ANALYSIS OF SNOWMOBILE ACCIDENTS INVOLVING YOUNG OPERATORS IN THE STATE OF NEW YORK

Thesis for the Degree of Ph. D.
MICHIGAN STATE UNIVERSITY
THEODORE E. HINCKLEY
1971

This is to certify that the

thesis entitled

ANALYSIS OF SNOWMOBILE ACCIDENTS INVOLVING YOUNG OPERATORS IN THE STATE OF NEW YORK

presented by

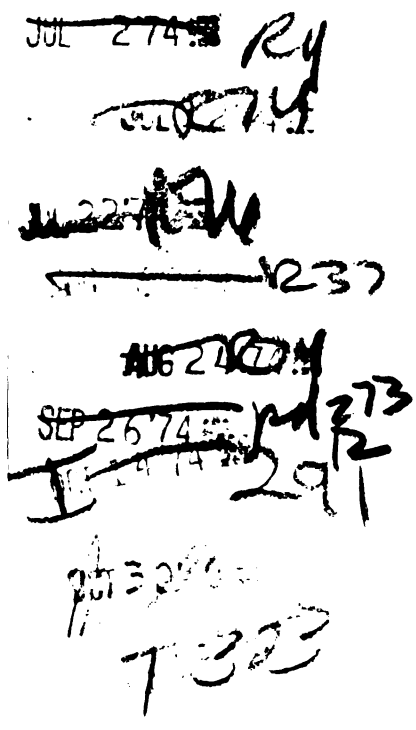
Theodore E. Hinckley

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Education

Robert E. Swartzfager
Major professor

MAY 12 1971



G-70216

ABSTRACT

ANALYSIS OF SNOWMOBILE ACCIDENTS INVOLVING YOUNG OPERATORS IN THE STATE OF NEW YORK

By

Theodore E. Hinckley

Statement of the Problem

An estimated one million snowmobiles operating in North America during the 1969-1970 winter season attest to the public acceptance of snowmobiling and hearld a potential snowmobile problem. Due to the high and increasing density of registered and nonregistered snowmobiles, and the concomitant increase in accidents resulting in death and injury to operators and passengers, as well as accompanying property damage, this study endeavored to identify the commonalities of these occurrences. The accidents included 70 on-road and 23 off-road occurrences, in which 75 personal injury-type accidents accounted for 98 personal injuries.

The research was conducted in New York because of the atypical registration law which permitted registered snowmobiles use of the highways.

Methods of Procedure

This descriptive survey compiled the factors found to reside with the operator, the vehicle, and the environment. The young operators were selected for analysis because of the disproportionate accident experience in that age group. Subjects were further selected on the basis of having filed an accident report and the state police completion of a snowmobile accident report form. Ninety-three persons 24 years of age or younger involved in snowmobile accidents in New York State during the 1969-1970 winter season comprised the population. From the population of 93 individuals, 42 subjects, on whom a special snowmobile accident report had been filed, were utilized for an in-depth study. Data were collected from the accident report, the snowmobile accident report, subject interview, school record report, and abstract of driving record. The data were computer analyzed for distributions of specified record columns and correlation of selected inter-item coefficients.

The Major Findings

1. Fifty-seven per cent of the subjects constituting the sample felt that alcohol in their system may have been a factor in the accident.
2. The majority of the subjects would have taken a course in snowmobile operation and maintenance had it been available before they became accident involved, and slightly less than half still maintained their interest

in participating in such a course, since they became accident involved.

3. The subjects were involved in the emotional satisfactions derived from the snowmobile.
4. Fifty per cent of the subjects in the sample rated themselves better than average snowmobile operators.
5. The majority of the sample subjects were reported to be average students in all respects.
6. The majority of the snowmobiles in this study were unregistered.
7. Vehicle deficiencies were found to be a factor in 11.8 per cent of the accidents in the total population. Sticking throttle, inadequate lighting or windshielding, and high noise levels were factors in four fatal injury occurrences.
8. The majority of accidents occurred under seemingly ideal conditions of weather, light, terrain, and topography.
9. The site of 75.3 per cent of the 93 accidents was the public highway, and in 74.2 per cent of the cases the collision was with another motor vehicle.

ANALYSIS OF SNOWMOBILE ACCIDENTS INVOLVING YOUNG OPERATORS IN THE STATE OF NEW YORK

By

Theodore E. Hinckley, Jr.

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

College of Education

1971

ACKNOWLEDGMENTS

This study would not have been initiated or completed without the encouragement of numerous individuals and agencies. It is with a feeling of gratitude that these acknowledgments are thankfully given:

To Mr. Charles W. Bostick, Director, Mr. Philip K. Raeder, Former Director, and D. Barry Negri of the Division of Research and Development of the New York State Department of Motor Vehicles for furnishing accident reports, snowmobile accident reports, abstracts of driver's records and encouragement for the study.

To the members of the Doctoral Guidance Committee, Dr. Robert E. Gustafson, Chairman, Dr. Calhoun C. Collier, Dr. William A. Mann, and Dr. Robert O. Nolan, who encouraged this investigation into an emerging area of safety.

To K. R. Baldwin, J. R. Bertoni, M. Brown, B. F. Buckingham, B. D. Burke, C. L. Butler, J. A. Cheney, R. S. Crawford, T. Doyle, D. M. Fish, D. W. Gillen, J. D. Harrington, H. Hendrell, D. P. Horan, P. T. Kuno, P. R. LaJoie, F. Moran, C. R. Napper, J. J. Piazza, T. E. Potter, R. A. Racine, B. A. Smith, J. L. Steinfeld,

H. S. Thomas, E. F. Troha, W. Waligunda, G. E. Ward, P. Weeks and J. W. Wondrasch for assistance during the subject contact phase of the study.

To Nancy G. Hinckley, my wife, for continuing encouragement and support from inception to the finale of this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

THE PROBLEM

Motorized over-snow travel became practical when Igor Sikorsky piloted his five-passenger, propeller-driven "sleigh" in 1909 around Kiev in Russia.[1] In the United States the revolution of effective vehicles for winter travel came a few years later.

In 1913, Virgil D. White, a Ford dealer in West Ossipee, New Hampshire, invented the Model T snowmobile, patented it, and copyrighted the name.[2] White converted a Model T Ford truck for snow travel by substituting skis in place of the front wheels and adding an additional differential to the rear which afforded the use of two rear driving half-tracks.

Joseph-Armand Bombardier in 1923 attempted to build a propeller-driven sled; his attempt ended in disaster. Mr. Bombardier's first practical snow vehicle, perfected in 1936, was a seven passenger, enclosed cabin on

---

[1] C. B. Colby, "Getting the Picture," Outdoor Life, November, 1969, p. 6.

