favor of stricter enforcement practices.

Operation of snowmobiles by those 14 years and under.--The majority (77%) of the respondents were opposed to allowing children 14 years old and under to operate snowmobiles without adult supervision. However, a large proportion (85%) were in favor of permitting this age group to operate a machine if it was done within view of a supervising adult (see Table 16).

No association was detected between the opinions expressed by the respondents and their region of residence.

Regulation of the noise level.--The overall response indicated that two-thirds of the snowmobile owners were in favor of regulating the amount of noise a snowmobile should be allowed to emit (see Table 17). However, the respondents from Region III differed in their expressed opinion from those in the other two regions, being less in favor of noise controls.

Regulation of snowmobiling near ice-fishermen.--Three-fifths of all snowmobile owners in the sample were in favor of establishing regulations that would control

TABLE 15

SHOULD ENFORCEMENT OF SNOWMOBILING REGULATIONS BE MORE STRICT

Opinion	Code	Region I		Region II		Region III		State	
		No.	%	No.	%	No.	%	No.	%
Much more strict	1	43	7	79	8	110	6	232	7
More strict	2	235	36	413	40	600	35	1248	37
Unchanged	3	290	45	450	44	872	50	1612	47
Less strict	4	75	12	73	7	129	8	277	8
Much less strict	5	4	1	6	1	20	1	30	1
Total		647	101	1023	100	1731	100	3399	100

	Source	df	χ^2	p
Partition of Chi-square	I & II vs III	4	16.82	.01
	I vs II	4	11.04	.05
	Total	8	27.86	.001

TABLE 16

SHOULD CHILDREN 14 YEARS OF AGE AND UNDER OPERATE SNOWMOBILES

Opinion	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
Without Supervision								
Yes	118	23	205	25	295	21	618	23
No	388	77	612	75	1089	79	2089	77
Total	506	100	817	100	1384	100	2707	100
Chi-square	The total $\chi^2_2 = 4.24$, which was not significant at the .05 level.							
With Supervision								
Yes	419	86	746	85	1315	85	2552	85
No	84	14	136	15	326	15	456	15
Total	575	100	882	100	1551	100	3008	100
Chi-square	The total $\chi^2_2 = 1.59$, which was not significant at the .05 level.							

TABLE 17

SHOULD SNOWMOBILE NOISE LEVELS BE REGULATED

Opinion	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
Yes	444	69	721	71	1135	65	2300	67
No	200	31	300	29	619	35	1119	32
Total	644	100	1021	100	1754	100	3419	99

	Source	df	χ^2	p
Partition of Chi-square	I & II vs III	1	10.74	.001
	I vs II	1	.50	NS
	Total	2	11.24	.01

snowmobile activity near persons engaged in ice-fishing (see Table 18). However, owners in Region I were different in their attitude from those in the other two regions, being about evenly divided on this issue.

Allowing snowmobiling on public thoroughfares.--A large majority (93%) of the respondents were opposed to permitting snowmobiling along main highways (see Table 19). No regional differences were found in the respondents' opinion on this question.

However, in responding to the question about allowing such activity on secondary highways, snowmobile owners across the state were evenly divided in their opinion (see Table 19). A significant difference was found between the opinions of the respondents from Region III and those from the two other regions. Those from Regions I and II were less in favor of permitting such activity.

A large majority (89%) of all respondents favored allowing snowmobiling along highway shoulders (see Table 19). Snowmobilers in Region III were somewhat less in favor.

In response to the question about permitting snowmobiling on town and village streets, three-fifths were in favor of allowing such practices (see Table 19). However, the opinions expressed varied more from region to region than on any other question (although the

TABLE 18

SHOULD SNOWMOBILING NEAR PERSONS ICE-FISHING BE REGULATED

Opinion	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
Yes	335	53	602	60	1062	62	1999	60
No	303	48	402	40	657	38	1362	41
Total	638	101	1004	100	1719	100	3361	101

	Source	df	χ^2	p
Partition of Chi-square	I vs II & III	1	15.87	.001
	II vs III	1	.87	NS
	Total	2	16.74	.001

TABLE 19

SHOULD SNOWMOBILES BE ALLOWED TO DRIVE ON A:

Opinion	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
Main Highway								
Yes	36	6	67	7	128	8	231	7
No	552	94	875	93	1467	92	2894	93
Total	588	100	942	100	1595	100	3125	100
Chi-square	The total $\chi^2_2 = 2.29$, which was not significant at the .05 level.							
Secondary Highway								
Yes	261	43	462	48	882	53	1605	50
No	340	57	504	52	768	47	1612	50
Total	601	100	966	100	1650	100	3217	100

	Source	df	χ^2	p
Partition of Chi-square	I & II vs III	1	17.20	.001
	I vs II	1	2.87	NS
	Total	2	20.07	.001

Highway Shoulder								
Yes	587	90	929	91	1517	87	3033	89
No	64	10	88	9	226	13	378	11
Total	651	100	1017	100	1743	100	3411	100

	Source	df	χ^2	p
Partition of Chi-square	I & II vs III	1	12.84	.001
	I vs II	1	.56	NS
	Total	2	13.40	.01

TABLE 19--Continued

Opinion	Region I		Region II		Region III		State	
	No.	%	No.	%	No.	%	No.	%
Town or Village Street								
Yes	170	28	324	35	768	48	1262	40
No	429	72	616	66	838	52	1883	60
Total	599	100	940	101	1606	100	3145	100

	Source	df	χ^2	p
Partition of Chi-square	I & II vs III	1	80.85	.001
	I vs II	1	5.64	.05
	Total	2	86.47	.001

partitioning did not test each part). The more urban the region the more inclined those owners were to favor permitting snowmobiling on town and village streets.[1]

Patterns of Snowmobile Use

Snowmobile owners were asked to indicate their participation in snowmobiling measured in number of days, by counting any part of a day spent on the sport as one day. For each of the following classes of questions they were asked to report the number of days spent: (1) snowmobiling in each of the three counties of most use, (2) snowmobiling on different classes of land, (3) doing a particular snowmobiling activity, (4) participating in activities associated with a snowmobile trip, and (5) on overnight trips. In each of the above classes of questions, except (1), double counting of days was expected to occur in varying degrees. Very little double counting was expected in the reporting of the number of days spent in the three counties of most use. However, for the other four classes of questions it was expected that the number of days reported for each class would exceed the actual number of days reported in Question 3. In other words, a snowmobiler may have used

[1]Snowmobilers from Region III did a large portion of their snowmobiling outside their county of residence (which will be discussed later), hence, it is possible that this was an expression, by some, favoring snowmobiling on someone else's streets.

three classes of land in one day, so this would appear as three days in Question 6, but only be represented as one day in Question 3.

The number of days reported ranged from zero to ninety-five days.[1] For most of the activities there was a large variation in the amount of use that was reported which was reflected by large standard deviations.

Amount of snowmobile use.--When the total amount of snowmobile use was examined (Question 3), the results indicated that the respondents from Region III did less snowmobiling than those from each of the other two regions (see Table 20). No significant difference was observed between the respondents of Region I and of Region II. However, when the amount of snowmobiling done in the owners' county of residence was considered, the number of days reported by respondents differed according to region (see Table 20). The mean number of snowmobiling days reported for the county of residence ranged from twenty-seven days in Region III to forty-nine days in Region I.

The lower average number of snowmobiling days reported by owners in Region III was probably closely related to the fact that Region III received much less

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[1]Where individuals reported a number in excess of ninety-five days, it was coded as ninety-six. The maximum number of respondents reporting over ninety-five days in any activity was 5 percent.

TABLE 20

TOTAL AMOUNT OF SNOWMOBILE USE PER SNOWMOBILE OWNER DURING 1969-70 SEASON

Region	Total Number of Days[a]				Days in Resident County			
	Days	Owners	Mean	SD	Days	% of Tot.	Mean	SD
Region I	33,500	596	56	35	29,400	88	49	30
Region II	51,400	949	54	35	41,800	82	44	28
Region III	69,300	1649	42	29	44,200	64	27	23
State	154,200	3194	48	32	114,000	74	35	28
Comparison of Means	Region III differed from Region I and from Region II (.05 level).				All regions differed from each other (.05 level).			

[a]The total number of days spent snowmobiling was calculated by summing the number of days spent snowmobiling in the county of: (1) most use, (2) second most use, and (3) third most use.

snowfall than the other two regions (see Appendix E). Another factor which probably acted as a constraint was the relative lack of public lands available; none in the case of national and state forests (see Appendix H). The available lands also had to serve a much larger population.

It was also likely that the above factors were closely associated with Region III snowmobilers using counties other than their own 36 percent of the time. Indications were that a considerable portion of this time was spent in counties outside of Region III. Approximately one-third of these respondents spent an average of seven days taking two- to three-day trips of 100 miles or more from their place of residence (see Table 24).

Ownership of land used for snowmobiling.--It was expected that the relationships observed with respect to the total amount of time spent snowmobiling, discussed above, would be reflected in the responses to the amount of time spent on different types of land. In general, this appeared to be the case. Respondents from Region III differed from those in the other two regions with respect to use of each classification of land except the category "other" where no differences were observed (see Table 21). Again, no differences were observed in the use patterns between snowmobile owners from Region I and Region II

TABLE 21

AMOUNT OF SNOWMOBILING ON VARIOUS CLASSES OF LAND PER SNOWMOBILE OWNER

	Region I			Region II			Region III			State		
	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.
Snowmobile Owner's Land												
	13.0	25	377	25.0	30	638	27.6	30	962	65.7	29	1977
Mean		34			39			28			33	
SD		31			31			24			28	
Comparison of Means	All regions differed from each other (.05 level).											
Private Land												
	12.2	23	399	18.9	23	633	24.8	27	1150	55.9	25	2182
Mean		31			30			22			26	
SD		28			27			20			24	
Comparison of Means	Region III differed from Region I and from Region II (.05 level.)											

TABLE 21--Continued

	Region I			Region II			Region III			State		
	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.
State Land												
	9.5	18	358	15.8	19	648	16.7	18	1065	42.0	19	2071
Mean		27			24			16			21	
SD		26			24			16			21	
Comparison of Means	Region III differed from Region I and from Region II (.05 level).											
Local Roads												
	5.5	11	269	10.3	13	446	6.8	7	579	23.5	10	1294
Mean		20			23			12			17	
SD		24			26			15			21	
Comparison of Means	Region III differed from Region I and from Region II (.05 level).											

TABLE 21--Continued

	Region I			Region II			Region III			State		
	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.
County Land												
	5.9	11	215	5.2	6	219	6.2	7	362	17.3	8	796
Mean		27			24			16			21	
SD		26			26			18			23	
Comparison of Means	Region III differed from Region I and from Region II (.05 level).											
Federal Land												
	3.6	7	181	3.1	4	161	4.0	4	277	10.7	5	619
Mean		19			19			13			16	
SD		21			22			14			19	
Comparison of Means	Region III differed from Region I and from Region II (.05 level).											

TABLE 21--Continued

	Region I			Region II			Region III			State		
	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.
Other Land[b]												
	2.5	5	89	3.9	5	149	5.3	6	241	11.7	5	479
Mean		28			26			22			24	
SD		25			25			23			24	
Comparison of Means	The F ratio was not significant at the .05 level.											
Total Use[c]												
	52.2	100	1888	82.2	100	2894	91.4	99	4636	226.8	101	9418
Mean		28			28			20			24	

[a]The percentage of total use on all classes of land reported by respondents.

[b]In checking the category "other," respondents from each region indicated that more than half of this time was spent snowmobiling on lakes and rivers.

[c]The large combined number of responses indicated the extent of double counting.

except in the use of the owners' own land. In the latter instance, those from Region II spent a greater number of days snowmobiling on their own land, compared to owners from each of the other two regions.

It was interesting to examine the proportion of time respondents from each region spent using each of these types of land. Snowmobilers from all regions spent the same percentage of their time on state owned land. The proportion of time using local roads for snowmobiling varied from 7 percent in Region III, 11 percent in Region I to 13 percent in Region II. A greater proportion of the snowmobilers' time in Region I was spent using county owned land compared to those in the other two regions. Federal lands were used the fewest number of days. However, respondents from Region I spent almost twice as large a proportion of their time on this classification of land than did those from the rest of the state. Owners from Region II and III spent approximately the same percentage of their time using their own land, while those from Region I spent a smaller proportion.

In Minnesota it was calculated that snowmobilers spent 49 percent of their time on private land compared to 47 percent on public land.[1] When the above categories (excluding "other") were collapsed, it was found that

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[1]Bureau of Planning, Minnesota Snowmobile Study, 1970 (St. Paul, Minn.: Department of Conservation, 1970), p. 11.

snowmobilers in Michigan spent 54 percent of their time on privately owned land compared to 42 percent on public land. However, the proportions observed in Region I were almost identical to the results obtained in Minnesota.

Kinds of snowmobile activity.--Snowmobile owners in Michigan spent a greater mean number of days trail riding than doing any other snowmobiling activity. Respondents from each region differed from those in each other region in this respect, spending an average of forty days in Region I, thirty-five days in Region II, and twenty-five days in Region III (see Table 22). Snowmobilers in Region III spent a smaller average number of days "scrambling" (that is, snowmobiling in open areas) differing considerably from those in Region I and in Region II. To an even greater degree, respondents in Region III differed from those in the other two regions in using the machines for travelling to work. However, no regional differences appeared in the amount of time spent racing snowmobiles.

In examining the proportion of time spent in these activities, it was found that a greater percentage (58%) of snowmobiling was done on trails compared to scrambling (31%). However, respondents from Region III devoted a greater proportion of their time (35%) to scrambling compared to those in the other two regions (27% and 29%). In Minnesota it was estimated that

TABLE 22

KINDS OF SNOWMOBILE ACTIVITY PER HOUSEHOLD

	Region I			Region II			Region III			State		
	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.
Trail Riding												
	20.6	64	520	28.2	59	815	34.1	54	1376	82.8	58	2711
Mean		40			35			25			31	
SD		29			28			22			26	
Comparison of Means	All regions differ from each other (.05 level).											
Scrambling												
	9.5	29	355	12.8	27	486	22.2	35	1002	44.5	31	1843
Mean		26			26			22			24	
SD		25			25			20			23	
Comparison of Means	Region III differed from Region I and from Region II (.05 level).											

TABLE 22--Continued

	Region I			Region II			Region III			State		
	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.
Riding to Work												
	1.6	5	66	2.2	5	132	1.3	2	125	5.1	4	323
Mean		24			17			10			16	
SD		31			24			16			23	
Comparison of Means	Region III differed from Region I and from Region II (.05 level).											
Snowmobile Racing												
	0.4	1	43	0.5	1	77	1.0	2	149	1.9	1	269
Mean		10			6			7			7	
SD		14			7			11			10	
Comparison of Means	The F ratio was not significant at the .05 level.											

TABLE 22--Continued

	Region I			Region II			Region III			State		
	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.
Other Activities												
	0.2	1	71	3.7	8	135	4.5	7	189	8.4	6	395
Mean		3			27			24			21	
Totals												
	32.3	100	1055	47.4	100	1645	63.1	100	2841	142.7	100	5541
Mean		31			29			22			26	

[a]The percentage of the total amount of snowmobile activity reported for each household.

snowmobilers spent 62 percent of their time on trails compared to 38 percent in open areas.[1] However, if only trail riding and scrambling were included in the calculations for Michigan, then the adjusted estimates, 60 percent and 40 percent, were very similar to those obtained in Minnesota.

In all regions using a snowmobile for travelling to work or participating in snowmobile races made up a small proportion of snowmobile activity (4% and 1% respectively) and also involved relatively few snowmobilers. In Minnesota, the pattern appeared to be similar as they estimated that 2 percent of the snowmobilers used their machine to travel to work and 1 percent were involved in racing.[2]

However, from the above data it could not be determined whether snowmobilers preferred trail snowmobiling to open space snowmobiling or whether the nature of the available resources determined the patterns observed. It did appear that there could be a relationship between the use of local roads (see Table 21) and using one's snowmobile for going to work. The proportions of time spent on both of these pursuits were much higher in Region I and II than in Region III.

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[1]Ibid., p. 13.

[2]Ibid., p. 21.

Activities associated with snowmobiling.--These activities were considered to be associated with or secondary to the principal activity of snowmobiling; hence, it was expected that the means would be relatively low (see Table 23). A comparison of the mean number of days indicated that snowmobiling households in Region III differed from those in Regions I and II in spending less time ice-fishing and on cook-outs, but spent more time overnight camping. No regional differences were observed in the case of hunting. However, households in Region I differed from those in the other regions in spending more days per household tobogganing, sledding, and skiing.

In examining the proportion of time spent on each of these activities by snowmobiling households, it was apparent that ice-fishing was the most popular activity associated with snowmobiling; households throughout the state spent approximately one-third of the time in this manner.[1] Having a cook-out while on a snowmobile outing appeared to be more common in Region II as they spent 26 percent of the time in this way compared to 17 percent and 18 percent in the other regions. The proportion of time spent hunting (14%) was similar in all regions.