[2] "The First Snowmobiles," Yankee, January, 1971, pp. 74-79.

half-tracks and skis.[3] Bombardier's product was very similar to the Model T Ford snow vehicle and the snow vehicles built by Ford Motor Company for Admiral Byrd's Polar expedition in 1928.[4]

The snowmobile as we know it today was invented and patented by Carl J. Ellison in 1929 in Northern Wisconsin. Ellison's creation possessed ski-like front runners and a rear drive track,[5] but lacked the aerodynamic cowling of today's models. In 1959, Bomardier built a snowmobile which was very similar in design to what prevails today. Differences between the 1959 models and today's models of Bombardier or other manufacturers are largely a matter of detail.[6]

Growth of Acceptance

Sales of snowmobiles have accelerated from 250 units in 1959 to 505,000 in 1969-1970, with an estimate by the industry of 600,000 units for the 1970-1971 season.[7] From utilitarian motives evolved a vehicle which is now the epitomy of winter adventure and recreation. "People used to sit around and hate each other," recalls

---

[3]Ronald Schiller, "The Cat that Conquered Winter," Rod and Gun in Canada, 70:10 (November, 1968), p. 11.

[4]James J. Tuite, Snowmobiles and Snowmobiling (New York: Cowles Book, 1969), p. 5.

[5]Stephen A. Briggs, II, "Snowmobile History," National Safety Congress Proceedings, 26:40 (1965), p. 40.

[6]"Snow Vehicles," Machine Design, 38:138 (January, 1966), p. 140.

[7]H. K. Howe, Snowmobile Industry Sales (Washington, D.C.: International Snowmobile Industry Association, June, 1970), p. 1.

Maine's Governor Kenneth Curtis. "The snowmobile has changed all that."[8] The successful promotional efforts of snowmobile manufacturers have stimulated man's imagination for adventure. Some purchasers are enticed by Ski-Doo's jumping record of 69 feet.[9] Other buyers are impressed by record speed, which is officially 114.5 miles per hour.[10] However, Tom Earhart, aboard his "super snowmobile," claims a top speed of 170 miles per hour.[11] Other prospective snowmobilers are enthralled by the endurance of the snowmobiles, which enabled the Plaisted expedition to reach the North Pole successfully in 1968.[12]

The economic impact of the snowmobile is welcomed in most states. For example, the average snowmobiler invests $1200 in equipment and vehicle,[13] upon which he pays the sales tax. Most owners register and insure their vehicles. The snowmobiler purchases a trailer to transport his snowmobile; this trailer, of course, is also registered. The outdoorsman drives to the most snow-covered part of his

---

[8]"With an Earsplitting Roar Comes the Marvelous Menace," Life, 66:60, January 31, 1969, p. 60.

[9]Joel Heath, "Winter Fun Vehicle--The Snowmobile," Consumer Bulletin, March 16, 1970, p. 30.

[10]J. R. Olsen, "Bad Show Out in the Cold Snow," Sports Illustrated, 32:20, March 16, 1970, p. 30.

[11]"It Had to Come," The Christian Science Monitor, February 18, 1970, p. 15.

[12]Heath, op. cit., p. 34.

[13]D. E. Clarkin, "The Industry Pledge," Proceedings of the International Snowmobile Conference (Minnesota Department of Conservation, February, 1970), p. 5.

state for the weekend. Lodging, meals, and fuel are purchased, thus affecting the economy of that area. The total amount spent for snowmobiles and equipment during the 1969-1970 season is conservatively estimated at $606,000,000. This estimation is based on the released sales figures and the previously mentioned average investment. No one knows whether sales will continue to increase at such an astonishing rate, and if the sales rate continues, whether it will have an adverse effect on the nation's international balance of payments, since the majority of snowmobiles are imported.

Growth of Problems

The snowmobile dilemma is a manifestation of our affluent society's need for recreation and adventure. In addition to the economic impact of the snowmobile, there are recreational and environmental facets to consider as well as effects on participants and nonparticipants involved in the snowmobile scene.

Generally speaking, man's activities are regulated. For example, any game, contest, or competition has rules and regulations. All forms of transportation have federal, state, and even local regulations. It would appear that the inherent nature of man is such that he needs and requires regulation. Therefore, it seems reasonable that snowmobile travel and recreation likewise be regulated. In addition, manufacturers of transportation units and processors of ingested products and body preparations are

regulated. Even manufacturers of sporting goods are regulated. Therefore, it also seems reasonable that snowmobile manufacturers be regulated in respect to the production of nonhazardous, noninjurious units.

The environmental implications of the snowmobile are most often minimized by manufacturers, operators, and state departments of economic development. There is an effort to "trade-off" the detrimental effects of the snowmobile on the environment for the economic uplift.[14] The snowmobile engine pollutes atmospherically with unburned hydrocarbons; and sonically, with a decibel rating in excess of 85 on the A scale measured at 50 feet, the threshold of damage to human hearing.[15] The odor and high noise level have an adverse effect on wildlife, especially during times of food scarcity.[16] Animals tend to overreact to intruders in their sanctuary, resulting in death from exhaustion or starvation. The packing of snow may benefit the wildlife by providing paths; however, it also provides convenient access for predatory

---

[14]K. J. Whitney, "Economic Impact of Minnesota Snowmobiling," Proceedings of the International Snowmobile Conference (Minnesota Department of Conservation, February, 1970), p. 33.

[15]Richard E. Griffith, "Environmental Impact Workshop," Proceedings of the International Snowmobile Conference (Minnesota Department of Conservation, February, 1970), p. 72.

[16]Richard E. Griffith, "Environmental Quality Impact," Proceedings of the International Snowmobile Conference (Albany, New York: New York State Department of Conservation, May, 1969), p. 80.

dogs to previously inaccessible areas.[17] The damage to plant life should not be minimized. The snowmobiler, exercising his pseudoright of eminent domain extending over all lands upon which snow has fallen, has caused extensive damage in tree nurseries and tree plantations.[18]

From a recreational standpoint, the snowmobile fulfills society's hard-pressed need for wholesome winter recreation, especially in areas not topographically suited to skiing. This vehicle has improved the quality of winter adventure for many people, even persons physically incapable of skiing, skating, or snowshoeing. Many clubs and cliques have formed to fulfill the participants' need for association and companionship.[19]

Implications relating to the participants of snowmobiling are grim in some respects. The high decibel levels may cause hearing damage to the operator and passengers.[20] The high vibration level, added to the high noise level, may cause operator fatigue, which is a factor in accidents, injuries, and fatalities.[21] The lack of sufficient supportive padding on the vehicle seat, combined with rough

---

[17] Ibid.

[18] Olsen, loc. cit.

[19] P. A. Snook, "Snowmobiling," National Wildlife, Vol. 7, December-January, 1969, p. 43.

[20] A. P. Peterson and E. E. Gross, Handbook of Noise Measurement (West Concord, Massachusetts: General Radio Company, 1969), p. 27.

[21] D. Bell, "The Move to Harness the Snowmobiliacs," Maclean's, Vol. 80:4 (April, 1967), p. 3.

terrain (not jumping), has resulted in multiple compression fractures of the spine.[22] Riding in the kneeling position has resulted in "Ski-Doo Knee," a chronic, pretibial soft-tissue contusion of the knee.[23] Attempts by operators to live up to the advertisers' projected image has produced many tragic results.[24] Exposed mechanisms are another omnipresent hazard,[25] as well as sudden upset from unseen obstructions.[26]

For nonparticipants, the snowmobile represents an invasion of their privacy, either by trespass or by sonic pollution from nearby operators.[27] They view this as an abridgement of their freedoms. Concern is growing about the sonic pollution, trespass, and efficient access to out-of-the-way cabins and wildlife areas that the

---

[22]Stanley E. Chism and A. Bradley Soule, "Snowmobile Injuries: Hazards from a Popular New Winter Sport," Journal of the American Medical Association, Vol. 209, No. 11 (September, 1969), p. 1673.

[23]William Castor and Hugh McIntyre, "Snowmobile Accidents," Canadian Medical Association Journal, Vol. 102:421 (February, 1970), p. 421.

[24]J. W. Martyn, "Snowmobile Accidents," Canadian Medical Association Journal, Vol. 101:770-72 (September, 1969), p. 771.

[25]"The Alluring but Alarming Snowmobile," Family Safety, Vol. 28 (Winter, 1969), p. 5.

[26]Charles Garrison, "Maine Safety Report," Recreational Industry, November, 1969, p. 13.

[27]Elizabeth N. Layne, "Abominable Snowmen," American Heritage, Vol. 21:113 (February, 1970), p. 113.

vehicle affords to thieves, and to outlaw hunters and fishermen.[28] To the amelioration of these concerns, the province of Saskatchewan requires all snowmobiles to have identification on the tread which will leave an identifiable impression.[29] The tempo and tenor of legislation are increasing as states enact and amend laws to protect participants and nonparticipants alike.[30]

The snowmobile problem has as many complexities as our present society. This study will deal with only a small segment of the dilemma.

The Current Problem

A disproportionate percentage of young people are victims of snowmobile accidents. In New York, during the winter of 1967-1968, 39 per cent of the operators and 60 per cent of the passengers injured in snowmobile accidents were found to be 24 years of age and younger. For the winter of 1968-1969, the Ontario Department of Transport found that 57 per cent of the accidents involved operators who were 24 years of age or younger.[31]

---

[28]Diane Lansing, "Snowmobiles Push Farther Afield," Christian Science Monitor, November 25, 1969, p. 6.

[29]"Winter's Horseless Sleigh: New State Law--Proposed Local Regulations of Snowmobiles," Municipality, Vol. 65:30 (February, 1970), p. 30.

[30]Ibid., p. 39.

[31]Ontario Department of Transport, "Snowmobile Collisions on Highways and Roads in Ontario," Prepared for the 1970 International Snowmobile Congress Congress, Duluth, Minnesota, by the Research Section (Toronto, Canada: Ontario Department of Transport, February, 1970), p. 18.

The present study was undertaken because of the unusual conditions that existed in New York State during the winters of 1967 through 1970. A unique application of the motor vehicle law allowed snowmobiles to be operated upon the public highways of the state. Snowmobiles were insured and registered for highway use.[32]

Purpose of the Study

The purpose of this study was to determine the operator, vehicle, and environmental factors present in reported snowmobile accidents involving drivers 24 years of age or younger, that occurred during the 1969-70 winter season in the state of New York. Specific tasks involved were the preparation of case summaries of selected snowmobile accidents involving young operators; the discernment of the conditional commonalities present in the accidents studied--specifically, those factors most prevalent related to the operator, the vehicle, and the environment; and the determination of common data regarding reported snowmobile accidents and operators involved, that occurred during the period of the study and within the selected age group, as obtained from accident reports filed with the New York Department of Motor Vehicles.

---

[32]"Vehicle and Traffic Law," New York Department of Motor Vehicles (Albany, New York: September, 1969), p. 193.

Assumptions

It was assumed that case study data could be gathered and conditional commonalities ascertained through information gathered from the accident report form (MV 104), the driving record abstract (DS-242), the snowmobile accident report form (11/69), and the school record report. Further, the assumption was made that a structured personal interview would uniquely augment the other collected data.

Importance of the Study

At this point in time no studies have been completed, that have utilized an extensive personal interview. While there have been compilations of accident report data; vehicle studies; and summaries of injury severity, types, and location, the accident victim has been summarily neglected.

Public and legislative concern has fostered some inappropriate actions based upon misconceptions. Hopefully, the information revealed through this study will assist concerned persons in making meaningful decisions, and help elected representatives in proposing and passing legislation which will deal effectively with the problem.

Definition of Terms

Abstract of Operating Record (DS-242)

A summary of information on file with the New York Department of Motor Vehicles. This information is recorded

on magnetic tape and is subject to recall either by name, date of birth, or license identification number. The recorded information includes license restrictions and type; dates and disposition of violations, accidents, and departmental action; as well as descriptions of the actions.

Accident

An event, occurrence, or happening which is unexpected or undesigned; it has an element of chance or probability, and has undesirable or unfortunate results.[33]

Motor Vehicle Accident Report

The accident report form MV 104 which must be completed by a police officer for any accident meeting statute definitions for on- or off-road accidents. A copy of the report is contained in Appendix A.

Off-Road Accident

An accident that occurs outside of the highway right of way. Reporting of such occurrences is not required, except in the case of a fatal injury.

On-Road Accident

An accident that occurs within the highway right way, resulting in personal injury and/or property damage

---

[33]Stannard J. Baker and William R. Stebbins, Jr., Dictionary of Highway Traffic (Evanston, Illinois: Northwestern University, 1960), p. 2.

in excess of $150.00 which, according to law, must be reported to the Motor Vehicle Department.

Snowmobile

A motor-driven sled propelled by an endless track and steered by the use of a ski-like structure, designed to be operated on snow.

Snowmobile Accident Report

The Snowmobile Report Form 11/69, developed by the Director of the Division of Research and Development, New York State Department of Motor Vehicles, to obtain objective data regarding the vehicle, operator, and environment. The Form 11/69 was completed by state police officers for all snowmobile accidents occurring within selected areas of jurisdiction. A copy of the report is contained in Appendix B.

Winter Season

Beginning October 15, 1969, and continuing through March 15, 1970.

Organization of the Study

In Chapter II an extensive review of the literature related to snowmobile accidents is presented. The chapter is divided into three categories: accident statistics, summary of prevailing factors in snowmobile accidents, and related studies.

In Chapter III the design and methodology of the study, as well as the sampling procedures employed, will be described.

The data will be compiled and analyzed in Chapter IV. Tabulations and depictions will be enumerated, in addition to the identification of conditional commonalities present in the reported occurrences.

Chapter V will contain a summary, conclusions, discussion, recommendations, and suggestions for further research.

CHAPTER II

REVIEW OF THE LITERATURE

Much significant literature has been written containing findings and recommendations regarding the snowmobile syndrome. Some of the recommendations appear to be contradictory; others are the result of researchers' static tests, which should not be applied to vehicle dynamics. This chapter contains the major findings and recommendations which were revealed through a review of the literature. Two major areas, snowmobile accident statistics and prevailing factors in snowmobile accidents, will serve to structure the chapter.

Snowmobile Accident Statistics

Fleming reported at the First International Snowmobile Conference that state officials from snow belt states disclosed a total of 39 fatal accidents for the winter of 1968-1969. During the same period, the province of Quebec had 24 fatalities and 700 injury-producing accidents, while Ontario reported 29 deaths and 300 non-fatal injuries.[1] Negri studied snowmobile accidents in

[1]John P. Fleming, "Summary of Snowmobile Fatalities 1968-1969 Winter Season," A Report of a Study Given at the International Snowmobile Conference (Albany, New York: May 20-21, 1969).