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[1]The calculation of these proportions was based on the total amount of time reported spent on these associated activities. In other words the percentage of time spent at one of these activities should not be identified with a percentage of total time spent snowmobiling.

TABLE 23

ACTIVITIES UNDERTAKEN PER HOUSEHOLD IN ASSOCIATION WITH SNOWMOBILING

	Region I			Region II			Region III			State		
	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.
Ice Fishing												
	2.9	33	196	3.9	35	316	4.3	30	454	11.1	32	966
Mean		15			17			9			11	
SD		18			12			13			16	
Comparison of Means	Region III differed from Region I and from Region II (.05 level).											
Cook-outs												
	1.6	18	208	2.9	26	371	2.4	17	349	6.9	20	928
Mean		8			8			5			7	
SD		10			11			6			9	
Comparison of Means	Region III differed from Region I and from Region II (.05 level).											

TABLE 23--Continued

	Region I			Region II			Region III			State		
	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.
Hunting												
	1.2	14	125	1.5	13	165	2.2	15	283	4.9	14	573
Mean		9			9			8			8	
SD		10			12			8			10	
Comparison of Means	The F ratio was not significant at the .05 level.											
Tobogganing, Sledding, and Skiing												
	1.0	11	84	1.1	10	142	2.2	15	272	4.3	13	498
Mean		12			7			8			9	
SD		16			10			10			11	
Comparison of Means	Region I differed from Region II and from Region III (.05 level).											

TABLE 23--Continued

	Region I			Region II			Region III			State		
	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.	1000 Days	% of Use[a]	No.
Overnight Camping												
	0.5	6	86	0.3	3	58	1.3	9	127	2.2	6	271
Mean		6			6			10			8	
SD		6			5			13			10	
Comparison of Means	Region III differed from Region I and from Region II (.05 level).											
Other Activities												
	1.6	18	53	1.6	14	59	1.8	13	101	5.0	15	213
Mean		30			27			18			23	
Totals												
	8.8	100	752	11.3	101	1111	14.2	99	1586	34.4	100	3449
Mean		12			10			9			10	

[a]The percentage of the total amount of activity associated with snowmobiling reported for each household.

Households in Region III spent a greater percentage of the time (15%) tobogganing, sledding, and skiing than did those in the other regions.

Overnight snowmobile trips.--The response to question 16, which asked snowmobile owners to report the number of their overnight trips, resulted in a number of the fifteen cells in the five-by-three chart having very low frequencies. Therefore, the categories of both the time and distance variables were collapsed, as indicated in Table 24.

No regional differences (significant at the .05 level) were observed in the number of overnight trips taken or in the distances travelled. However, it was of interest to examine the different proportions of trips taken in each region. Distance appeared to be a dominant factor for respondents in all regions. In Region I, 86 percent of the trips reported were less than 100 miles from the respondent's home. However, in Region III, 71 percent of the trips were over 100 miles from the owner's residence. In Region II, the influence of distance did not appear to be as strong, as 68 percent of the respondents travelled less than 100 miles from home, but 58 percent took trips extending over two or three nights. It appeared that respondents from Region III had a greater tendency to travel long distances than those from the other two regions, especially when it

TABLE 24

OVERNIGHT SNOWMOBILE TRIPS

	Region I			Region II			Region III			State		
	Trips	%[a]	No.[b]	SM	%	No.	Trips	%	No.	Trips	%	No.
One-Night Trips Less Than 100 Miles												
	793	57	140	660	34	111	1511	16	192	2964	23	443
Mean		6			6			8			7	
SD		12			8			13			11	
Comparison of Means	The F ratio was not significant at the .05 level.											
One-Night Trips More Than 100 Miles												
	73	5	16	126	7	47	1933	20	314	2132	17	377
Mean		5			3			6			6	
SD		3			3			10			9	
Comparison of Means	The F ratio was not significant at the .05 level.											

TABLE 24--Continued

	Region I			Region II			Region III			State		
	Trips	%[a]	No.[b]	SM	%	No.	Trips	%	No.	Trips	%	No.
Two- and Three-Night Trips Less Than 100 Miles												
	399	29	62	660	34	79	1210	13	146	2269	18	282
Mean		6			8			8			8	
SD		13			15			14			14	
Comparison of Means	The F ratio was not significant at the .05 level.											
Two- and Three-Night Trips More Than 100 Miles												
	130	9	15	469	24	90	4913	51	707	5582	43	822
Mean		9			5			7			7	
SD		23			12			10			11	
Comparison of Means	The F ratio was not significant at the .05 level.											
Total Trips												
	1395	100	233	1915	99	327	9567	100	1360	12947	101	1920

[a]Percentage of total number of trips.

[b]Number of snowmobile owners responding.

was noted that approximately one-fifth of those who reported trips in excess of 100 miles actually took trips in excess of 300 miles.

Expanded Snowmobile Use Days

It was decided to expand the data to obtain a better picture of the magnitude and distribution of snowmobile activity in Michigan. The calculation of the weighting factors was based on the proportion of the number of usable responses to the number of registered snowmobiles in each of the eleven sub-regions (see Appendix G). Using these weights the data were expanded for each county. In some counties, the sample was small (less than twenty) which increased the probability of sampling variation. Therefore, whatever errors occurred in the estimates were magnified in the expansion. However, when examined at a regional level the data were expected to provide good estimates of the snowmobiling activity.

The expansion of the data was placed in Table 25. The first column contained the total number of snowmobile days generated by residents of each county. The difference between this number and the number of days spent snowmobiling in the county of residence resulted in the number of "out-flow" days; that is, the number of days spent snowmobiling outside one's county of residence. The number of days spent in each county by both residents

TABLE 25

EXPANDED SNOWMOBILE USE DAYS[a]
- IN THOUSANDS OF DAYS -

County	Tot Dys From Cty of Origin[b]	Dys in Cty of Origin[c]	Out Flow Days	Dys in Cty of Destin[d]	In Flow Days	Net Gain or Loss	Percent Gained Or Lost
			Region I				
Alger	43	38	5	69	31	+ 26	+ 61
Baraga	32	30	2	37	7	+ 5	+ 16
Chippewa	141	134	7	154	20	+ 13	+ 9
Delta	139	110	29	116	6	- 23	- 17
Dickinson	63	54	9	57	3	- 6	- 10
Gogebic	48	38	10	47	9	- 1	- 2
Houghton	51	44	7	50	6	- 1	- 2
Iron	45	39	6	49	10	+ 4	+ 19
Keweenaw	1	1	0	9	8	+ 8	+800[e]
Luce	40	32	8	43	11	+ 3	+ 8
Mackinac	61	50	11	74	24	+ 13	+ 21
Marquette	175	159	16	180	21	+ 5	+ 3
Menominee	43	41	2	49	8	+ 6	+ 14
Ontonagon	52	49	3	60	11	+ 8	+ 15
Schoolcraft	44	39	5	51	12	+ 7	+ 16
Total	978	858	120	1,045	187	+ 65	+ 7

TABLE 25--Continued

County	Tot Dys From Cty of Origin[b]	Dys in Cty of Origin[c]	Out Flow Days	Dys in Cty of Destin[d]	In Flow Days	Net Gain or Loss	Percent Gained Or Lost
			Region II				
Alcona	35	33	2	57	25	+ 22	+ 63
Alpena	93	77	16	86	9	- 7	- 8
Antrim	69	57	12	78	21	+ 9	+ 13
Arenac	61	50	11	63	13	+ 2	+ 3
Bay	157	100	57	116	16	- 41	- 26
Benzie	17	12	5	29	17	+ 12	+ 71
Charlevoix	63	53	10	72	19	+ 9	+ 14
Cheboygan	105	92	13	130	38	+ 25	+ 24
Clare	54	48	6	103	55	+ 49	+ 91
Crawford	19	17	2	72	55	+ 53	+279
Emmet	50	42	8	62	20	+ 12	+ 24
Gladwin	28	23	5	59	36	+ 31	+111
Grand Trav.	125	101	24	138	37	+ 13	+ 10
Iosco	76	68	8	105	37	+ 29	+ 38
Isabella	75	60	15	69	9	- 6	- 8
Kalkaska	32	24	8	57	33	+ 25	+ 78
Lake	.5	-	0	37	37	+ 37	+ 74[e]
Leelanau	60	51	9	61	10	+ 1	+ 2
Manistee	51	35	16	45	10	- 6	- 12[f]
Mason	26	25	1	39	14	+ 13	+ 50[f]
Mecosta	24	21	3	52	31	+ 28	+117
Midland	62	44	18	54	10	- 8	- 13
Missaukee	27	20	7	48	28	+ 21	+ 78[f]
Montmorency	13	12	1	41	29	+ 28	+215[e]
Newaygo	44	38	6	71	33	+ 27	+ 61

TABLE 25--Continued

County	Tot Dys From Cty of Origin[b]	Dys in Cty of Origin[c]	Out Flow Days	Dys in Cty of Destin[d]	In Flow Days	Net Gain or Loss	Percent Gained Or Lost
Oceana	62	59	3	75	16	+ 13	+ 21
Ogemaw	28	26	2	96	70	+ 68	+243[f]
Osceola	48	39	9	67	28	+ 19	+ 40
Oscoda	12	12	0	37	25	+ 25	+208[e]
Otsego	80	61	19	97	36	+ 17	+ 21
Presque Isle	37	33	4	46	13	+ 9	+ 24
Roscommon	77	67	10	222	155	+145	+188
Wexford	51	43	8	78	35	+ 27	+ 53
Total	1,761	1,443	318	2,462	1,019	+701	+ 40
Region III							
Allegan	70	57	13	70	13	0	-
Barry	61	47	14	62	15	+ 2	+ 3
Berrien	56	47	9	48	1	- 8	- 14
Branch	19	14	5	17	3	- 2	- 11[e]
Calhoun	32	20	12	23	3	- 9	- 28[f]
Cass	11	9	2	14	5	+ 3	+ 27[e]
Clinton	73	32	41	35	3	- 38	- 52
Eaton	49	20	29	23	3	- 26	- 53
Genesee	273	168	105	181	13	- 92	- 34
Gratiot	38	24	14	31	7	- 7	- 18
Hillsdale	30	26	4	29	3	- 1	- 3[f]
Huron	47	42	5	51	9	+ 4	+ 9

TABLE 25--Continued

County	Tot Dys From Cty of Origin[b]	Dys in Cty of Origin[c]	Out Flow Days	Dys in Cty of Destin[d]	In Flow Days	Net Gain or Loss	Percent Gained Or Lost
Ingham	124	53	71	58	5	- 66	- 53
Ionia	20	15	5	19	4	- 1	- 5[f]
Jackson	67	45	22	49	4	- 18	- 27
Kalamazoo	57	45	12	46	1	- 11	- 19
Kent	214	143	71	162	19	- 52	- 24
Lapeer	71	58	13	70	12	- 1	- 1
Lenawee	20	15	5	23	8	+ 3	+ 15[e]
Livingston	38	26	12	37	11	- 1	- 3[f]
Macomb	113	53	60	62	9	- 51	- 45
Monroe	8	6	2	9	3	+ 1	+ 13
Montcalm	81	58	23	71	13	- 10	- 12
Muskegon	128	97	31	104	7	- 24	- 18
Oakland	279	169	110	180	11	- 99	- 36
Ottawa	102	73	29	81	8	- 21	- 21
Saginaw	172	95	77	99	4	- 73	- 42
Sanilac	70	57	13	66	9	- 4	- 6
Shiawassee	36	18	18	20	2	- 16	- 44
St. Clair	78	62	16	71	9	- 7	- 9
St. Joseph	25	23	2	23	0	- 2	- 8
Tuscola	101	70	31	79	9	- 22	- 22
Van Buren	29	21	8	22	1	- 7	- 24
Washtenaw	47	27	20	35	9	- 12	- 26
Wayne	141	40	101	43	3	- 98	- 70
Total	2,780	1,775	1,005	2,012	237	-766	- 28
TOTAL	5,519	4,076	1,443	5,519	1,443	0	

TABLE 25--Continued

[a]The multipliers used to expand the sample data were based on the number of "usable responses" received for each of the eleven sub-regions described in Sample Design, above. For a description of the weights see Appendix G.

[b]Total number of days generated by snowmobile owners from the county of their origin (residence).

[c]Number of days that owners spent snowmobiling in their county of origin (residence).

[d]Number of days spent snowmobiling in a county, by snowmobile owners throughout the state.

[e]The number of usable responses was less than 10.

[f]The number of usable responses was less than 20.

and nonresidents constituted the number of days at the county of destination. The contribution made by non-residents was considered to be the number of "in-flow" days. The net gain or loss of snowmobile activity for a county amounted to the difference between the number of in-flow and out-flow days (see Figure 3). The percentage gained or lost was also calculated (see Figure 4). These last two columns provided a summary of the patterns of flow in and out of the counties and of the regions. However, caution was needed in interpreting the resulting estimates for those counties which had small samples, particularly those of less than ten respondents.

It was interesting to examine the expanded data for the three regions. A net gain accruing to a region represented the amount of snowmobile activity done in that region by residents from one or both of the other two regions. The converse was true for a net loss.

In addition to the calculations presented in Table 25, it was determined that Region I gained 1 percent, Region II gained 13 percent, and Region III lost 14 percent of the snowmobiling they generated.

Even though it was estimated that the residents of Region III only generated forty-two days per owner, compared to fifty-six and fifty-four days for Regions I and II, respectively, they did account for 50 percent of the total amount of use in the state.

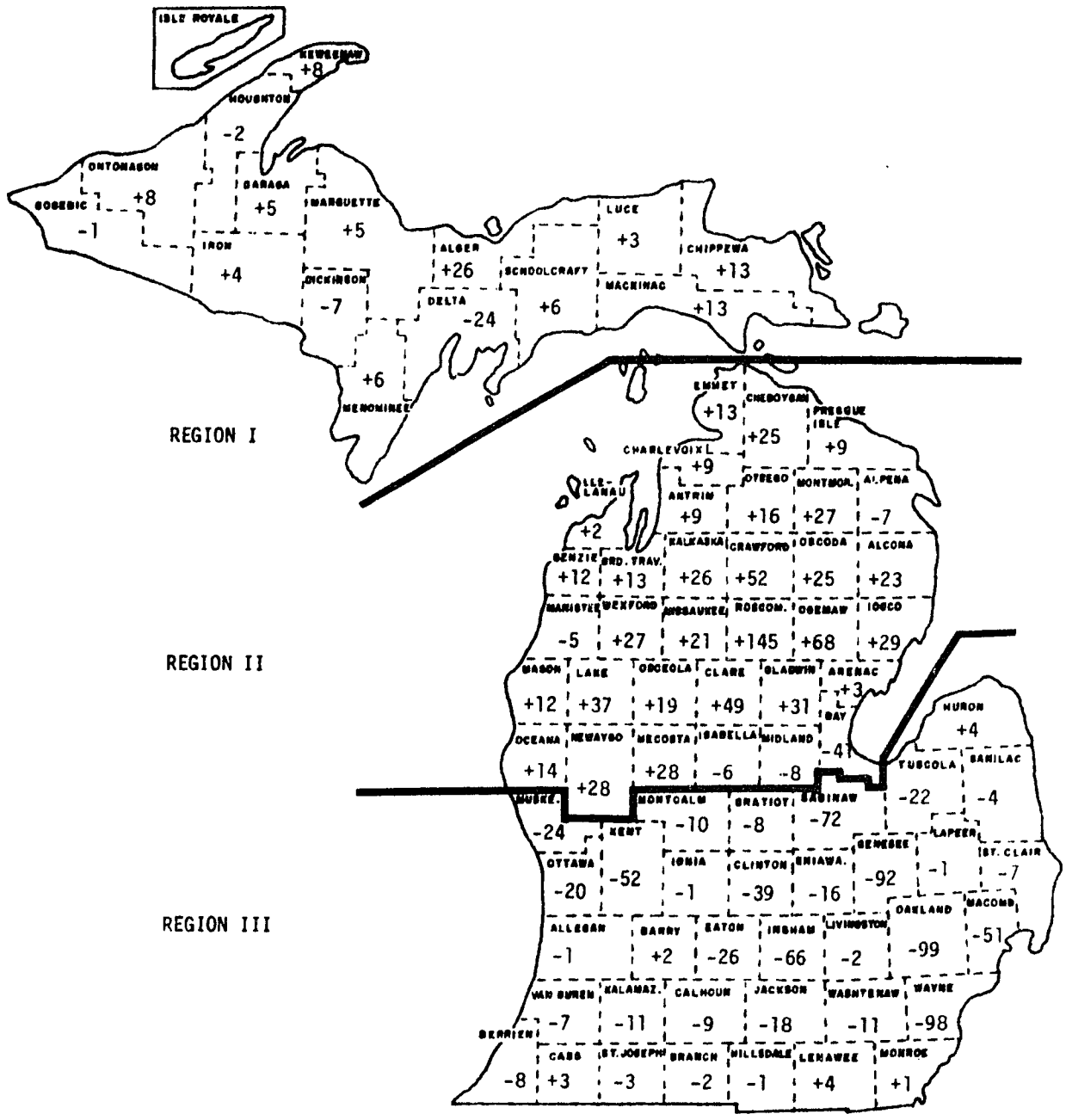

Fig. 3. Net gain or loss, in thousands of snowmobile days.