New York during the 1967-1968 winter. During that period 93 accidents resulted in 79 occupant injuries and four fatalities.[2] The Public Utilities section of the National Safety Council reported a 24 per cent injury rate for the use of snowmobiles by public utilities during the winter of 1968-1969.[3] A study by Negri in New York of the snowmobile accident reports for the 1969 calendar year revealed a total of 18 fatal, 316 personal injury, and 64 property-damage accidents.[4] The study involved 227 on-road and 171 off-road accidents and represented the final effort by New York State's Motor Vehicle Department in studying snowmobile accidents, as legislation was passed transferring the regulation of snowmobiles to the Office of Parks and Recreation in the Executive Department.[5]

The increase in injuries and fatalities was viewed with concern, especially when high and increasing numbers

---

[2]D. B. Negri, Accidents Involving Snowmobiles--A Preliminary Review, New York State Department of Motor Vehicles, Division of Research and Development, No. 1970-1 (Albany: February, 1970).

[3]"Snowmobile Survey," Research Committee, Public Utilities Section, National Safety Council (Chicago, Illinois: August, 1969).

[4]D. B. Negri, Snowmobile Accidents--A Detailed Investigation, New York Department of Motor Vehicles, Division of Research and Development, No. 1970-2 (Albany: December, 1970).

[5]J. L. Harris, et al., "An Act to Amend the Vehicle and Traffic Law and Conservation Law in Relation to Registration, Operation and Control of Snowmobiles," The Assembly of the State of New York, No. 4862-A (February, 1970).

of accident involvement were attributed to young operators. Ontario reported that 59 per cent of the accidents involved operators 24 years of age and younger.[6] Using a group of victims ranging from ages 2 to 63, Martyn found that 60 per cent of those injured were 30 years of age or younger.[7] During the 1967-1968 winter season, 59 per cent of the injured and 35 per cent of the fatalities were 24 years of age or younger. Negri reported an increase from the 1967-1968 season to the 1969-1970 season of 32 per cent of the accident operators who were in the 24 year or younger age group.[8]

A study by McLay, funded by a National Safety Council grant, was conducted in Vermont. Apparently, accident reports or hospital admission records were the original source of information. Some accident victims were interviewed and members of snowmobiling clubs were consulted. McLay's recommendations were related to the operational factors; lacking was any recommendation for further study.[9]

---

[6]Ontario Department of Transportation, "Snowmobile Collisions on Highways and Roads in Ontario," prepared for the 1970 International Snowmobile Congress, Duluth, Minnesota by the Research Section, Ontario Department of Transport, Toronto, Canada (February, 1970).

[7]J. W. Martyn, "Snowmobile Accidents," Canadian Medical Association Review, Vol. 101:770-72 (September 15, 1969).

[8]Negri, loc. cit.

[9]Richard W. McLay and Stanley E. Chism, "A Snowmobile Accident Study," A Report of a Study Given at the International Snowmobile Conference (Albany, New York, May 20-21, 1969).

Negri analyzed 93 snowmobile accidents from the 1967-1968 winter season,[10] and 398 from the calendar year of 1969 and the first six months of 1970.[11] In both of these studies, in-depth analyses were performed from the motor vehicle accident reports and the snowmobile accident report forms for traffic and non-traffic accidents. Recommendations were made for further study in the areas of equipment and public information.

King performed a descriptive study, in which he evaluated information taken from motor vehicle accident reports, driving records, and telephone interviews. Further study was recommended in the areas of legislation, equipment, and impact on flora and fauna.[12]

Most of the literature reviewed was statistically oriented. The content numerically described accidents or mechanical deficiencies of the vehicle. A significant amount of literature dealt with the regions and extent of trauma. Chism stated that the most commonly occurring type of injury was a compression fracture of one or more vertebral bodies, especially T-11, T-12, and L-1, occasionally T-4 and L-3.[13] Castor found that 62 per cent of the

---

[10]Negri, 1970-1. [11]Negri, 1970-2.

[12]Alfred S. King, "A Study of Selected Factors Related to Snowmobile Traffic Accidents in the State of Michigan" (unpublished Doctoral dissertation, Michigan State University, 1971).

[13]Chism and Soule, loc. cit.

injuries were incurred by the lower extremity, with 17 per cent occurring to the head, neck, and eyes.[14]

The statistical studies cited indicated a high and increasing involvement with snowmobiles by young operators.

Prevailing Factors in Snowmobile Accidents

Unfortunately, the history of accident prevention activities in this country appears to be . . . "Let's permit a series of accidents to occur. Then we will somehow or sometime get around to recognize the problem and plan countermeasures."[15] The problem has now been recognized and countermeasures have been suggested by researchers.

The use of helmets by operators was first recommended by Kao in May of 1969, at the First International Snowmobile Conference.[16] During the Safety Committee Meeting, McLay advocated the use of goggles with various tinted lenses for protection of the eyes of snowmobile operators,[17] A 20 per cent reduction in the casualty rate was Martyn's conservative estimate, in favor of the use of

---

[14] Castor and McIntyre, loc. cit.

[15] Fleming, loc. cit.

[16] Henry Kao, "Human Factors," Recommendations of a Human Factors Workshop Held at the International Snowmobile Conference (Albany, New York, May 20-21, 1969).

[17] Richard W. McLay, "Machine Considerations," Recommendations of a Machine Safety Workshop Held at the International Snowmobile Conference (Albany, New York, May 20-21, 1969).

helmets and goggles.[18] Many other researchers made less conservative claims, and some even suggested that head and eye protection be required for operation, just as they are in sanctioned competitions.[19,20,21,22,23,24,25] In contrast, Hoene, of the International Snowmobile Industry Association, stated, ". . . We wouldn't seriously consider any mandatory helmet regulations until we find out something more about snowmobile accidents."[26] The industry's unusual position in regard to head protection seems to substantiate Baker's allogations, ". . . The snowmobile people are not really interested in protection: They just want to sell more of these snowmobiles."[27] The research section of the Ontario Department of Transportation felt more injury and

---

[18]Martyn, loc. cit. [19]Negri, 1970-1.

[20]Castor and McIntyre, loc. cit.

[21]King, loc. cit. [22]Negri, 1970-2.

[23]Martyn, loc. cit.

[24]R. L. Withington and L. W. Hall, "Snowmobile Accidents: A Review of Injuries Sustained in the Use of Snowmobiles in Northern New England During the 1967-1969 Season," Journal of Trauma, Vol. 10 (September, 1970).

[25]R. H. Dominici and E. H. Drake, "Speed on Snow--The Motorized Sled," The American Journal of Surgery, Vol. 119 (April, 1970).

[26]Proceedings of the 1970 International Snowmobile Congress (Duluth, Minnesota, February, 1970; St. Paul, Minnesota: Minnesota Department of Conversation, March, 1970).

[27]W. J. Baker, "Discussion," The American Journal of Surgery, Vol. 119 (April, 1970).

helmet data were needed before any conclusions regarding the value of protective headgear could be reached.[28]

Researchers called upon the snowmobile industry to refrain from use of spectacular forms of advertising, such as jumping and other hazardous stunts.[29,30,31,32] During the First International Snowmobile Conference, the industry representatives present agreed to terminate the spectacular scenes in their advertising campaigns.[33] Apparently the tenor of the advertising did not change. Many researchers found that the false impressions created as to proper snowmobile use by dramatic commercials did promote sales but did not induce the rational use of the vehicles.[34,35,36,37] Jumping was found to produce approximately 8.5 G's impact on landing, with resultant compression fractures of the spine.[38]

A survey of films produced by or for the industry revealed a total of 29 films with a total running time of

---

[28]Ontario Department of Transportation, loc. cit.

[29]Chism and Soule, op. cit., p. 1672.

[30]McLay, loc. cit.

[31]Castor and McIntyre, loc. cit.

[32]Withington, loc. cit. [33]McLay, loc. cit.

[34]McLay and Chism, loc. cit.

[35]Chism and Soule, loc. cit.

[36]Castor and McIntyre, loc. cit.

[37]Withington and Hall, loc. cit.

[38]McLay and Chism, loc. cit.

640 minutes. However, only 17 per cent of the films and 16 per cent of the running time were devoted to the instructional or safety aspects of snowmobiling.

Equipment difficulties were cited either as a factor in the accident or as contributing to the severity of the injury, by most of the studies and reports dealing with snowmobile accidents. One of the most frequently mentioned equipment deficiencies was the lack of sufficient supportive, shock-absorbent padding on the seat.[39,40,41,42,43,44,45,46] The injury related to this deficiency is a chronic contusion diagnosed as "Ski-Doo Knee," which occurs when the vehicle is operated from a kneeling position for long periods of time.[47] Another equipment deficiency often mentioned was the lack of adequate lighting. Lights were reported to be inadequate both

[39] R. C. Sturgis, et al., "Ergonomic Study of Snowmobiles," a Study made at the Highway Safety Research Institute, Ann Arbor, Michigan: Supported in part by an Exploratory Research Grant from the National Safety Council, Chicago, Illinois, June 30, 1970.

[40] McLay, loc. cit. [41] Kao, loc. cit.

[42] Chism and Soule, loc. cit.

[43] Castor and McIntyre, loc. cit.

[44] McLay and Chism, loc. cit.

[45] Richard W. McLay, Paul M. Whalen, and William T. Kurth, "Methods for Eliminating Snowmobile Caused Spinal Injuries," Presented at the International Snowmobile Conference (Duluth, Minnesota, February 9-11, 1970).

[46] Sturgis, loc. cit.

[47] Castor and McIntyre, loc. cit.

for illumination of the intended path ahead and for recognition by other vehicles.[48,49,50,51,52,53,54] Throttles locking in the full open position,[55,56,57,58,59] compounded by high horsepower yielding high speeds,[60,61,62,63] and the inherent instability[64,65,66] and ineffective steering[67,68,69] of the vehicle, have also resulted in many tragedies. Ineffective brakes,[70,71,72,73] the hazard of unshielded mechanisms,[74,75,76] and ineffective

---

[48]McLay, loc. cit. [49]Kao, loc. cit.

[50]Martyn, loc. cit. [51]Dominici and Drake, loc. cit.

[52]Withington, loc. cit. [53]Negri, 1970-2.

[54]Sturgis, loc. cit. [55]Negri, 1970-1.

[56]Martyn, loc. cit. [57]Dominici and Drake, loc. cit.

[58]Withington and Hall, loc. cit.

[59]Negri, 1970-2. [60]McLay, loc. cit.

[61]Kao, loc. cit. [62]Dominici and Drake, loc. cit.

[63]Negri, 1970-2. [64]Chism and Soule, loc. cit.

[65]Martyn, loc. cit. [66]Dominici and Drake, loc. cit.

[67]Chism and Soule, loc. cit.

[68]Martyn, loc. cit. [69]Dominici and Drake, loc. cit.

[70]McLay, loc. cit. [71]Chism and Soule, loc. cit.

[72]Martyn, loc. cit. [73]Dominici and Drake, loc. cit.

[74]"Snowmobile Accidents in Canada Winter of 1969-1970," Canada Safety Council (Ottawa: October, 1970).

[75]Chism and Soule, loc. cit.

[76]Dominici and Drake, loc. cit.

maintenance[77,78,79,80] (some performed by dealers)[81] were also cited in the literature as factors contributing to accidents or to the severity of the injury.

Sturgis recommended many design changes, some of which had already been condemned by other researchers. For example, he recommended a steel reinforcement at the top of the windshield, whereas other studies recommended that the windshield be flexible.[82,83] Significant recommendations were made by Sturgis in the areas of overall design, seats, footrests, handle bars, brakes, throttle, passenger seating, lighting, and maintenance.[84] While many researchers did not make specific recommendations, their discussions and statements of inadequacies were tantamount to recommendations for the improvement of those deficiencies. Basic remedial activities, based on accident data, were recommended in the areas of legislation,[85,86,87]

---

[77] McLay, loc. cit. [78] Negri, 1970-1.

[79] Fleming, loc. cit. [80] McLay and Chism, loc. cit.

[81] Accident Description--Appendix F.

[82] Dominici and Drake, loc. cit.

[83] Withington and Hall, loc. cit.

[84] Sturgis, et al., loc. cit.

[85] King, loc. cit.

[86] Chism and Soule, loc. cit.

[87] Withington and Hall, loc. cit.

educational training programs,[88,89,90,91,92,93,94,95] vehicle design,[96,97,98,99,100,101] and public information programs.[102,103] Publication of owners-operators manuals[104,105,106] and safety materials,[107,108] as well as improved forms for accident reporting,[109,110] were also recommended by some researchers.

Few studies related to the life style of the accident subjects were found. Negri commended that experience indicated a more expedient safety-improvement action would be to modify equipment rather than to attempt to alter

---

[88]King, loc. cit. [89]Negri, 1970-1.

[90]C. E. Garrison, "Maine Safety Report," Recreational Industry (November, 1969), p. 13.

[91]Raymond T. O'Dell, "Report on Oversnow Vehicles," United States Department of Interior, National Parks Services (June, 1968), p. 17.

[92]Martyn, loc. cit. [93]Castor and McIntyre, loc. cit.

[94]Withington and Hall, loc. cit.

[95]"Snowmobile Survey," loc. cit.

[96]Negri, 1970-2. [97]King, loc. cit.

[98]McLay, Whalen, Kurth, loc. cit.

[99]Chism and Soule, loc. cit.

[100]Dominici and Drake, loc. cit.

[101]Withington and Hall, loc. cit.

[102]King, loc. cit. [103]Negri, 1970-2.

[104]King, loc. cit. [105]O'Dell, loc. cit.

[106]"Snowmobile Survey," loc. cit. [107]Ibid.

[108]Negri, 1970-2. [109]King, loc. cit.