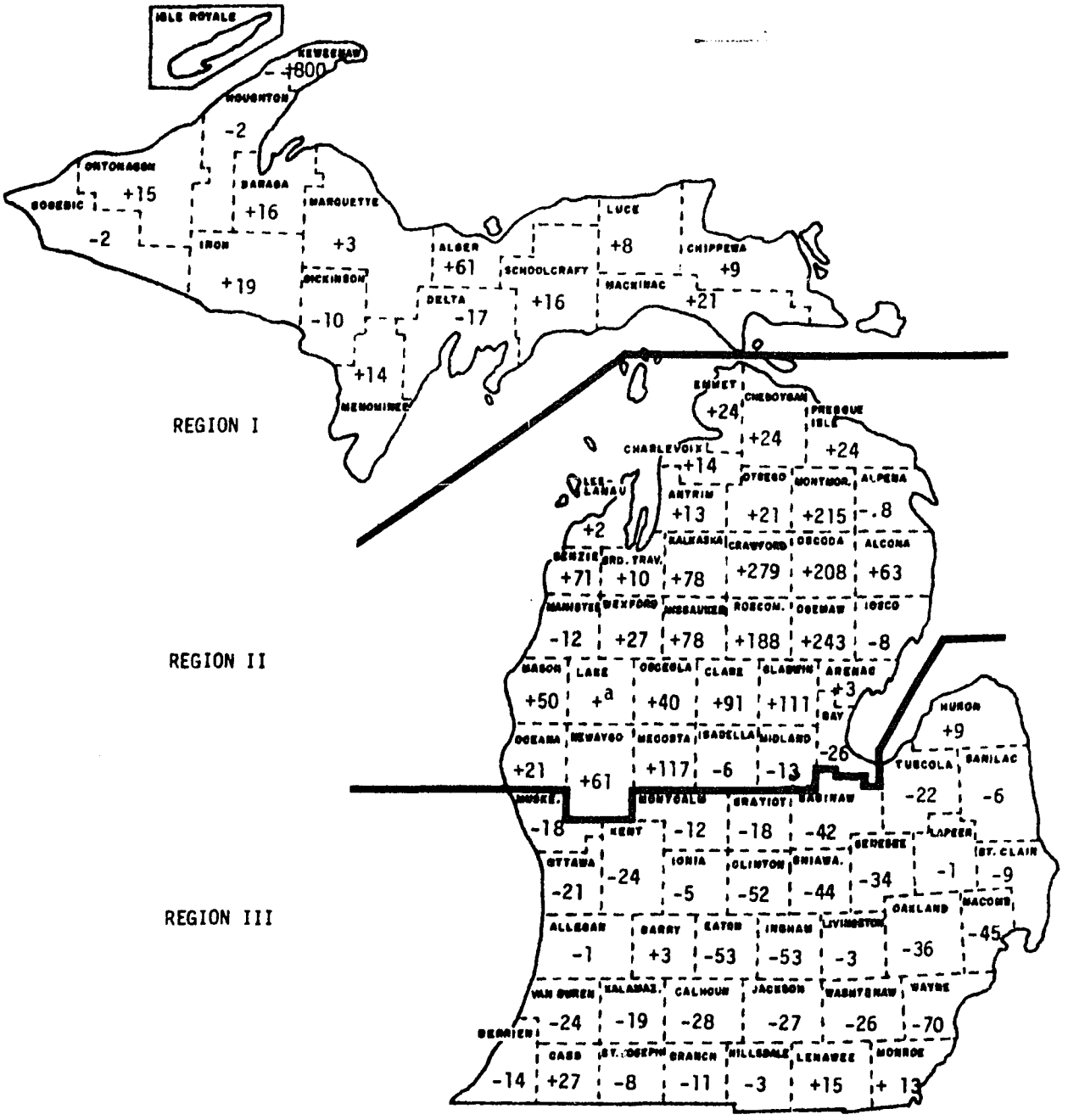

Fig. 4. Percentage of gain or loss in snowmobile days.

[a]Insufficient data to make calculations.

A number of factors appeared to be operative in determining the above use patterns, such as: (1) the amount of snowfall received, or perhaps of greater significance, the number of days for which there was some minimum number of inches, (2) the system of highways in the state, particularly in the Lower Peninsula, (3) the distribution of the snowmobile population (by county of residence), (4) the availability and suitability of the land resources, and (5) the wide range of social factors associated with snowmobile outings.

The above combination of factors appeared to favor Region II as a desirable snowmobiling area for many Michiganders. Most of its counties received over sixty inches of snow in 1969-70 and many had approximately 100 inches (see Appendix E). There were five major highway systems leading to this region which originated in the populated areas of Region III (see Figure 2). Federal and state owned land was in large supply (see Appendix H). There were also numerous resort areas that had been developed for winter skiing and for summer vacationing.

The attractiveness of Region II is also illustrated by the fact that 45 percent of the snowmobiling activity took place there even though only 25 percent of the registered snowmobilers resided there. As pointed out above, much of this additional activity originated

in the more urban region where 57 percent of the snowmobilers lived but where only 36 percent of the snowmobiling was done.

Nonresponse

The response rate to the mailed questionnaire (70%) was considered high. However, it was deemed important that some steps be taken to estimate whether or not the 30 percent who did not respond were significantly different from those that did reply. Therefore, telephone interviews were conducted in the counties of Ingham and Kent. A random selection of both respondents and nonrespondents was made. Forty-eight nonrespondent and thirty-nine respondent interviews were conducted in Ingham County; in Kent County forty-three nonrespondent and thirty-five respondent interviews were carried out.

The responses from these two sets of interviews were compared on three variables: education, income, and amount of snowmobile use. Igo found that there were no significant differences between the nonrespondents and the respondents based on the information obtained for these three questions.[1]

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[1]Alison Igo, "An Analysis of the Validity of Mail Surveys for Use in Recreation Research" (Master's Thesis, Michigan State University, 1971).

Based on the findings of Ingo's analysis it appeared reasonable to assume that in this survey the nonrespondents were not significantly different from the respondents.

Phase II

In Phase II, the AID computer program was used to examine the relationship between the dependent variable, days spent snowmobiling, and selected independent variables. A description of these sixteen predictor variables and their associated classes is presented in Table 26. The goals were to: (1) determine the amount of variation in the dependent variable that was accounted for by these predictors and (2) examine the results tree to gain greater insight into the more prominent relationships that existed between the variables.

The results of the algorithm were presented in the form of a tree, one for each region. Created groups were numbered, in pairs, according to the order in which the splits occurred. The letter in the lower right-hand corner of the box of the final groups indicated why they were not split further. Groups labelled E did not contain the fifty observations required to be eligible. Attempts were made to split groups labelled R; however, no predictor was able to meet the reducibility criteria. In

TABLE 26

PREDICTOR VARIABLES AND CLASSES USED IN THE AID ANALYSIS

Variable No.	Variable Classes		Ordering Constraints
2	Weights (see Appendix J)		
3	Age of Head of Household		
	1. Under 25 yrs.	4. 45-54 yrs.	Order
	2. 25-34 yrs.	5. 55-64 yrs.	Maintained
	3. 35-44 yrs.	6. 65 & over	
4	Occupation of Head of Household		
	1. Professional	6. Service	Free
	2. Self-employed	7. Farm Operators	
	3. Clerical/sales	8. Retired	
	4. Skilled	9. Other	
	5. Semi-skilled		
5	Education of Head of Household		
	1. 0-8 yrs.	4. 13-14 yrs.	Order
	2. 9-11 yrs.	5. 15-16 yrs.	Maintained
	3. 12 yrs.	6. 17 yrs & over	
6	Income of Household		
	3. Under $6000	6. $15,000-19,999	Order
	4. $6,000-$9,999	7. $20,000-24,999	Maintained
	5. $10,000-14,999	8. $25,000-29,999	
		9. $30,000 & over	
7	Age Range of Children		
	0. Zero	2. Under 12 yrs.	Order
	1. Under 6 yrs.	3. Under 19 yrs.	Maintained
8	Horsepower		
	1. Under 16 hp.	3. 21-25 hp	Order
	2. 16-20 hp	4. 26 hp & over	Maintained
9	Age of Snowmobile		
	1. One year	3. Three years	Order
	2. Two years	4. Four years & over	Maintained
10	Owner of Snowmobile		
	1. Head	4. Daughter	Free
	2. Wife	5. Brother	
	3. Son	8. Other	

TABLE 26--Continued

Variable No.	Variable Classes		Ordering Constraints
11	Number of Snowmobiles Owned by Household		
	0. Zero	3. Three	Order
	1. One	4. Four & over	Maintained
	2. Two		
12	First Years of Snowmobiling		
	3. Before 1966	6. 1968	Order
	4. 1966	7. 1969	Maintained
	5. 1967	8. 1970	
13	Snowfall in County of Residence		
	1. 30-44 in.	5. 90-104 in.	Order
	2. 45-59 in.	6. 105-119 in.	Maintained
	3. 60-74 in.	7. 120 in.& over	
	4. 75-89 in.		
14	Present Regulations Should Be:		
	1. More strict	6. Less strict	Free
	4. Unchanged		
15	Enforcement of Regulation Should Be:		
	1. More strict	6. Less strict	Free
	4. Unchanged		
16	Regulations Near Ice-fishing		
	1. Yes	6. No.	Free
17	Club Membership		
	1. Yes	6. No	Free
18	Preferred Snowmobile Group		
	1. Alone	5. Organized group	Free
	2. Wife		
	3. Children	6. Family	
	4. Friends	7. Relations	

other words, no one variable explained enough of the variation for the BSS_p/TSS_T to meet the criterion set for each region.

Region I

It is important to note, according to Sonquist, the variables included in the tree and the order in which they appeared. Those variables with high predictive power tended to be used early in the analysis; those which affected small sub-groups appeared in later splits.[1] Another property of the tree was that of nonsymmetry, in terms of the extent and manner in which variables were used in the various branches, which indicated the presence of interaction effects. If a variable operated in a different manner in different branches or if it only had utility, or potential utility, in reducing predictive error in one branch then it was a clear indication that such a variable interacted with those used in preceding splits.[2]

The results tree obtained for Region I using the predictor variables and the program restrictions outlined above was presented in Figure 5. This tree was initially split into two main branches, on the number of snowmobiles

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[1]Sonquist, Multivariate Model Building, p. 96.

[2]Ibid.; Sonquist and Morgan, Detecting Interaction Effects, pp. 111-12.

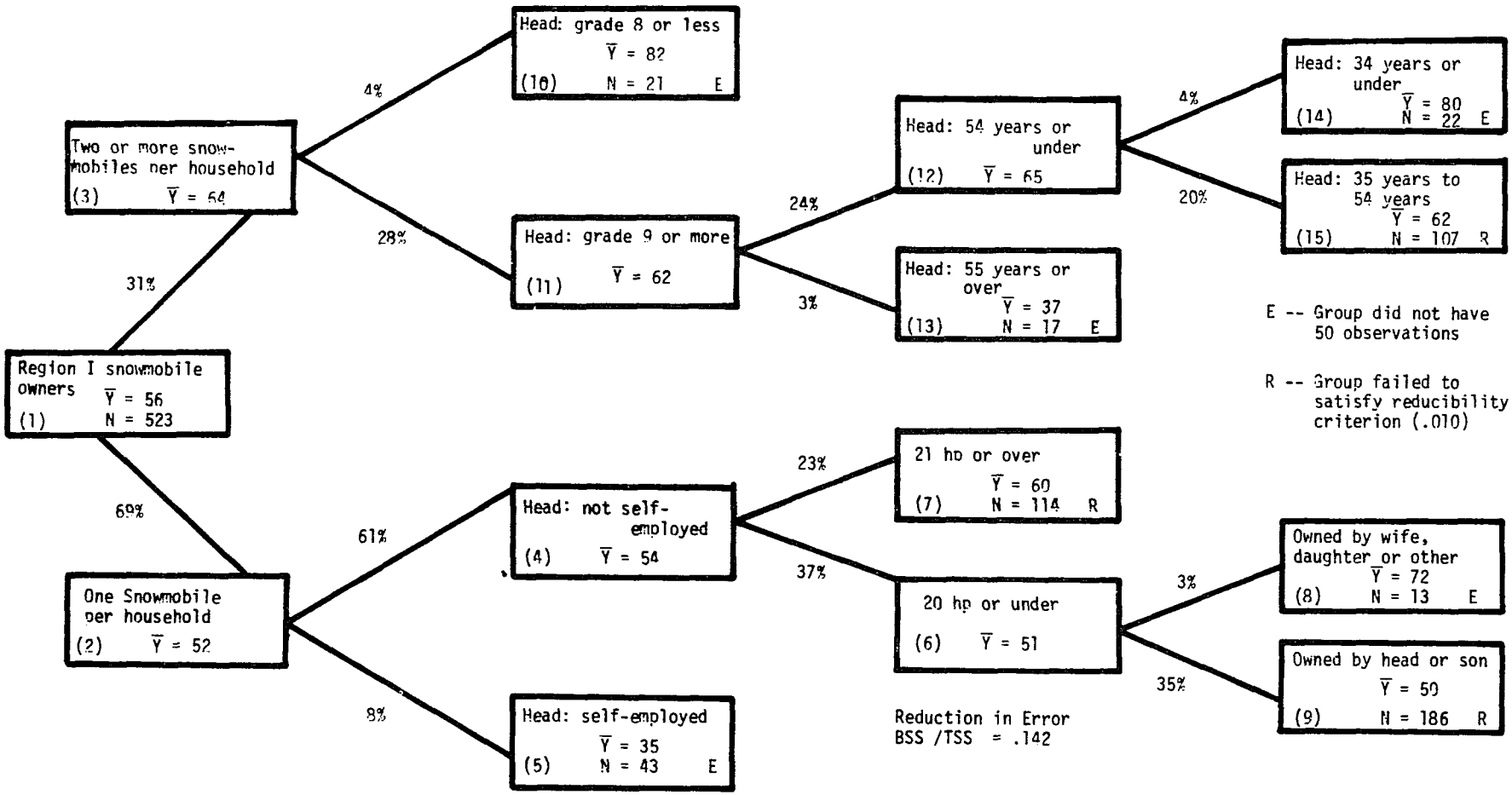

Fig. 5. AID "results tree": an analysis of the number of snowmobiling days in Region I.

owned by the household. This produced a high-use group that owned two or more snowmobiles and a low-use group having but one machine (this group included two respondents who had disposed of their snowmobile). After this initial split, this predictor lost its power to reduce the variation in the dependent variable.

The occupation variable was found to be the most powerful predictor for group 2, the low-use group, to split on; no other predictor came close, even though six predictors satisfied the criterion (see Table 27).[1] It was used later in an attempt to split group 7, but failed since it did not satisfy the reducibility criterion. Occupation also demonstrated potential strength in the top branch of the tree.

Horsepower retained the strength it had demonstrated in group 2 and was used to split group 4. However, after this split it gave no further evidence of power.

The use of snowmobile ownership to partition group 6 was of special interest as its use was very likely spurious. The group was badly skewed on this variable, 88 percent of the group being heads of households.

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[1]This table did not indicate the proportion that the between sum of squares was of the total sum of squares (BSS_p/TSS_T). This proportion was calculated for each of the regions and placed in Appendix K. Statistics for the splits which were attempted but failed were not included in the table.

TABLE 27

REGION I: PROPORTION OF VARIATION IN EACH GROUP EXPLAINED BY EACH PREDICTOR VARIABLE[a]

Predictor	Parent Group Number[b]						
	1	2	3	4	6	11	12
Age	.023	.018	.047[c]	.011	.011	.092[d]	.060[d]
Occupation	.026[c]	.043[d]	.044	.008	.012	.042[c]	.044[c]
Education	.015	.014	.052[d]	.018[c]	.020	.008	.030
Income	.008	.010	.043	.013	.032	.024	.021
Age Range	.023	.015	.021	.017	.022	.029	.005
Horsepower	.012	.019	.011	.022[d]	.005	.014	.004
Age of SnowM.	.003	.011	.022	.015	.033[c]	.036	.033
Owner	.013	.009	.013	.009	.036[d]	.024	.038
No. of SnowM.	.034[d]	.001	.000	.001	.002	.013	.006
Years of SnowM.	.002	.007	.009	.005	.008	.012	.006
Snowfall	.005	.003	.022	.009	.018	.014	.029
Regulations	.014	.016	.006	.009	.008	.004	.006
Enforcement	.020	.020[c]	.010	.017	.012	.008	.004
Ice-fishing	.000	.002	.007	.001	.000	.003	.008
Club Member	.002	.001	.000	.007	.012	.001	.000
Preferred Grp.	.012	.016	.030	.017	.022	.035	.010
N	523	356	167	313	199	146	129
Mean	56	52	64	55	51	62	65
TSS_i/TSS_T	1.00	.674	.293	.598	.380	.247	.209

[a]Proportion of variation in group i explained by each predictor $(BSS/TSS)_i$.

[b]The group numbers correspond to those in the lower left-hand corner of the boxes in Figure 5.

[c]Predictor which contained the second largest $(BSS/TSS)_i$.

[d]Predictor on which the partition was made.

Therefore, it was primarily the shape of this predictor that was responsible for the split rather than the influence of its components in reducing the predictive error.

In the top branch, group 3 was split next in the iteration on education. This isolated a small group of high users that had less than grade 9 education. This predictor was used in an attempt to split group 15 and was the second best predictor in group 4 in the bottom branch.

Age was the last variable to be used, producing splits in groups 11 and 12 in succession.[1]

Only six of the sixteen predictor variables were used in this analysis; however, several other predictors came close to being used. Income and age of snowmobile each demonstrated potential in both branches; for example, both came close to partitioning group 6. Attitude toward enforcement of snowmobile regulations, age range of children, and preferred snowmobile groups all showed potential power in the bottom branch.

The analysis produced a reduction in the error variance (BSS/TSS) of 14.2 percent. An examination of

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[1]In discussions with J. Paul Johnston, Associate Professor of Political Science, University of Alberta, June 1974, he pointed out that when a predictor was involved in successive splits on one branch, usually it was responding to the nonlinearity present in the group on that predictor.

the final groups (see Table 28) showed that three of them still contained a large number of observations (over 100). These remained as "unexplained" groups as no predictor was capable of reducing the unexplained variance the required amount.[1]

Region II

A more complex pattern of interaction effects was observed in the results tree of Region II (see Figure 6). The initial parent group was split, as in Region I, on number of snowmobiles. This partition used up this predictor's utility in both branches (see Table 29).

Age range and snowfall, which were the second and third best predictors on the initial group, were used alternately in the next four splits. This process exhausted the utility of age range; however, snowfall was able to maintain a moderate relationship with the dependent variable in the bottom branch. Snowfall also acted, to a degree, as a proxy for geographic location, for example, those respondents from counties receiving less than seventy-five inches of snow (group 10) resided in one of the ten counties in the southeast corner of the region (see Appendix E).

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[1]Sonquist and Morgan, Detection of Interaction Effects, pp. 50-51. To reduce the error in these groups would have required: (1) lowering the reducibility criterion, or (2) introducing other predictors into the analysis, or (3) some combination of these two alternatives.

TABLE 28

REGION I: CHARACTERISTICS OF THE FINAL GROUPS CREATED IN THE AID ANALYSIS[a]

Group	Characteristics of Groups	N	Mean	SD
	Owned Two or More Snowmobiles and:			
10	Head had grade 8 or less	21	82	27
14	Head had grade 8 or less, and was under 35 years old	22	80	29
15	Head had grade 9 or more, and was 35 to 54 years old	107	62	22
13	Head had grade 9 or more, and was 55 years or older	17	37	22
	Owned One Snowmobile and:			
8	Head was not self-employed; snowmobile had less than 21 hp, and was owned by wife or daughter	13	72	30
7	Head was not self-employed, and snowmobile had 21 hp or more	114	60	29
9	Head was not self-employed; snowmobile had under 21 hp, and was owned by head or son	186	50	30
5	Head was self-employed	43	35	23
	Total Sample	523	56	31

[a]The final groups were arranged under the two main branches of the tree and in descending order of their means.

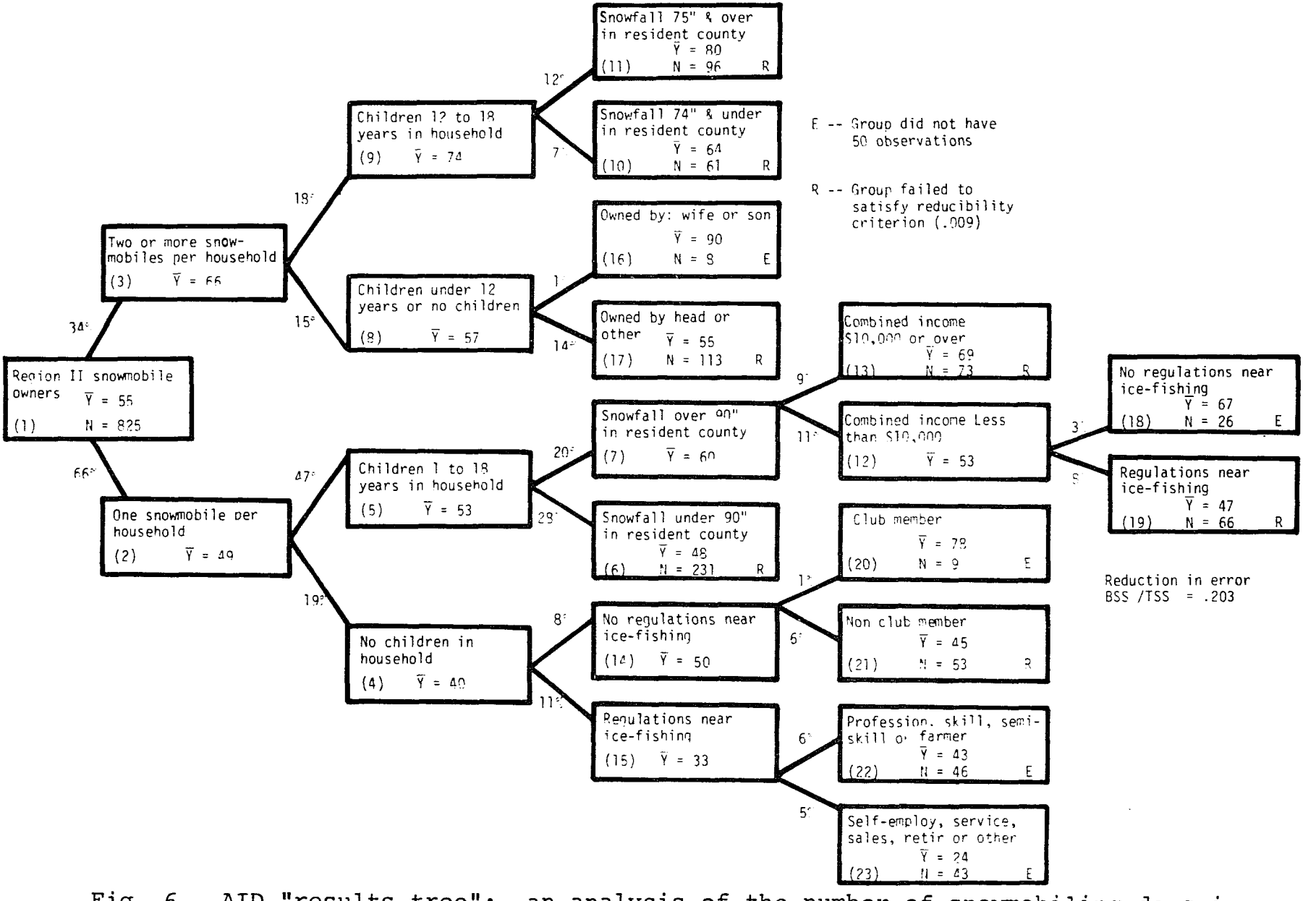

Fig. 6. AID "results tree": an analysis of the number of snowmobiling days in Region II.

TABLE 29

REGION II: PROPORTION OF VARIATION IN EACH GROUP EXPLAINED BY EACH PREDICTOR[a]

Predictor	Parent Group Number[b]										
	1	2	3	4	5	7	8	9	12	14	15
Age	.027	.030	.036	.036	.014	.016	.060[c]	.018	.033	.015	.143[c]
Occupation	.018	.024	.019	.044	.011	.030	.031	.024	.056	.121[c]	.170[d]
Education	.003	.001	.022	.002	.002	.041[c]	.016	.025	.013	.045	.016
Income	.005	.004	.026	.018	.008	.070[d]	.034	.021	.004	.088	.035
Age Range	.049[c]	.042[d]	.070[d]	.000	.006	.029	.006	.000	.019	.000	.000
Horsepower	.002	.003	.001	.038	.002	.006	.010	.004	.032	.002	.132
Age of SnowM.	.002	.013	.003	.026	.019[c]	.038	.008	.011	.061	.064	.048
Owner	.010	.007	.010	.036	.010	.015	.068[d]	.006	.020	.094	.006
No. of SnowM.	.064[d]	.002	.003	.002	.002	.000	.005	.003	.000	.000	.002
Years of SnowM.	.006	.012	.001	.014	.013	.001	.006	.001	.017	.028	.023
Snowfall	.029	.030	.033	.021	.039[d]	.007	.019	.062[d]	.024	.109	.031
Regulations	.022	.009	.039[c]	.014	.014	.019	.032	.062[c]	.022	.082	.045
Enforcement	.014	.010	.008	.045	.001	.006	.009	.006	.008	.007	.114
Ice-fishing	.021	.032[c]	.003	.089[d]	.019	.040	.021	.010	.113[d]	.000	.000
Club Member	.019	.026	.001	.083[c]	.016	.011	.020	.004	.000	.152[d]	.025
Preferred Grp.	.008	.009	.010	.041	.011	.015	.044	.010	.087[c]	.077	.063
N	825	547	278	151	396	165	121	157	92	62	89
Mean	55	49	66	40	53	60	57	74	53	50	33
TSS_i/TSS_T	1.00	.596	.340	.154	.417	.172	.136	.180	.086	.076	.065

[a]Proportion of variation in group i explained by each predictor $(BSS/TSS)_i$.

[b]The group numbers correspond to those used in Figure 6.

[c]Predictor which contained the second largest $(BSS/TSS)_i$.

[d]Predictor on which the partition was made.

Group 7 was partitioned on income; $10,000 acting as the cutting point. This predictor also exhibited potential utility on group 3 of the top branch.

Attitude toward regulations near ice-fishing was used next to split group 4. Respondents who were opposed to the establishment of regulations limiting snowmobile activity near ice-fishing did more snowmobiling. This predictor was also used later to split group 12, but was never useful in the top branch.

The ownership variable came forth again, as it did in Region I, to produce a spurious split (for the same reasons as stated above) on group 8. Age, which was not used in Region II, was a close second-best in this situation and was also used in an attempt to split group 17. Age also demonstrated potential power in splitting the groups on which age range was used.

Membership in a snowmobile club only exhibited power in the bottom branch, finally being used to split group 14. Being a club member was associated with high snowmobile use.

Even though occupation was the last predictor to be used, splitting group 15, it exhibited potential utility throughout the tree. If the reducibility criterion had been set at a lower level then this variable would have been used to split groups 13 and 16.

The analysis reduced the amount of variation by 20.3 percent. Of the twelve final groups only two were considered to be very large (see Table 30).

Region III

In Region III, as in the other regions, the initial parent group was split on number of snowmobiles (see Figure 7).[1] However, in this region, this predictor did exhibit some power in the later stages of the tree (see Table 31).

The predictors, age and occupation, demonstrated greater utility in this region, as both were used to split groups on three occasions throughout the analysis and showed strength in two other instances. As an indication of a high degree of interaction, their mode of operation was different in each instance.

Snowfall, as in Region II, was a powerful predictor, being used twice to split groups, showing strength on two other occasions and was selected twice to attempt splits on final groups (groups 16 and 22). However, the interaction picture was not clear as on the two occasions in which it was used the split occurred at the same point, but no information was available from the analysis as to its manner of operation in the other

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[1]Group 2, one snowmobile households, also included eight households in which the owners had disposed of their snowmobile.

TABLE 30

REGION II: CHARACTERISTICS OF THE FINAL GROUPS CREATED IN THE AID ANALYSIS[a]

Group	Characteristics of Groups	N	Mean	SD
	Owned Two or More Snowmobiles and:			
16	Household had children under 12 years old or no children, and first reported snowmobile owned by wife or son	8	90	18
11	Household had children 12 to 18 years old, and county received 75 inches or more of snow	96	80	29
10	Household had children 12 to 18 years old, and county received less than 75 inches of snow	61	64	32
17	Household had children under 12 years old or no children	113	55	16
	Owned One Snowmobile and:			
20	Household had no children; respondent was opposed to regulations near ice-fishing, and was a member of a snowmobile club	9	78	25
13	Household had children 1 to 18 years old; county received 90 inches or more of snow, and household earned $10,000 or more	73	69	29
18	Household had children 1 to 18 years old; county received 90 inches or more of snow; household earned less than $10,000, and respondent was opposed to regulations near ice-fishing	26	67	28
6	Household had children 1 to 18 years old; and county received under 90 inches of snow	231	48	29

TABLE 30--Continued

Group	Characteristics of Groups	N	Mean	SD
	Owned One Snowmobile and:			
19	Household had children 1 to 18 years old; county received 90 inches or more of snow; household earned under $10,000, and respondent favored regulations near ice-fishing	66	47	25
21	Household had no children; respondent opposed regulation near ice-fishing, and did not belong to a snowmobile club	53	45	30
22	Household had no children; respondent favored regulations near ice-fishing, and head was a professional, skilled, semi-skilled or farmer	46	43	25
23	Household had no children; respondent favored regulations near ice-fishing, and head was self-employed, clerical/sales or retired	43	24	17
	Total Sample	825	55	31

[a]The final groups were arranged under the two main branches of the tree and in descending order of their means.

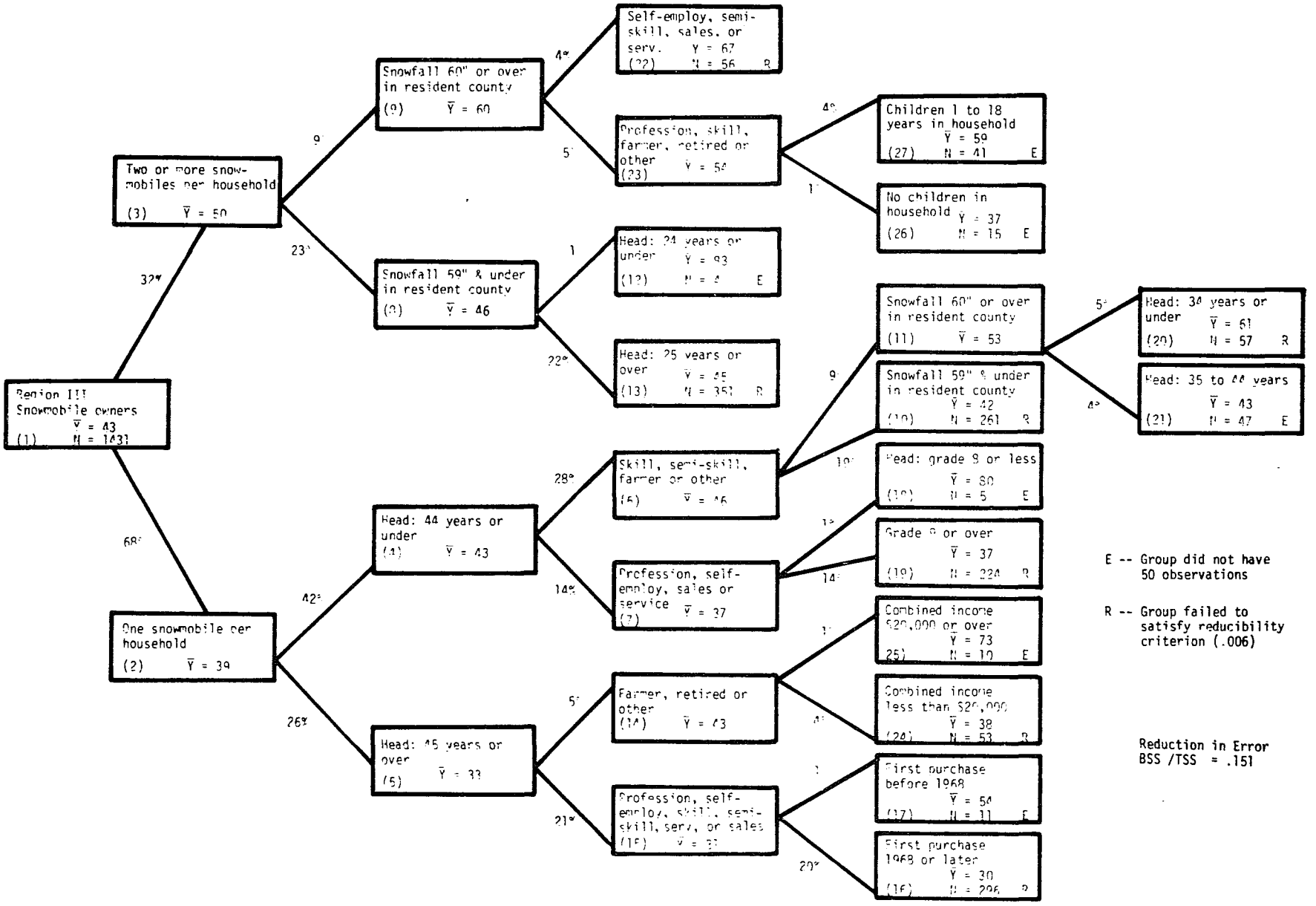

Fig. 7. AID "results tree": an analysis of the number of snowmobiling days in Region III.