[110]Withington and Hall, loc. cit.

human behavioral patterns.[111] The use of alcohol relates directly to life style, and was found by Martyn to be the prodrome to a serious situation.[112] Garrison reported that 50 per cent of the fatalities reported in Maine during 1968 were related to heavy drinking prior to involvement.[113] Ontario reported that 27 per cent of the operators involved in accidents were identified as ability impaired or had been drinking. Fifty-eight per cent of the fatalities indicated alcohol consumption, and 57 per cent of those cases had an alcohol level exceeding 0.17 per cent by weight.[114] Two other indicators of life style by the accident subjects were imitations of daring deeds[115,116] and time of accident. Most of the researchers reported both daylight and darkness within one time span.[117,118,119,120,121,122,123,124] The Canada Safety Council's report is atypical; they recognized it is dark before five, six, or eight o'clock p.m. during

---

[111] Negri, 1970-2. [112] Martyn, loc. cit.

[113] Garrison, loc. cit.

[114] Ontario Department of Transport, loc. cit.

[115] Martyn, loc. cit.

[116] Castor and McIntyre, loc. cit.

[117] Ibid. [118] King, loc. cit.

[119] Negri, 1970-2. [120] Negri, 1970-1.

[121] Garrison, loc. cit. [122] Fleming, loc. cit.

[123] Dominici and Drake, loc. cit.

[124] Withington and Hall, loc. cit.

part of the winter in the snow belt area.[125] Therefore, depictions of light conditions relative to the operational habits of the snowmobile operator were erroneous, due to inappropriate selection of day-night demarcation by many researchers.

Summary

Findings and recommendations were reported from studies which summarized snowmobile accident data and studies which determined factors prevalent in snowmobile accident occurrences.

The Design and Methodology used in this study will be described in Chapter III.

---

[125] Snowmobile Accidents in Canada, loc. cit.

CHAPTER III

DESIGN AND METHODOLOGY

The purpose of this study was to compile the factors found to reside with the operator, the vehicle, and the environment which may have contributed to snowmobile accidents. Past studies have been able to reveal common factors peculiar to automobile and motorcycle accidents. In 1959 R. W. Bishop conducted a study in Michigan that revealed the common factors contributing to single automobile accidents. Bishop employed the interview as one of his data collecting methods.[1] In 1968 D. R. Johnson conducted a study employing the interview method in Illinois that examined the commonalities contributing to motorcycle accidents.[2] In 1971 A. S. King conducted a study in Michigan of selected factors related to snowmobile accidents. King also used an interview to gather data.[3] It

---

[1]Richard W. Bishop, "Case Studies of One Car Accidents Involving Young Drivers" (unpublished Ed.D. Dissertation, New York University, 1961.)

[2]Duane R. Johnson, "A Case Study Analysis of Motorcycle Accidents in Three Illinois Counties" (unpublished Ph.D. Dissertation, Michigan State University, 1968.)

[3]Alfred S. King, "A Study of Selected Factors Relating to Snowmobile Traffic Accidents in the State of Michigan" (unpublished Ph.D. Dissertation, Michigan State University, 1971.)

was therefore felt that a personal interview could be used to supplement the information gathered through the Motor Vehicle Accident Report From (MV 104) and the Snowmobile Accident Report Form (11/69).

This chapter includes a description of the methods used to select the population and the sample, variables of concern in this study, development of the interview instrument, formulation of the subject contact letter, evolution of the school record request, collection of the data, codification of the data, procedures for measurement of the variables, and treatment of the data.

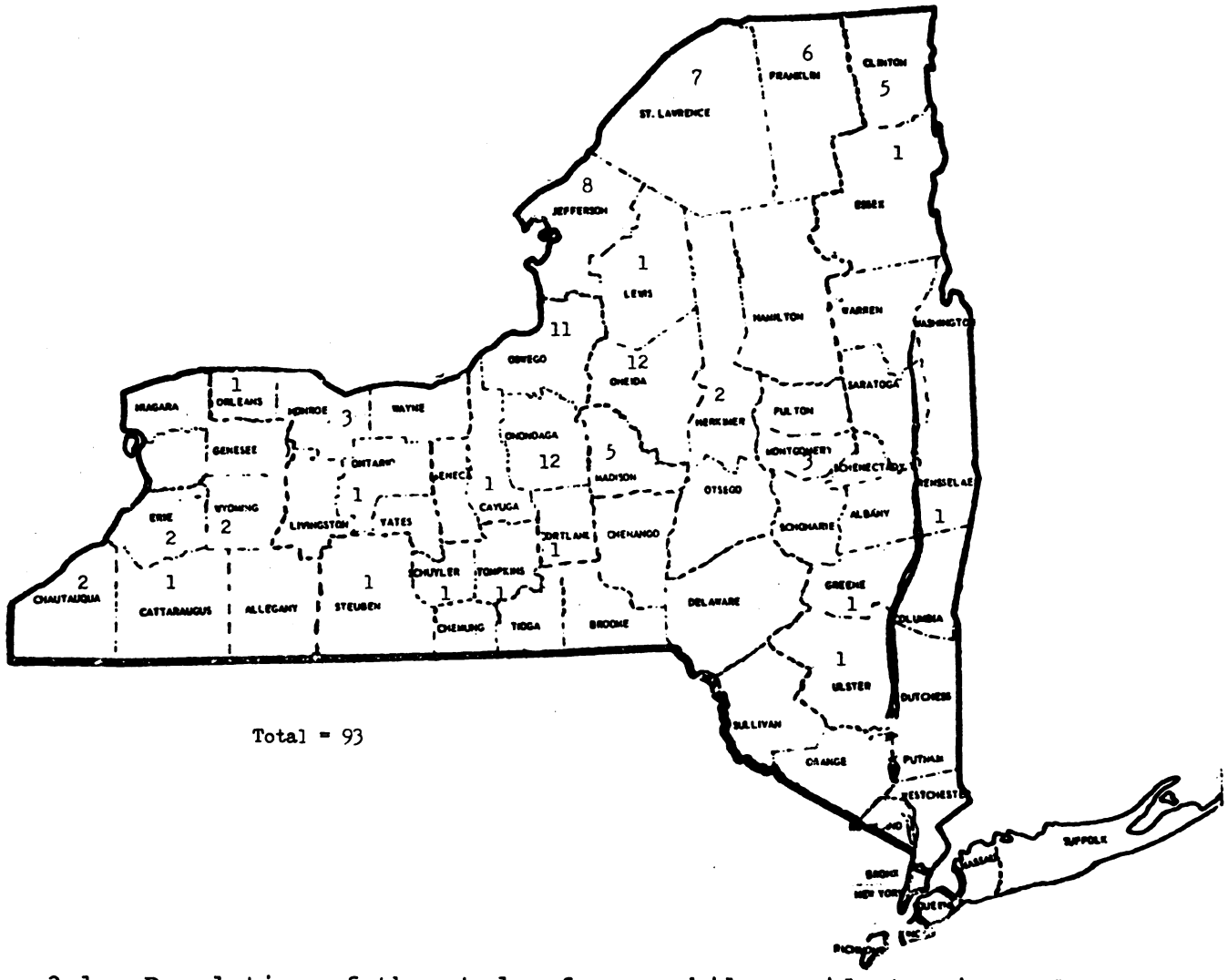
Selection of the Population

Because of the high level of snowmobile accident involvement of young people, the 24 years of age and younger group (see Table 3.1) was selected as the population of interest for this study. All snowmobile accidents for the selected age group during the 1969-1970 winter season which were reported to the Department of Motor Vehicles via the Motor Vehicle Accident Report Form constituted the population of this study (see Figure 3.1). The population consisted of 93 persons whose ages ranged from 8 to 24 years. The mean, median, and mode of the population were 18.6 years, 17.1 years, and 23.3 years, respectively.