TABLE 31

REGION III: PROPORTION OF VARIATION IN EACH GROUP EXPLAINED BY EACH PREDICTOR[a]

Predictor	Parent Group Number[b]													
	1	2	3	4	5	6	7	8	9	10	11	14	15	23
Age	.026[c]	.035[d]	.013	.013	.008	.017	.020	.029[d]	.033	.002	.102[d]	.009	.011	.114[c]
Occupation	.009	.022	.015	.023[d]	.040[d]	.005	.003	.015[c]	.081[d]	.010	.011	.013	.009	.055
Education	.004	.004	.012	.003	.005	.001	.054[d]	.007	.007	.005	.019	.021	.006	.033
Income	.003	.005	.012	.009	.008	.005	.032[c]	.003	.066	.002	.012	.202[d]	.005	.081
Age Range	.014	.011	.016[c]	.003	.006	.001	.001	.004	.068[c]	.003	.023	.035	.001	.178[d]
Horsepower	.004	.009	.005	.008	.009	.013	.007	.004	.022	.021[c]	.044[c]	.027	.007	.056
Age of SnowM.	.001	.004	.006	.002	.004	.003	.011	.013	.002	.006	.015	.012	.006	.022
Owner	.007	.002	.012	.003	.003	.005	.014	.013	.059	.002	.008	.024	.010	.068
No. of SnowM.	.034[d]	.001	.015	.003	.000	.004	.003	.007	.037	.002	.022	.000	.000	.105
Years of SnowM.	.003	.005	.003	.004	.033	.010	.001	.003	.008	.017	.003	.021	.049[d]	.022
Snowfall	.022	.015	.063[d]	.013	.027	.036[d]	.008	.001	.012	.000	.004	.015	.031	.014
Regulations	.005	.003	.006	.004	.004	.003	.016	.006	.019	.013	.032	.183[c]	.017	.024
Enforcement	.001	.004	.002	.001	.018	.010	.021	.004	.008	.011	.025	.014	.018	.024
Ice-fishing	.002	.006	.000	.002	.021	.000	.006	.001	.001	.001	.015	.023	.022	.004
Club Member	.008	.013	.000	.010	.017	.006	.012	.004	.019	.002	.026	.004	.022	.037
Preferred Grp.	.021	.032[c]	.005	.023[c]	.035[c]	.023[c]	.030	.012	.022	.042[d]	.044	.093	.039[c]	.029
N	1431	964	467	594	370	365	229	355	112	261	104	63	307	56
Mean	31	39	50	43	33	46	38	46	60	42	53	43	31	54
TSS_i/TSS_T	1.00	.659	.307	.434	.202	.299	.125	.213	.075	.187	.101	.052	.142	.034

[a]Proportion of variation in group i explained by each predictor $(BSS/TSS)_i$.

[b]The group numbers correspond to those used in Figure 7.

[c]Predictor which contained the second largest $(BSS/TSS)_i$.

[d]Predictor on which the partition was made.

demonstrations of power. It was observed that 73 percent of the total number of respondents resided in counties receiving less than sixty inches of snowfall.

Three other variables, age range, education, and income, were used once and were second-best on one other occasion. The number of years a respondent had been snowmobiling was introduced for the first time; it was used once and was third-best on another occasion.

The preferred group predictor was of special interest. It produced a split on group 10 but was deleted from the tree due to its spurious nature. Not only was it a free predictor but it also contained a large number of classes, several of which overlapped.

The analysis reduced the predictive error by 15.2 percent. An examination of the final groups (see Table 32) pointed out that four contained a large number of observations.

Summary

In each analysis the selected predictor variables explained a relatively small proportion of the variation (20% or less). The presence, in each analysis, of a number of large final groups which still contained a large amount of variation (unexplainable groups) indicated that either additional variables were needed or

TABLE 32

REGION III: CHARACTERISTICS OF THE FINAL GROUPS CREATED IN THE AID ANALYSIS[a]

Group	Characteristics of Groups	N	Mean	SD
	Owned Two or More Snowmobiles and:			
12	County received under 60 inches of snow, and respondent was under 25 years old	4	83	14
22	County received over 60 inches of snow, and head was self-employed, semi-skilled or clerical/sales	56	67	24
27	County received over 60 inches of snow; head was professional, skilled, farmer or other, and household had children 1 to 18 years old	41	59	22
13	County received under 60 inches of snow, and head was 25 years old or over	351	45	25
26	County received over 60 inches of snow; head was professional, skilled, farmer or other, and household had no children	15	37	12
	Owned One Snowmobile and:			
18	Head was under 45 years old; a professional, clerical/sales or self-employed, and had grade 8 or less	5	80	31
25	Head was 45 years or over, a farmer, retired or other, and household earned $20,000 or more	10	73	33
20	Head was under 35 years, a skilled, semi-skilled, farmer or other, and county received 60 inches or more of snow	57	61	28

TABLE 32--Continued

Group	Characteristics of Groups	N	Mean	SD
	Owned One Snowmobile and:			
17	Head was 45 years or over; a professional, skilled, semi-skilled, clerical/sales or self-employed, and started snowmobiling before 1968	11	54	26
21	Head was 35 to 44 years old; a skilled, semi-skilled, farmer or other, and the county received 60 inches or more of snow	47	43	23
10	Head was under 45 years; a skilled, semi-skilled, farmer or other, and county received under 60 inches of snow	261	42	26
24	Head was 45 years or over; a farmer, retired or other, and household earned under $20,000	53	38	22
19	Head was under 45 years; a professional, clerical/sales or self-employed, and had grade 9 or more	224	37	24
16	Head was 45 years or over; a professional, skilled, semi-skilled, clerical/sales or self-employed, and started snowmobiling in 1968 or later	296	30	21
	Total Sample	1431	43	26

[a]The final groups were arranged under the two main branches of the tree and in descending order of their means.

the present ones should be restructured in order to reduce the predictive error.[1]

The nonsymmetry exhibited by the three trees implied that interaction effects were present, that is, effects of a combination of factors. In other words, when a predictor was used in one trunk of the tree and did not exhibit actual or potential utility in the other branch, then this indicated that there was an interaction effect present between that predictor and those used in the preceding splits.[2] Also, as pointed out above, when a variable was partitioned in a different manner in one branch compared to another, it was usually responding to the nonlinearity present in that group on that predictor. Only in the case of the variable "snowfall" in the analysis of Region III was it observed that a predictor behaved in the same manner in both trunks of a tree.

Where only one predictor showed up as being important in producing a split, then it was unlikely that its predictive power was a result of sampling variability. However, when several predictors displayed similar strength in their ability to partition a group then the chances were greater that the choice of one

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[1]Sonquist and Morgan, Detection of Interaction Effects, pp. 110-13.

[2]Ibid.

over another was due to sampling variability.[1] For example, in Region II "age of household head" was second best on two occasions but was never used to split a group.

Interaction effects between predictor variables is a complex phenomenon and its assessment requires considerable information about the variables concerned. In order to gain greater insight into these effects, it would be useful to obtain additional information, such as: (1) the distribution of the variables in the parent groups, particularly since variables may become skewed in the partitioning process and (2) the frequency distribution of the residuals to provide information about the extent that one variable substitutes for another.

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[1]Ibid., pp. 124-25.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Context of the Study

At the time this study was conducted, snowmobiling was still a relatively new recreation activity. It was not until the late 1960's that it began to gain widespread popularity in Michigan. Initially, it gathered adherents in the Upper Peninsula and then spread south into the more urban regions.

The state of Michigan has several characteristics that present special problems for recreation land management agencies. In particular, the concentration of two-thirds of the population in the southeast corner of the state while the great majority of public recreation lands are in the north and west portions of the state places great pressure on the state parks and recreation areas near the densely populated urban areas. The task of providing recreation resources for snowmobiling is further complicated by the shortage of snowfall in the southeast portion.

This study has three major thrusts. The first is concerned with the methods of selecting data for a study

of this magnitude about snowmobiling. Since no studies of this nature had been conducted it was considered important to examine the methods that were selected for this study. The second is to determine, on a broad base, the use patterns and user characteristics of registered snowmobile owners in the state of Michigan. The third is to consider the implications for decision-making that the results have for planning and management agencies.

When this study was conceived it was decided to conduct it on a state-wide basis. In order to improve measurement precision, the state was stratified by the three major geographical regions, as discussed earlier.

The boundaries of these regions also coincided with the major divisions used by the Department of Natural Resources in planning and managing the state's resources. However, these regions are not homogeneous in some of their characteristics, such as: degree of urbanization, amount of snowfall, available public land for snowmobiling, etc. Because of this situation the results are not as useful for on-site planning and management as they are for state-wide recreation planning.

Recommendation.--In subsequent studies of snowmobilers it is recommended that the spatial units used for collecting and analyzing data should be more homogeneous in terms of the variables being investigated.

Data analyzed on this basis should provide greater insights into the use patterns and user characteristics which would assist in the management of the resource base.

Study Methods

Response rate.--A problem frequently encountered with self-administered questionnaires is low response. In this study it was demonstrated that a high response rate may be obtained by giving attention to details, such as: (1) obtaining sponsorship that is acceptable to the respondent, (2) carefully describing the nature of the project, using explanatory letters, (3) sending reminders to nonrespondents when the initial response rate begins to diminish, (4) mailing a second questionnaire to non-respondents as soon as the response to reminder cards drops off, and (5) designing a questionnaire that is attractive and appears to require a short time to complete.

Attitude scales.--Respondents in this study were asked to respond to two types of attitude scales: (1) one that provided a range of responses including a neutral response and (2) one which only offered a dichotomous choice. It was of interest to note that where the opportunity for a neutral response was provided, over 50 percent of the respondents chose such a response. This behavior would seem to imply that if respondents were

not given this choice then the response rate would diminish considerably. However, this was not the case in this study, as there was only a slight drop in response when respondents were only given an opportunity to answer "yes" or "no." Therefore, the best solution would appear to be that of offering respondents some range to express their opinion but to eliminate the choice of a neutral response.

Measurement of time.--In this study, time spent snowmobiling was measured in "days" where any part of a day was counted as one day. This method has been used frequently in recreation surveys; however, it does present some problems in terms of precision. For example, those that went snowmobiling for many hours per day would be represented by the same number of days as those who had only spent a few hours per day on this activity. It also resulted in double counting in some instances, such as: reporting use of three classes of land used in one day would be reported as three days. Some improvement in measurement of time would be desirable.

Recommendation.--In subsequent studies of snowmobile use it is recommended that the use of "day" as a unit of measurement be refined. In addition to reporting the number of snowmobiling days the respondent should be requested to estimate the average number of hours per day

that he devotes to snowmobiling and, also, to consider the proportion of time spent on each component of the variable being studied (for example, estimation of the proportion of time spent on each kind of snowmobile activity, such as: trail riding, scrambling, etc.). The use of such techniques, if thoroughly field tested, should provide more precise estimates of the amount of time spent on various snowmobile uses.

Estimation of socio-economic variables.--In this study, some difficulty was experienced in estimating the socio-economic characteristics of snowmobile owners since much of the information collected was for heads of households. Eighty-seven percent of the respondents in this study were heads of households so that the socio-economic data collected may not have been exactly the same as information for the snowmobile owners.

Recommendation.--It is recommended that in future studies of snowmobile owners the socio-economic data be collected for owners rather than heads of households. This would enable the researcher to more accurately describe such respondents.

Detection of interaction effects.--The Automatic Interaction Detector (AID) technique was used in the analysis phase to determine the presence of interaction

effects among the independent variables (the dependent variable was "number of snowmobiling days").

The socio-economic variables, in particular, "occupation" and "age" of head of household, demonstrated power as "predictors" of the amount of snowmobiling undertaken, when they were used in the AID analyses.[1] The variable "number of snowmobiles owned" by each household explained the largest proportion of variation in the dependent variable compared to all other predictor variables used. However, it is suggested that much of the power exhibited by this predictor was due to its action as a proxy variable for "income." In other words, the strength of income as a predictor of snowmobile use may have been much stronger than the analyses indicated.

The number of socio-economic variables used in each of the AID analyses varied from three, in Regions I and II, to all five in Region III. The results of the algorithm indicated that interaction effects were present in a number of groupings of these variables. However, the nature and extent of these interaction effects was not determined, therefore, their roles as predictors could not be assessed accurately.

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[1]The power of predictor variable for each parent group is the proportion of variation (BSS_i/TSS) in the dependent variable that the predictor contains for that group. (As explained earlier, the term "predictor" is not used here in terms of developing a functional equation.)

Recommendation.--It is recommended that in future studies the nature and extent of the interaction between predictor variables should be determined. In order to accomplish this, the correlations between the variables of interest should be established. After the "parent groups" have been produced by the AID algorithm, profiles for the predictor variables across the dependent variable should be developed for each of these groups. An examination of the shape of these distributions along with correlation information will enable the researcher to understand the nature of the interaction effects that are present.

User Characteristics

Age level of head of household.--The heads of snowmobile-owning households in Region I were older, having a mean age of 44.4 years compared to 42.6 years and 41.7 years in Regions II and III, respectively. These patterns between the three regions were similar to those found in the general population. Fifty-nine percent of the heads of snowmobile-owning households in the state were between 35 and 54 years of age, whereas in the general population this age group only made up 34 percent of the population. Compared to the percentage of those 20-24 years old in the general population, the proportion of heads of snowmobile-owning households who were 25 years and under was much smaller.

As was expected, only a small percentage of the general population in the 65 years and over category owned snowmobiles.

Educational level of head of household.--For the state as a whole, 70 percent of the heads of snowmobile-owning households had completed high school. Those in Region III had completed more years of education than the heads from the other two regions: this pattern was similar to that found in the general population. The proportion of heads of snowmobile-owning households that went beyond high school was three times as great in the samples from Regions II and III as it was in the general population. In Region I it was four times as large.

Income of household.--There were marked differences between the combined gross income of snowmobile-owning households in each of the three regions. In addition, the incomes of snowmobile-owning households were considerably higher than those found in the general population. The observed differences (from $10,900 to $15,200) may have reflected, at least in part, the disparities in the cost of snowmobiling in each of the regions. In other words, since it cost more to go snowmobiling in Region III, due to increased travel costs, etc., the activity tended to be restricted to members of households having higher incomes.

A much smaller proportion of the general population in Region III owned snowmobiles compared to the other regions. This may have been due to the presence of a greater variety of recreational opportunities in the urban centers as well as less public land and poorer snow conditions.

It is of interest, from a management perspective, to note that snowmobilers in Region III are relatively affluent, as 40 percent of the snowmobile-owning households earned $15,000 or more. Therefore, many of them are financially able to pay more than a nominal fee to gain access to land for snowmobiling. This suggests that it would be useful to examine the respective roles of public and private agencies in providing land resources for snowmobiling.

Occupation of head of household.--The observed regional differences in occupation patterns and region were of a more complex nature. A large percentage of heads of snowmobile-owning households in each region were self-employed persons and managers. In comparison, a small proportion of those persons employed in clerical, sales, service, and unskilled positions were respondent household heads. These differences appear to reflect the close relationship between these occupations and income.

The professional, skilled, semi-skilled, and farm management occupations did not exhibit consistent patterns from region to region. For example, in Regions I and II, a larger proportion of heads of snowmobile-owning households was skilled persons than in the general population; however, this relationship was reversed in Region III. It appeared that there was considerable interaction between these components of the occupation variable and other factors, such as income.

Size of household.--A statistically significant difference was obtained in the number of children per household, 18 years old and under, in each of the regions. From the point of view of a management agency, these differences do not appear meaningful. Respondent households of the state had an overall average of 1.8 children. However, only 71 percent of the households reported having children 18 years old and under: the average for these households was 2.5 children.

Patterns of Use

Amount of snowmobile use.--Snowmobile owners in Regions I and II spent a significantly greater number of days snowmobiling than did respondents from Region III (an average of 56 and 54 days compared to 42 days, respectively). However, since there were 1.3 times as many registered snowmobiles in Region III than in

the other two regions combined, the Region III snowmobilers generated 50 percent of the total number of snowmobiling days for the state as a whole. Twenty-eight percent of the days originating in Region III was spent outside of this region, mainly in Region II (see Table 25). While Region III experienced an outflow of snowmobiling activity, Region II received an inflow of approximately the same magnitude.

This inflow of snowmobilers should have considerable economic impact on the region and, more particularly, on principal destination counties such as Roscommon County. That county provided a total of 222,000 snowmobile days in the 1969-70 season representing a 188 percent increase over the 77,000 days generated by its residents. The expanded data, which only provided rough estimates at the county level, did suggest that the snowmobile use varied greatly from county to county. The reasons for this in each case was not evident; however, such information would be useful to planners and to managers of resources used for snowmobiling.

Classes of land used.--In examining the classes of land used for snowmobiling, it was found that respondents in Regions II and III spent 30 percent of their snowmobiling time on their own land. It is of interest that this proportion was so high for snowmobilers in Region III, many of whom reside in cities. The conclusion would

appear to be that snowmobilers in this region who lived in a rural setting tend to do most of their snowmobiling on their own land; however, this needs further study. Respondents throughout the state reported a majority (54%) of their time was spent on nonpublic land ("owners land" and "private land"), with only 42 percent on land owned by county, state, and federal governments (including reported use of "local roads").[1] Since the activity on nonpublic land constituted such a large portion of total snowmobile use, it is important for management and planning agencies to determine if it is of a different nature than the use of public lands and, if so, what is the relationship between the two use patterns?

Snowmobiling and associated activities.--Snowmobilers spent a greater proportion of their time (58%) trail riding compared to scrambling in open areas (31%). It would be of interest from a management point of view to know to what extent these different proportions reflected the users' preferences rather than the opportunities available to them. It was noted that respondents from Region III spent 7 percent more time scrambling than those from the other regions, but it was not determined if this was related to: (1) their greater use of

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[1] Respondents indicated that only 0.4 percent of their time was spent snowmobiling on privately owned land for which a fee was charged.

privately owned land, (2) the lighter snow cover, which is more conducive to scrambling than deep snow, or (3) a greater preference for scrambling by those from an urban region.

The study showed that the recreation activity of snowmobiling involved more than just "snowmobiling." Twenty-four percent of snowmobile activity was closely associated with a number of other recreation activities.[1] Not only were snowmobiles used on hunting and fishing trips, where snowmobiling may have played a secondary role, but they were also involved in "outings" in which members of the household participated in such activities as skiing, tobaggoning, and cook-outs. This implies that, in many cases, the area chosen for snowmobiling is influenced by the opportunities for household members to participate in one or more of these associated activities. Therefore, management may be able to influence the amount of snowmobile use an area will receive, by either encouraging or curtailing participation in other recreation activities. The social nature of snowmobiling was also indicated by a majority of respondents stating that they preferred to snowmobile with their family or friends; only 5 percent preferred to go snowmobiling alone.

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[1]Based on the total reported number of days spent on "associated activities" (see Table 23) compared to the total number of days spent participating in "kinds of snowmobile activity" (see Table 22).

Mobility.--Snowmobilers throughout the state appeared to have a high degree of mobility (ability to transport their snowmobiles). In particular, 68 percent of Region III snowmobilers reported that they owned a snowmobile trailer. In addition, 13 percent indicated that they owned a truck which could be used to transport their snowmobiles.

For snowmobilers in Region III, the importance of having mobility was further illustrated by 36 percent of their snowmobiling being done outside of their county of residence compared to only 12 percent for respondents in Region I and 18 percent in Region II.[1]

Much of the travel done by snowmobilers in Region III consisted of overnight trips; 39 percent of them reported taking an average of seven trips of over 100 miles from home involving two or three nights away from their residence. Snowmobilers in Region I were more inclined to take short trips; 21 percent reported taking an average of six overnight trips of less than 100 miles. However, respondents in Region II did not appear to travel extensively, as no more than 10 percent of them reported taking any one class of trip.

This mobility and apparent willingness of many snowmobilers in Region III to travel considerable

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[1]As was noted above, 28 percent of the snowmobiling days originating in Region III was spent in the other two regions.

distances indicates that they not only respond to changing snow conditions but also exercise considerable selectivity in choosing sites for snowmobiling. However, for this kind of information to be useful to planners and managers, it should be based on much smaller geographical units.

Recommendation.--It is recommended that high priority be given to the study of snowmobiling in the Lower Peninsula, in particular, those areas that contain heavily used resources and those areas where large numbers of snowmobilers' residences are concentrated. In such a study, the variables that should be given primary consideration are: (1) number of days for which there is a specified minimum number of inches of snow cover (which should provide a better indication of the snowmobiling potential of the area than does average snowfall), (2) classes of land used, including private lands, (3) types of activities pursued, (4) preferences of users in terms of the resources and facilities, and (5) travel patterns of snowmobilers.

Implications for Planning and Management

Need to examine changing behavior.--We are living in an era of rapidly changing behavior patterns. This phenomenon is readily observed in outdoor recreation where both new and old activities experience periods of

rapid growth followed by plateaus in participation (for example, snowmobiling and cross country skiing). Such changes in recreation behavior frequently impose pressures to change existing policies and management procedures. However, according to Chubb, there are only a few studies that appear to have the detection of change as a major goal.[1] Apparently, many agencies view research primarily as a tool to help solve immediate problems--from improving management of existing resources and facilities to justifying continued financial support. In such a changing society it is very likely that such myopic studies will be out of date by the time they are completed. In addition to many studies being designed for a single purpose, the problem of examining change, as Chubb goes on to point out, is further complicated by study designs being changed from one study to another to such an extent that comparisons of data are impossible.[2] Such a situation makes it difficult to determine trends in behavior.

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[1]Michael Chubb, "Recreation Behavior Studies: Emperical Indicators of Change" (paper presented at the National Research Symposium on Indicators of Change in the Recreation Environment, Pennsylvania State University, University Park, Pennsylvania, July 9, 1974), p. 10.

[2]Ibid., p. 12.

Recommendation.--It is recommended that new snowmobile studies be conducted in order to determine trends in snowmobiling behavior. In order to accomplish this task, such investigations should use some or all of the variables (with comparable structures) used in this study. These trends could then be compared to other known trends in recreation and provide land management agencies with a clearer indication of possible future changes in recreation desires and behavior.

Need to forecast behavior.--In order to plan more effectively for the future, it is important for planners to be able to forecast use patterns from a knowledge of other variables, such as user characteristics, snowfall patterns, etc. Not only would this kind of information facilitate long-range planning, but it would enable agencies to anticipate changes in use patterns that effect their management programs.

Recommendation.--It is strongly recommended that a study be undertaken to establish the functional relationship between selected user and resource characteristics and the use patterns of snowmobilers. It is suggested that the AID algorithm be used to determine the nature of the interaction effects between the selected independent variables. Once these relationships have been established, an appropriate multiple regression

model that will accommodate these interaction effects should be developed to determine the set of variables that best predict snowmobile use.

Application of Recreation Research Generally

Life style of users.--Studying and determining the behavior patterns of participants in a particular activity, or even in several, can provide very useful information. However, according to Chappelle, in order to gain an understanding of the recreation phenomenon we need to broaden our scope and examine the total process.[1] In other words, we need study the life styles of various user groups and then to assess the place that a particular outdoor activity plays in these life styles.

If, as researchers we can reach the point where we have achieved significant insights into the role that outdoor recreation occupies, or the "needs" that it attempts to satisfy, then we will be much closer to being able to deal intelligently with the whole aspect of land use priorities and selection of alternative activities. For example, it would be useful to know if it is the outdoor environment or the social aspects or

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[1]Daniel E. Chappelle, "The Need for Outdoor Recreation: An Economic Conundrum?" Journal of Leisure Research, 5 (Fall 1973): 52.

some combination of both that is meeting these needs. It is very possible that many activities have a fairly low priority rating in some users' life styles, and, if forced to make a choice either of an economic or of an activity nature, would reject that activity as only a "frill" in his life style.

Recommendation.--It is recommended that serious consideration be given to the development of research studies that will examine the life styles of outdoor recreators. It is further suggested that such an endeavor be conceived and designed in cooperation with other fields concerned with human behavior such as psychology, sociology, and economics.

Underlying values.--It frequently appears that when agencies decide upon an area of concern to be examined scientifically, they fail to ask a fundamental question such as: are they responsible for providing for such an activity and, if so, to what extent. Often, they seem to be responding to public and political pressures. Chappelle, in questioning the need for recreation, states that: " . . . while many recreation professionals appear to regard availability of recreational experience as an inherent right of all citizens, they seem also to be relatively unconcerned with providing

all citizens equal opportunities to experience recreation."[1] In addition, professionals are frequently heard to expound on their mandate to protect the resources under their jurisdiction, yet they appear to encourage, or at least permit, environmentally damaging motorized recreation activities within their boundaries. Is this attitude primarily one of responding to the vocal and affluent segment of society so that their operation will run more smoothly?

These questions are not easily answered given the nature of the political decision-making process. Planners and managers are not the only ones who should consider these problems. Researchers must also ask themselves these questions throughout their work. As our natural resources become scarcer and if participation in outdoor recreation continues to increase, then these are questions that should be the concern of all those involved with recreation.

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[1]Ibid., p. 51.

APPENDICES

APPENDIX A

QUESTIONNAIRE LETTER OF TRANSMITTAL AND MAP

APPENDIX A

MICHIGAN STATE UNIVERSITY EAST LANSING · MICHIGAN 48823

DEPARTMENT OF PARK AND RECREATION RESOURCES · NATURAL RESOURCES BUILDING

Dear Snowmobiler:

Now that the snowmobile season is over we would like to ask for a few minutes of your time to answer some questions concerning where and how much you used your snowmobile during the past season.

We are conducting a survey of snowmobile use in Michigan in cooperation with the Michigan Department of Natural Resources. The purpose of the study is to learn more about how snowmobiles are used and the characteristics and opinions of the users. This information will help us forecast the future growth of snowmobiling and facilitate the planning and development of special areas to meet the growing needs of Michigan snowmobile operators.

Your name was selected at random from a list of all registered snowmobile owners in Michigan. We assure you that your answers will be held in strictest confidence. They will only be used with all other replies to show the patterns of snowmobiling and the opinions of snowmobilers in Michigan. Please assist us in carrying out this survey by completing the enclosed questionnaire, it should only take 15 to 20 minutes of your time.

Sincerely,

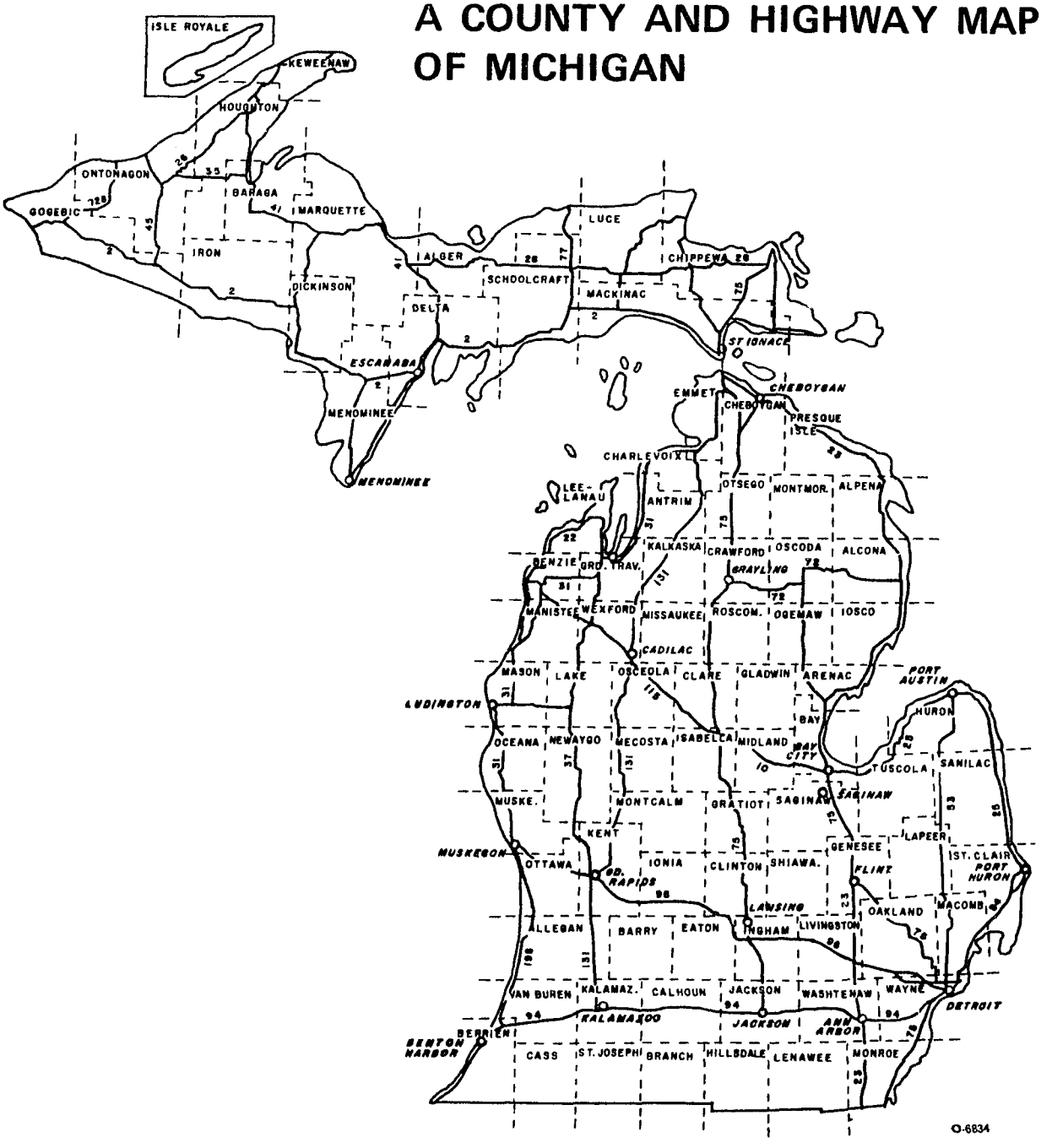
Michael Chubb, Director
Recreation Research & Planning Unit

Norman F. Smith, Chief
Recreation Resource Planning Division
Michigan Department of Natural Resources

MC:sjh

FOR YOUR ASSISTANCE:

A COUNTY AND HIGHWAY MAP OF MICHIGAN



APPENDIX B

REMINDER CARD

APPENDIX B

Dear Snowmobiler:

This is a reminder about the SNOWMOBILE questionnaire which was mailed to you recently. We have been receiving completed questionnaires from other snowmobile owners but at our last check yours was not among them. We realize that the questionnaire does take some time and effort to fill out. However it is important that we receive your reply, not only for this study but also for planning future snowmobile facilities.

Please send us your completed questionnaire!

Thank you,

Michigan Department of Natural Resources
Michigan State University

APPENDIX C

REVISED LETTER OF TRANSMITTAL

APPENDIX C

MICHIGAN STATE UNIVERSITY EAST LANSING · MICHIGAN 48823

DEPARTMENT OF PARK AND RECREATION RESOURCES · NATURAL RESOURCES BUILDING

Dear Snowmobiler:

Several weeks ago we mailed to you a SNOWMOBILE questionnaire, asking for information about how you used your snowmobile during the past season. So far we have not heard from you.

In case the questionnaire has gone astray, we have enclosed another which we hope you will complete and return as soon as possible. This survey is rapidly coming to a close and it is important that your information be included in the survey results, so that a more accurate picture of Michigan snowmobilers may be obtained.

The information you supply will be greatly appreciated and will, of course, be treated confidentially. Would you please complete this questionnaire and return it in the envelope provided.

Sincerely,

Michael Chubb, Director
Recreation Research & Planning Unit

Norman F. Smith, Chief
Recreation Resource Planning Division
Michigan Department of Natural Resources

APPENDIX D

TELEPHONE INTERVIEW SCHEDULES FOR NONRESPONDENTS

APPENDIX D

TELEPHONE INTERVIEW
FOR
MICHIGAN SNOWMOBILE USE STUDY

SURVEY OF NON-RESPONDENTS

County of Residence_____

Phone_____or_____

Answer to call ☐

Contacted party yes ☐
no ☐ ☐ ☐

Call back at_____; _____

Interview refusal ☐
accepted ☐

Date_____; _____; _____.

Time_____; _____; _____.

No answer ☐ ☐ ☐

Busy signal ☐ ☐ ☐

Wrong No. ☐

Does not own a snowmobile ☐

Number not available ☐

INTERVIEW

Hello! May I speak to Mr. (Mrs.)_____.

My name is_____. I am phoning on behalf of Michigan Sate University and the Department of Natural Resources about the Snowmobile Questionaire that was sent to you some time ago.

(If they indicate that they have sent it in, then ----)

1. When did you mail it? Before July 8
   After July 9
2. Did you fill it out no ☐
   yes ☐ (If so --- terminate)

We are calling a number of people in your county who did not fill out a questionaire and would appreciate it if we could take about ten minutes of your time to ask you a few questions. I want to assure you that your answers will be treated confidentially.