TABLE 3.1.--Distribution of population by age.

Months	Number	Percent
271-299	21	22.4
252-270	8	8.5
233-251	11	11.7
214-232	10	10.6
195-213	14	14.9
176-194	18	19.2
157-175	4	4.2
138-156	5	5.3
119-137	1	1.6
100-118	1	1.6
Total	93	100.0

	Mean	Mode	Median	Range
Months	222.47	280	205	101-288
Years	18.6	23.3	17.1	8-24



Total = 93

Figure 3.1.--Population of the study of snowmobile accidents winter 1969-1970.

Selection of the Sample

For the 1969-1970 winter season specific data were collected through the cooperation of the State Police in Troops A, B, and D (see Figure 3.2). Their jurisdictions included major areas of snowmobile operations, which are the northern section of the state along the Great Lakes, the St. Lawrence River Valley, together with several counties in the central portion of the state. From the 93 individuals constituting the population, 59 persons, upon whom special snowmobile accidents report forms were filed, were selected as the sample for this study. However, 16 subjects were eliminated from the sample because eight refused to be interviewed, four were fatally injured, and four had left the state. Thus the final number of individuals comprising the sample of this study was 43. As depicted in Table 3.2, the sample was comprised of 43 persons whose ages ranged from 13 to 24 years. The mean, median, and mode of the sample were 18.9 years, 18.8 years, and 23.3 years, respectively.

Variables of Concern in this Study

This study was concerned with variables relative to the operator, the vehicle, and the environment. Specific operator variables were: age; sex; family life; occupation; life goal and aim; driving record; self-concept as an automobile operator and snowmobile operator; operator experience level; mental, emotional, and physical state; and familiarity with the terrain. The vehicle

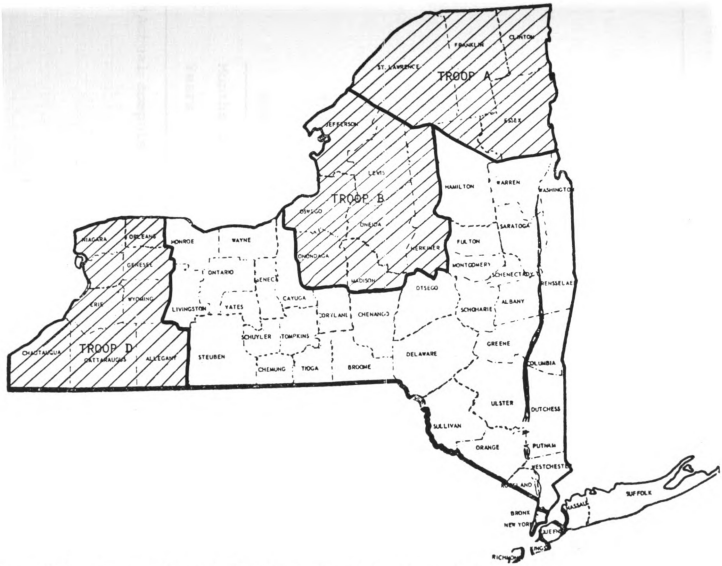


Figure 3.2.--Area of jurisdiction--Troup A, B, and D.

TABLE 3.2.--Distribution of sample by age.

Months	Number	Percent*
271-299	10	23.3
252-270	5	11.6
233-251	5	11.6
214-232	7	16.3
195-213	5	11.6
176-194	9	20.9
157-175	2	4.6
138-156	0	0
119-137	0	0
100-118	0	0
Total	43	99.9

	Mean	Mode	Median	Range
Months	227.78	280	226	156-288
Years	18.9	23.3	18.8	13-24

*Actual computed value rounded to the nearest tenth.

variables were: registration, make, horsepower, speed in the accident, preventive maintenance performed, proper function of components, and emergency equipment. The environmental variables were: surface conditions, visibility, time of day, and day of week. The sources of these data were: the accident report form (MV 104), the snowmobile accident report form (11/69), abstract of driving records (DS-242), school record report, and personal interview.

Development of the Interview Instrument

The interview instrument was developed to obtain detailed biographical information; to determine the sequence of events leading up to the accident; and to ascertain the driver, vehicle, and environmental conditions prior to and at the time of the accident. The following were major considerations in the evolution of the questionnaire: Will the phraseology and order of the questions produce a useful response, be readily understood by the subjects, enhance the subjects' confidence in the interviewer, develop rapport with the subjects, result in frankness on the part of the subjects? With these objectives and considerations in mind, conferences were held with Dr. Thomas Mustico, Director of Educational Research, State University College, Oswego; Phillip Raeder, Director, Division of Research and Development, Department of Motor Vehicles; and Robert Young, Deputy Commissioner, Department of Conservation, to gain insight into the types of questions

that would be the most effective. Subsequent to these conferences, correspondence was established with Dr. Richard Bishop regarding the use of segments of the interview schedule developed for his study entitled "One Car Accidents and the Young Driver."

An original draft of the questionnaire was duplicated. It was pretested on 36 volunteers of the 24 years and younger group. The instrument was critiqued by interviewers and interviewees in light of the objectives and considerations, then revised to incorporate improvements suggested from the initial pretest. The second pretest was administered, using the improved questionnaire on 36 additional volunteer subjects of the young age group. The instrument was further revised and a final edition was duplicated in quantity for use with the accident subjects.

A copy of the final instrument is attached in Appendix C.

Formulation of the Subject Contact Letter

A letter was developed to be sent to each person of interest in the sample to solicit his cooperation while expressing concern and consideration for him, and to assure him of his anonymity. The first draft was composed and presented to 10 volunteer subjects. Their reactions and criticisms were incorporated and then the letters were reproduced and sent to the subjects of the study. A copy of the letter is attached in Appendix D.

Evolution of the Subject School Record Request

An important aspect of this study was to elicit the cooperation of the subject's school district to provide information regarding his school record. Specific areas of interest were the subject's ability, achievement, social relationships, and history of repeated problems. Of prime concern was the protection of the subject's identity by the school district. Assistance in drafting the request was obtained from the assistant superintendent of schools and the director of pupil personnel services from the Oswego School District. Their suggestions were incorporated in the final draft of the letter. Copies of the school record request were sent to each subject's high school director of pupil personnel services.

A copy of the school record request is attached in Appendix E.

Collection of the Data

The Department of Motor Vehicles provided motor vehicle accident reports for the 93 persons in the population and 59 snowmobile accident reports for the persons in the sample. The Department of Motor Vehicles also provided 24 abstracts of driving records for the licensed operators in the sample. The remaining 19 subjects were not licensed.