(Reaction)_____

1. Are you the HEAD of your household? yes ☐ no ☐
   If no: What is your relationship wife ☐ son ☐ daughter ☐
   friend ☐ other ☐

2. Now, would you tell me the make, horsepower, and owner of each snowmobile owned by members of your household?

Make	Horsepower	Registered owner, eg., head, wife, son, etc.

(Interviewer comments)_____

_____

_____

3. We would like to ask some questions about the counties you used for snowmobiling.

   a) First, which county did you use the most for snowmobiling during the past winter? How many days did you go snowmobiling there? (Count part day as a whole day.)

   b) What was the county that you used the next most?
   Number of days?

   c) The county you used the third most?
   Number of days?

   d) How many days did you snowmobile in other counties?

	County of most use	County of 2nd most use	County of 3rd most use	All other county use
County Name				
No. of days used				

(Interviewer comments)_____

_____

_____

4. In what year did you buy your first snowmobile?_____

5. Now, would you tell us the kind of land you used for snowmobiling by indicating which of the following you used? (Place a check opposite the classification mentioned.) How many days did you go snowmobiling there?

Your own land	☐	____days	Private land, pay fee	☐	____days
Federal land	☐	____days	Local public roads not plowed	☐	____days
State owned land	☐	____days	City park land (including City golf courses	☐	____days
County owned land	☐	____days	Other_____ (specify)	☐	____days
Private land, no charge	☐	____days			
Lakes & rivers	☐	____days			

(Interviewer comments)_____

_____

_____

6. In order to forecast future demand for snowmobile areas in Michigan, it is necessary for us to be able to relate family characteristics to use patterns of snowmobilers. We would appreciate your answers to these questions.

a) What is the age and sex of the HEAD of your household? Age____Male____Female____

b) What is the occupation of the HEAD of your household?_____
Occupation (not organization)

c) How many grades of schooling have you completed? (Circle one).

4 5 6 7 8 9	10 11 12	13 14 15 16	17 or more
	high school	university	post grad.

d) We would like to have some idea of the total income of your household. I will read off a number of income catorgories, please stop me when I reach the right one.

under $3,000	☐	$8,000 - $9,999	☐	$20,000 - $24,999	☐
$3,000 - $5,999	☐	$10,000 - $14,999	☐	$25,000 - $29,999	☐
$6,000 - $7,999	☐	$15,000 - $19,999	☐	$30,000 and over	☐

(Interviewer comments)_____

_____

_____

7. Would you tell me which of the following activities you or members of your household took part in while using your snowmobile last season?
How many days did you spend on this activity? (Count each part day on an activity as one day.)

Scrambling in open areas and on lakes ☐ ____days

Snowmobiling to work or during your work ☐ ____days

Competive racing ☐ ____days

Trail riding and forest cruising ☐ ____days

Other_____ ☐ ____days
(specify)

(Interviewer comments)_____

_____

_____

8. We are very interested in learning what reasons you had for not filling out the questionaire. Would you care to comment? Please feel free to be quite frank.

_____

_____

_____

_____

_____

_____

_____

_____

_____

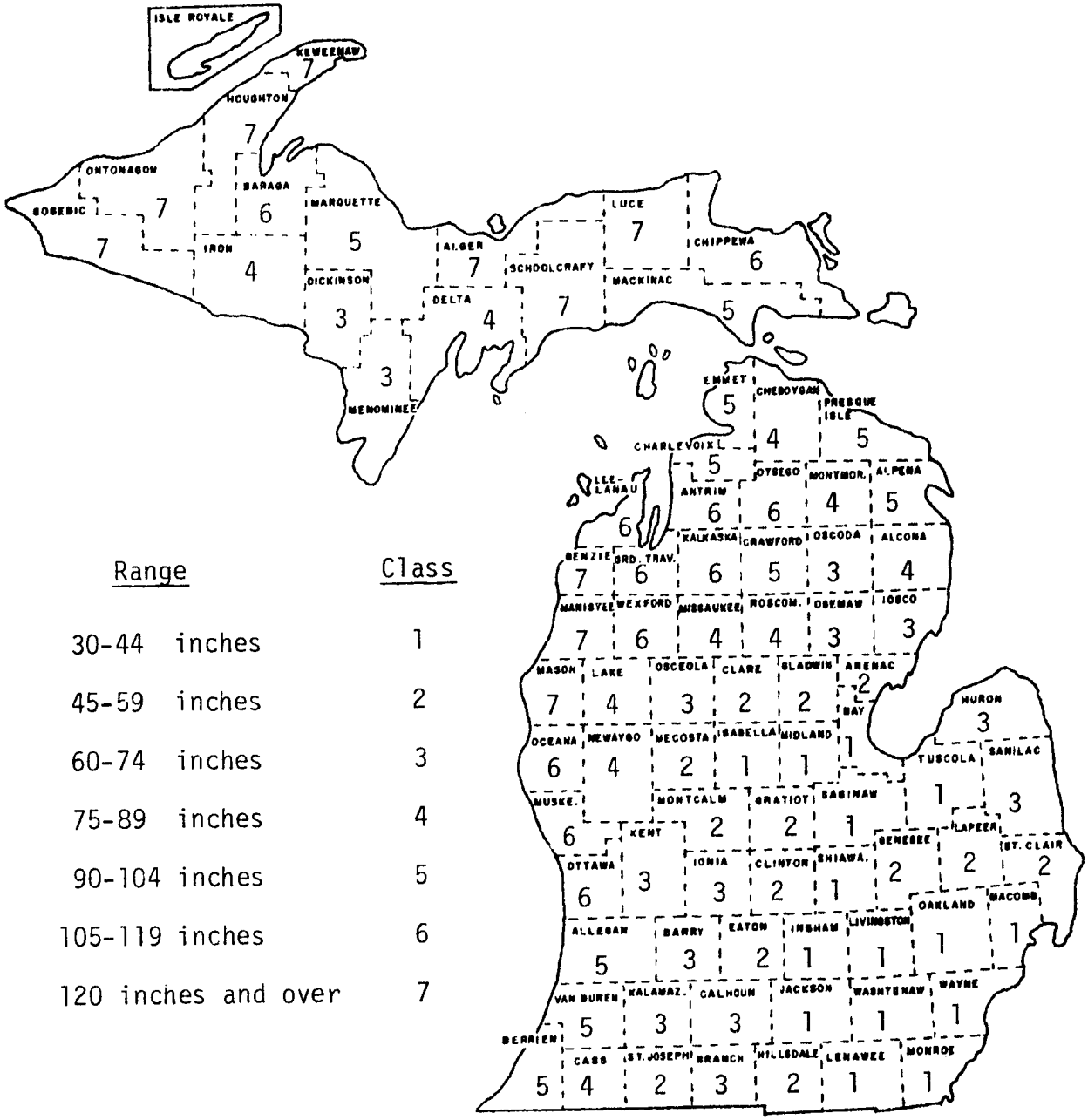
Thank you for your cooperation and assistance with this study.

APPENDIX E

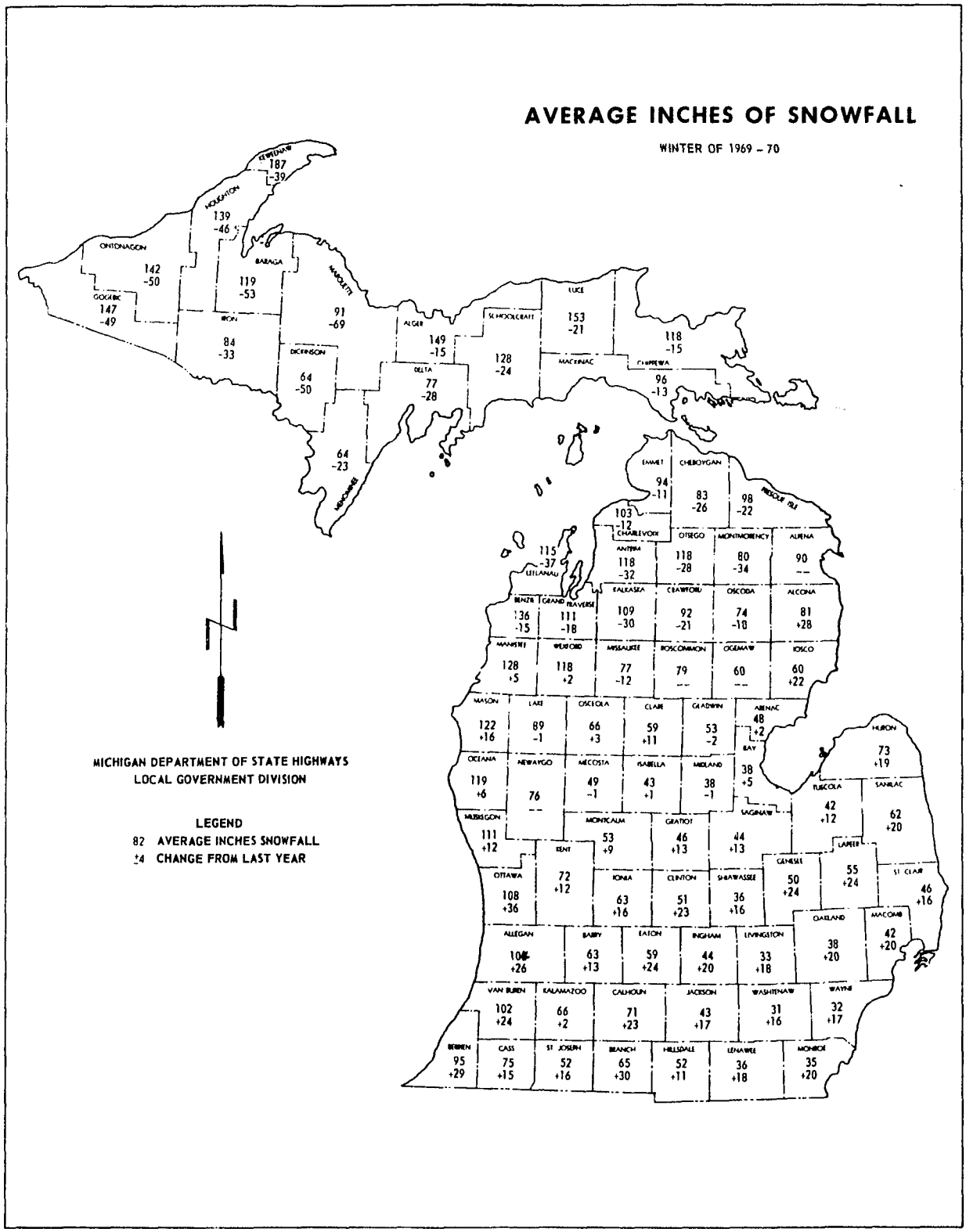
SNOWFALL INDEX AND AVERAGE INCHES OF SNOWFALL

APPENDIX E

SNOWFALL INDEX



Range	Class
30-44 inches	1
45-59 inches	2
60-74 inches	3
75-89 inches	4
90-104 inches	5
105-119 inches	6
120 inches and over	7


AVERAGE INCHES OF SNOWFALL
WINTER OF 1969 - 70
MICHIGAN DEPARTMENT OF STATE HIGHWAYS
LOCAL GOVERNMENT DIVISION
LEGEND
82 AVERAGE INCHES SNOWFALL
+4 CHANGE FROM LAST YEAR

APPENDIX F

CLASSIFICATION OF VARIABLES

APPENDIX F
TABLE 33

CLASSIFICATION OF VARIABLES

Quantitative Variables	Scale
Age of Household Head	ratio[a]
Education Level of Household Head	ratio[a]
Combined Gross Income of Household	interval[b]
Number of Children, 18 years and Under, in Household	ratio
Horsepower of Snowmobile	ratio
Year of First Snowmobile Purchase	interval
Number of Snowmobiles Owned by Household	ratio
Number of Snowmobiling Days	ratio
Number of Days on Each Class of Load	ratio
Number of Days for Each Snowmobiling Activity	ratio
Number of Days for Each Activity Associated With Snowmobiling	ratio
Number of Overnight Trips	ratio
Qualitative Variables	
Membership in Snowmobiling Clubs	nominal
Opinion Toward Present Snowmobiling Regulations	ordinal
Opinion Toward Enforcement of Snowmobiling Regulations	ordinal

Qualitative Variables	Scale
Opinion Toward the Operation of Snowmobiles by Children 14 years of Age and Under	nominal
Opinion Toward Regulations Governing Snowmobile Noise	nominal
Opinion Toward Regulations Governing Snowmobile Activity Near Ice-Fishing	nominal
Opinion Toward Allowing Snowmobiling on Public Thoroughfares	nominal

[a]The statistical analysis was calculated prior to the observations were grouped.

[b]Income information was collected in nine categories. For statistical purposes it was assumed that these were equal appearing intervals.

APPENDIX G

WEIGHTS USED IN EXPANSION OF DATA

APPENDIX G

WEIGHTS FOR 11 SUB-REGIONS.

Region I

02	Alger	35
07	Baraga	
17	Chippewa	
21	Delta	
22	Dickinson	
27	Gogebic	
31	Houghton	
36	Iron	
42	Keweenaw	35
48	Luce	
49	Mackinac	
52	Marquette -	17
55	Menominee	35
66	Ontonagon	
75	Schoolcraft	

Region II

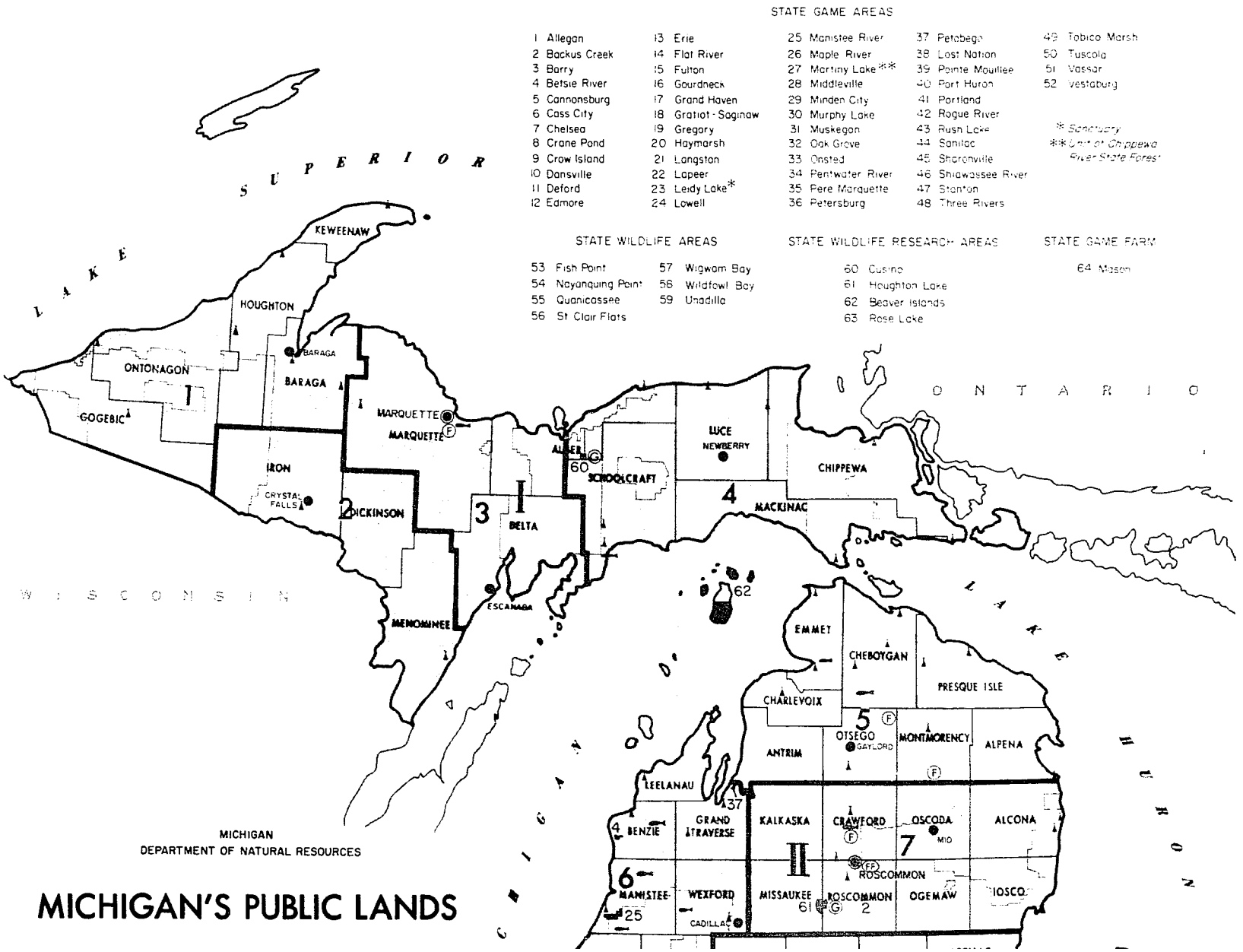
01	Alcona	41
04	Alpena	
05	Antrim	
06	Arenac	
09	Bay -	22
10	Benzie	41
15	Charlevoix	
16	Cheboygan	
18	Clare	
20	Crawford	
24	Emmet	
26	Gladwin	
28	Grand Traverse -	16
35	Iosco	41
37	Isabella	
40	Kalkaska	
43	Lake	
45	Leelanau	41
51	Manistee	
53	Mason	
54	Mecosta	
56	Midland	
57	Missaukee	
60	Montmorency	
62	Newaygo	
64	Oceana	
65	Ogemaw	
67	Osceola	
68	Oscoda	
69	Otsego	
71	Presque Isle	
72	Roscommon	
83	Wexford	

Region III

03	Allegan	56
08	Barry	
11	Barrien	
12	Branch	
13	Calhoun	
14	Cass	
19	Clinton	
23	Eaton	
25	Genesee -	36
29	Gratiot	56
30	Hillsdale	
32	Huron	
33	Ingham -	20
34	Ionia	56
38	Jackson	
39	Kalamazoo	
41	Kent -	23
44	Lapeer	56
46	Lenawee	
47	Livingston	
50	Macomb	
58	Monroe	
59	Montcalm	
61	Muskegon	
63	Oakland -	33
70	Ottawa	56
73	Saginaw	
74	Sanilac	
76	Shiawassee	
77	St. Clair	
78	St. Joseph	
79	Tuscola	
80	Van Buren	
81	Washtenaw	
82	Wayne -	25

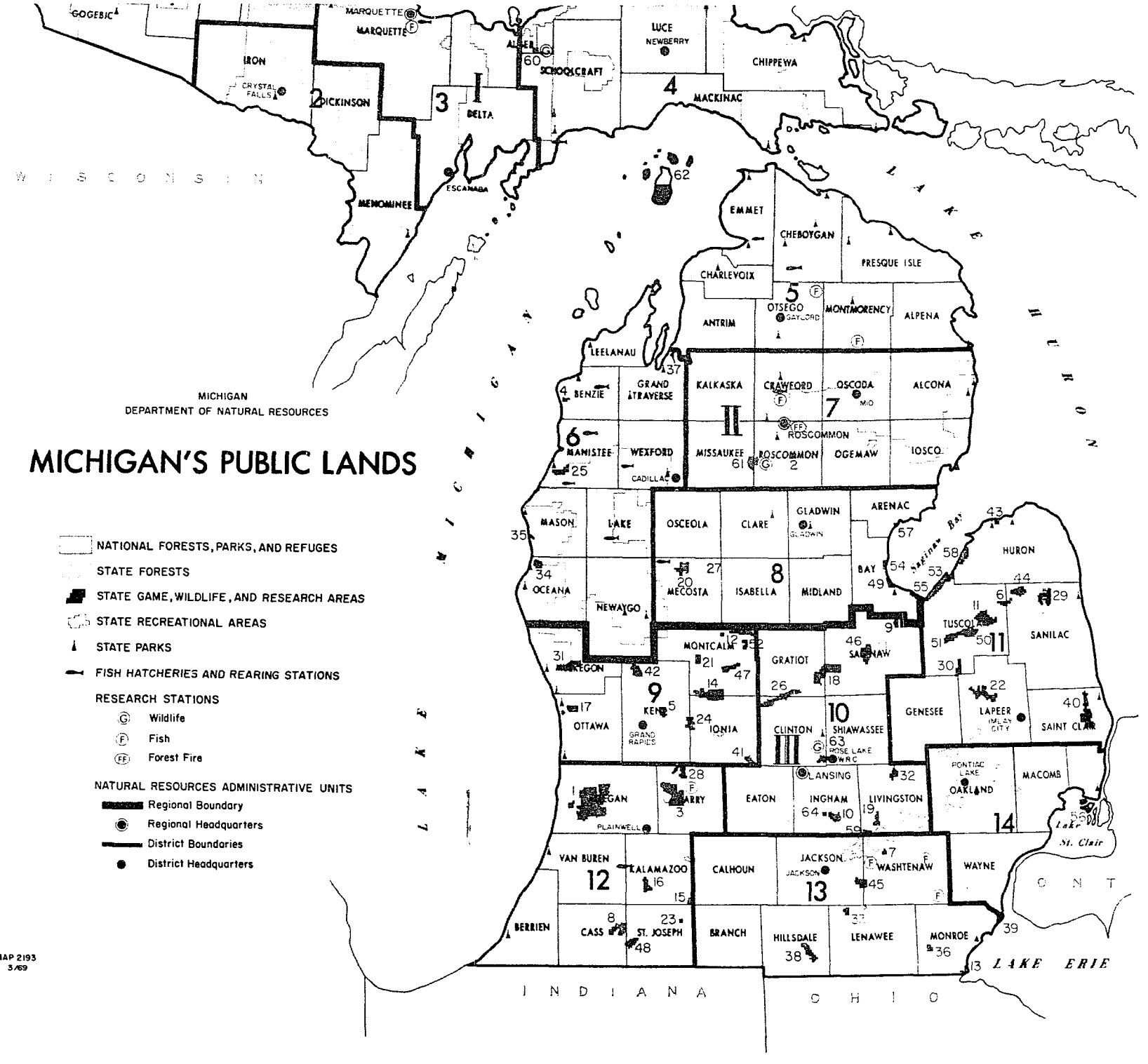
APPENDIX H

MICHIGAN'S PUBLIC LANDS



MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

MICHIGAN'S PUBLIC LANDS


MICHIGAN
DEPARTMENT OF NATURAL RESOURCES
MICHIGAN'S PUBLIC LANDS
NATIONAL FORESTS, PARKS, AND REFUGES
STATE FORESTS
STATE GAME, WILDLIFE, AND RESEARCH AREAS
STATE RECREATIONAL AREAS
STATE PARKS
FISH HATCHERIES AND REARING STATIONS
RESEARCH STATIONS
Wildlife
Fish
Forest Fire
NATURAL RESOURCES ADMINISTRATIVE UNITS
Regional Boundary
Regional Headquarters
District Boundaries
District Headquarters
MAP 2193
3/69
WISCONSIN
INDIANA
OHIO
ONTARIO
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
GOGEBIC
MARQUETTE
IRON
CRYSTAL FALLS
DICKINSON
MENOMINEE
ESCANABA
DELTA
SCHOOLCRAFT
ALGER
LUCE
NEWBERRY
CHIPPEWA
MACKINAC
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
ANTRIM
OTSEGO
GAYLORD
MONTMORENCY
ALPENA
LEELANAU
BENZIE
GRAND TRAVERSE
KALKASKA
CRAWFORD
OSCODA
MIO
ALCONA
ROSCOMMON
MANISTEE
WEXFORD
CADILLAC
MISSAUKEE
OGEMAW
IOSCO
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
ARENAC
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
BAY
HURON
TUSCOLA
SANILAC
MONTCALM
GRATIOT
SAGINAW
MUSKEGON
KENT
GRAND RAPIDS
IONIA
CLINTON
SHIAWASSEE
ROSE LAKE WRC
GENESEE
LAPEER
IMLAY CITY
SAINT CLAIR
OTTAWA
ALLEGAN
BARRY
PLAINWELL
EATON
LANSING
INGHAM
LIVINGSTON
PONTIAC LAKE
OAKLAND
MACOMB
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
BERRIEN
CASS
ST. JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
Lake St. Clair
Saginaw Bay

APPENDIX I

AID ALGORITHM

APPENDIX I

Section 1.3 Description of the Algorithm

1. The total input sample is considered the first (and indeed only) group at the start.

2. Select that unsplit sample group, group i, which has the largest total sum of squares

$$TSS_i = \sum_{\alpha=1}^{N_i} Y^2 - \frac{\left(\sum_{\alpha=1}^{N_i} Y_\alpha\right)^2}{N_i} \qquad (1.3.1)$$

such that for the i'th group

$$TSS_i \geq R\ (TSS_T) \quad \text{and} \quad N_i \geq M \qquad (1.3.2)$$

where R is an arbitrary parameter (normally $.01 \leq R \leq .10$) and M is an arbitrary integer (normally $20 \leq S \leq 40$).

The requirement (1.3.2) is made to prevent groups with little variation in them, or small numbers of observations, or both, from being split. That group with the largest total sum of squares (around its own mean) is selected, provided that this quantity is larger than a specified fraction of the original total sum of squares (around the grand mean), and that this group contains more than some minimum number of cases (so that any further splits will be credible and have some sampling stability as well as reducing the error variance in the sample).

3. Find the division of the C_k classes of any single predictor X_k such that combining classes to form the partition p of this group i into two nonoverlapping subgroups on this basis provides the largest reduction in the unexplained sum of squares. Thus, choose a partition so as to maximize the expression

$$(n_1\bar{y}_1^2 + n_2\bar{y}_2^2) - N_i\bar{Y}_i^2 = BSS_{ikp} \qquad (1.2.3)$$

where $N_i = n_1 + n_2$

and $\bar{Y}_i = \dfrac{n_1\bar{y}_1 + n_2\bar{y}_2}{N_i}$

for group i over all possible binary splits on all predictors, with restrictions that (a) the classes of each predictor are ordered into descending sequence, using their means as a key and (b) observations belonging to classes which are not contiguous (after sorting) are not placed together in one of the new groups to be formed. Restriction (a) may be removed, by option, for any predictor X_k.

4. For a partition p on variable k over group i to take place after the completion of step 3, it is required that

$$BSS_{ikp} \geq Q(TSS_T) \qquad (1.3.4)$$

where Q is an arbitrary parameter in the range $.001 \leq Q < R$, and TSS_T is the total sum of squares for the input sample. Otherwise group i is not capable of being split; that is, no variable is "useful" in reducing the predictive error in this group. The next most promising group (TSS_j = maximum) is selected via step 2 and step 3 is then applied to it, etc.

5. If there are no more unsplit groups such that requirement (1.3.2) is met, or if, for those groups meeting it, requirement (1.3.4) is not met (i.e., there is no "useful" predictor), or if the number of currently unsplit groups exceeds a specified input parameter, the process terminates.

AID (2) ALGORITHM

Preliminary Read in. Steps 1 and 2.

1. Read in all parameters and all input observations, including all predictors and the dependent variable Y. Screen out observations where Y is missing data or it is not desired to use this observation. Save all observations on tape if necessary.

2. To start, identify all observations used in the analysis as belonging to group number one. Group number one is the current candidate group. Go to Step 6.

Test for Termination of the Procedure. Step 3.

3. Determine whether or not the current number of unsplit groups is about to exceed the maximum permissible number; if so, go to Step 22, as the problem cannot proceed further.

Determine Which Group Should Be Selected for Attempted Partitioning. Steps 4-6.

4. Considering all groups constructed so far, find one of them such that

   a. the total sum of squares (TSS_i) of that group is greater than or equal to R per cent of the total sum of squares for the input observations (TSS_t);

   b. the number of observations in the group is not smaller than MSIZE;

   c. the group has not already been split up into two other groups;

   d. there has been no previous failure to split up the group;

   e. the total sum of squares of that group is not smaller than the sum of squares for any other group that meets the above four criteria.

5. If there is no such group, go to Step 23; the problem is complete.

6. The group selected is the current candidate group, which will be the subject of an attempted split. Identify it with its group number (i) and print out N_i, ΣY_i, ΣY_i^2, $\bar{Y}_i$, and TSS_i.

Partition Scan Over All Predictors. Steps 7-19.

7. Set $j = 1$ and go to Step 9.

8. Increment j by 1. If j is larger than the number of predictors being used in the analysis, the partition scan is complete; go to Step 20.

9. Compute N_{ijc}, ΣY_{ijc}, ΣY^2_{ijc}, $\bar{Y}_{ijc}$ for each class c of predictor j over group i.

10. Determine whether or not there exist two or more classes c, such that $N_{ijc} \neq 0$. If not, predictor j is a constant over group i; print an appropriate comment and go to step 8.

11. If predictor j has been defined as monotonic, skip Step 12, do not sort the Step 9 statistics, go to Step 13 instead.

12. Sort the statistics produced in Step 9, together with the class identifiers for predictor j, into descending sequence using $\bar{Y}_{ijc}$ as a key.

Partition Scan Over the c Classes of Predictor j. Steps 13-17.

13. Set $p = 1$ and go to Step 15.

14. Increase p by 1. If p is larger than $(c_j - 1)$, where c_j is the number of classes in the j'th predictor, then print the statistics for class c_j and go to Step 18 as all possible feasible splits have been examined.

15. If $\Sigma N_k = N_1 = 0$ for $k = 1, \ldots p$, or if $(N_i - N_1) = N_2 = 0$, go to Step 14 as this split cannot be made because of empty classes in this group for predictor j. Otherwise, compute BSS_p, the between-groups sum of squares for the attempted binary split of group i on predictor j between the sorted classes $(1, \ldots, p)$ and the adjacent sorted classes $(p+1, \ldots, c)$. Print the statistics for class p.

16. If this BSS_p is not larger than any BSS_p previously computed for this predictor over this group, go to Step 14.

17. This is the largest BSS_p encountered so far for this predictor. Remember BSS_p and the partition number p; print them and go to Step 14.

Determination of Best Predictor. Steps 18-19.

*18. Was the maximum BSS_p for predictor j larger than the largest BSS_p obtained from any of the other predictors previously tested over group i? If not, go to Step 8.

19. This is the best BSS_p produced by any of the predictors tested so far over group i. Remember this partition and this predictor and then go to Step 8.

Is the Best Predictor Worth Using? Steps 20-21.

*20. Was the maximum BSS retained after the scan of all predictors over group i equal to at least Q per cent of the total sum of squares? If not, mark group i as having failed in a split attempt and then go to Step 4.

21. Group i is to be split into two new groups and destroyed. Using the class identifiers and the partition rule remembered from Step 19, split the observations in group i into two parts. Identify the two new groups as having been created. Identify group i as having been split. Print the statistics from the successful partition attempt. Increase the total number of groups created so far by the quantity 2. Increase the current number of unsplit groups by one. Then go to Step 3.

Termination of the Algorithm. Steps 22-26.

22. The maximum number of permissible unsplit groups has been reached. Print an appropriate comment and go to Step 24.

23. There are no more groups eligible for further splitting. Print an appropriate comment and to go Step 24.

24. Print out a summary record of all groups created in the process of splitting, including the group number, its parent group, the values of the predictor class identifiers that were used in the partition which constructed the group, the predictor number used in this partition, an indication of whether or not this present group was ever split, and N_i, ΣY_i, ΣY_i^2, and TSS_i.

25. Determine whether punched or tape residuals are desired. If so, go to Step 26, otherwise go to Step 1.

26. Compute predicted values of Y and residuals and, by option, punch them and/or write them on tape with the data. Then go to Step 1.

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*These decision rules constitute the crucial steps in the algorithm.

Formulas

$$\bar{Y} = \Sigma Y/N$$

$$TSS = \Sigma Y^2 - \frac{(\Sigma Y)^2}{N}$$

$$BSS = \frac{(\Sigma Y_1)^2}{N_1} + \frac{(\Sigma Y_2)^2}{N_2} - \frac{(\Sigma Y)^2}{N}$$

$$WSS = TSS - BSS$$

$$Y_\alpha = \bar{Y}_i$$

$$R_\alpha = \tilde{Y}_\alpha - Y_\alpha$$

Source: Sonquist and Morgan, Detection of Interaction Effects, pp. 5-6, 158-61.

APPENDIX J

WEIGHTS USED IN AID PROGRAM

APPENDIX J

WEIGHTS USED IN AID PROGRAM *

Source of Data	Weight
Region I	
Marquette County	331
All Other Counties	669
	1000
Region II	
Bay County	174
Grand Traverse County	159
All Other Counties	667
	1000
Region III	
Genesee County	125
Ingham County	96
Kent County	114
Oakland County	120
Wayne County	106
All Other Counties	440
	1000

*Each weight is the proportion (times 1,000) that the number of observations in a sub-region is of the number of observations in that region.

APPENDIX K

PROPORTION OF VARIATION IN NUMBER OF SNOWMOBILING DAYS EXPLAINED BY PREDICTOR VARIABLES

APPENDIX K

TABLE 34

PROPORTION OF VARIATION IN NUMBER OF SNOWMOBILING DAYS EXPLAINED BY PREDICTOR VARIABLES

Predictor Variable	Proportion of Variation Explained (BSS_p/TSS_T)		
	Region I	Region II	Region III
Age of Household Head	.0354		.0375
Occupation of Household Head	.0291	.0110	.0241
Education Level of Household Head	.0153		.0068
Income of Household		.0121	.0105
Age Range of Children		.0484	.0061
Horsepower	.0130		
Ownership of Snowmobile	.0135	.0093	
Number of Snowmobiles Owned by Household	.0337	.0644	.0341
Years of Snowmobiling			.0070
Depth of Snowfall		.0277	.0301
Regulations Near Ice-Fishing		.0234	
Membership in Snowmobile Club		.0116	
Total Proportion of Variation Explained $(BSS/TSS)_T$	.140	.208	.158

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