Of the 59 persons selected as the sample for this study, 43 subjects were personally interviewed. Sixteen subjects had to be omitted from this phase of the study because eight refused to be interviewed, four were fatally injured, and four had left the state. The interview procedure was as follows: The subject received the contact letter (in some cases a positive written response was returned), the subject was then contacted via telephone by the interviewer, and a mutually agreeable time was arranged for the interview. The 12 interviewers were selected on the basis of successful interview experience with the two pretests, snowmobile experience, interest, and age level. It was also felt that the interviewer being the subject's contemporary would help to establish rapport and insure the veracity of the subject. The location of the subjects interviewed is depicted in Figure 3.3.

Because one completed interview was lost during this phase, the sample size became 42. Consequently, based on interview information, only 42 school record requests were sent to the subjects' respective schools and returned.

Codification of the Data

Codifying manuals were authored for use with the interview instrument, the accident report form, the snowmobile accident report form, the driving record abstract, and the school record report. Each variable was itemized

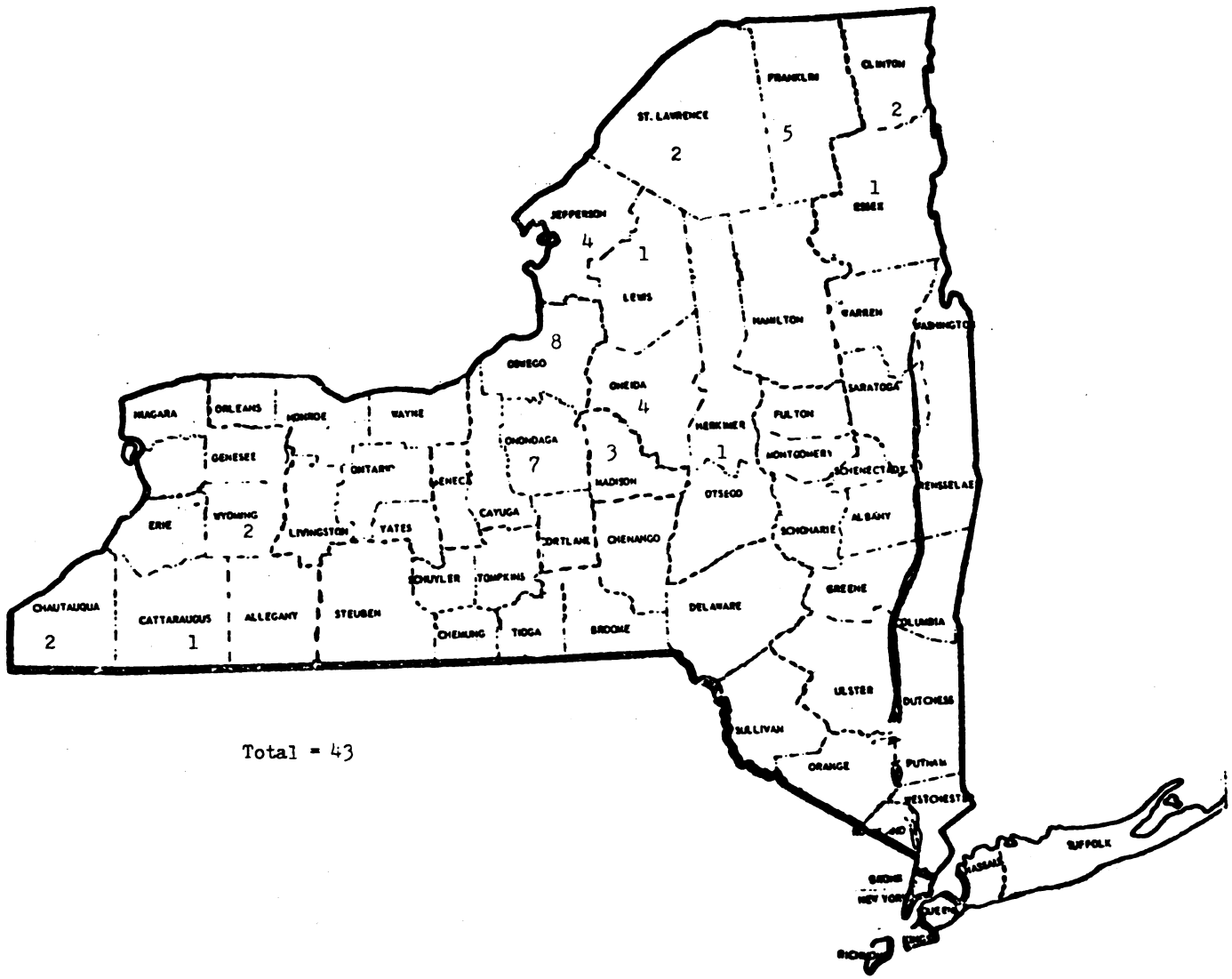


Figure 3.3.--Location of subjects interviewed by county.

with a selection of responses from 0 to 9. The responses were transferred to a summary sheet by use of the above-mentioned manuals, then transposed to punch cards.

Procedures for the Measurement of the Variables

The punch cards were submitted to the computer for distribution of specified record columns. Items were then resubmitted for correlation of selected inter-item coefficients. A method of controlling variables was utilized by the use of verifying questions upon which a check was effected. For example, some of the interview responses were verified or refuted by certain items from the accident report form, the snowmobile accident report form, the abstract of the driving record, and the school record report.

Treatment of the Data

The data were organized into four parts for analysis. Part one deals with the commonalities of the population accident data and the data relative to the population of 93 from the accident report form (MV 104). Part two concerns the data relative to the sample of 42 obtained from the interview, the abstract of the driving record, the snowmobile accident report (11/69), and the school record report. Two inter-item coefficients were calculated for the subject's responses relative to the number of accidents and convictions and the abstract of the subject's driving record. A coefficient was calculated for the subject's

self-concept as an automobile operator versus the number of convictions evidenced by the abstract of his driving record. Parts three and four deal with the vehicle and environmental factors, respectively, relative to the 42 subjects, which were predominantly obtained through the interview.

The data, as organized, will be presented in table and graph form in the following chapter. Case summaries and situational diagrams are provided for additional insight.

Summary

The design and methodology contained in this chapter described and delineated: the selection of the population and sample, variables of concern in this study, the interview instrument, the subject contact letter, and the school record request. Collection and codification of the data, as well as procedures for measurement of the variables and treatment of the data, were included in this chapter. The results of the computer analysis will be discussed and illustrated in Chapter IV.

CHAPTER IV

ANALYSIS OF THE DATA

This chapter contains an analysis of the data collected by methods described in the preceding chapter. The results of the analysis are reported in four parts, which will serve to structure the chapter. In part one the commonalities of accident data gathered from the accident report form (MV 104) relative to the population of 93 are presented. A compilation of the operator variables and selected individual case summaries obtained from personal interviews, snowmobile accident report (11/69), abstract of driving records (DS-242), and the school record reports for the sample of 42 resides in part two. The vehicle data findings for the sample of 42, assembled from the snowmobile accident reports (11/69) and personal interviews are found in part three. Part four contains the analysis of the environmental data relating to the sample of 42, gathered from the snowmobile accident reports (11/69) and the personal interviews. The analysis of the collected data will be revealed through figures, tables, and statements.

Commonalities of Accident Data of the Population

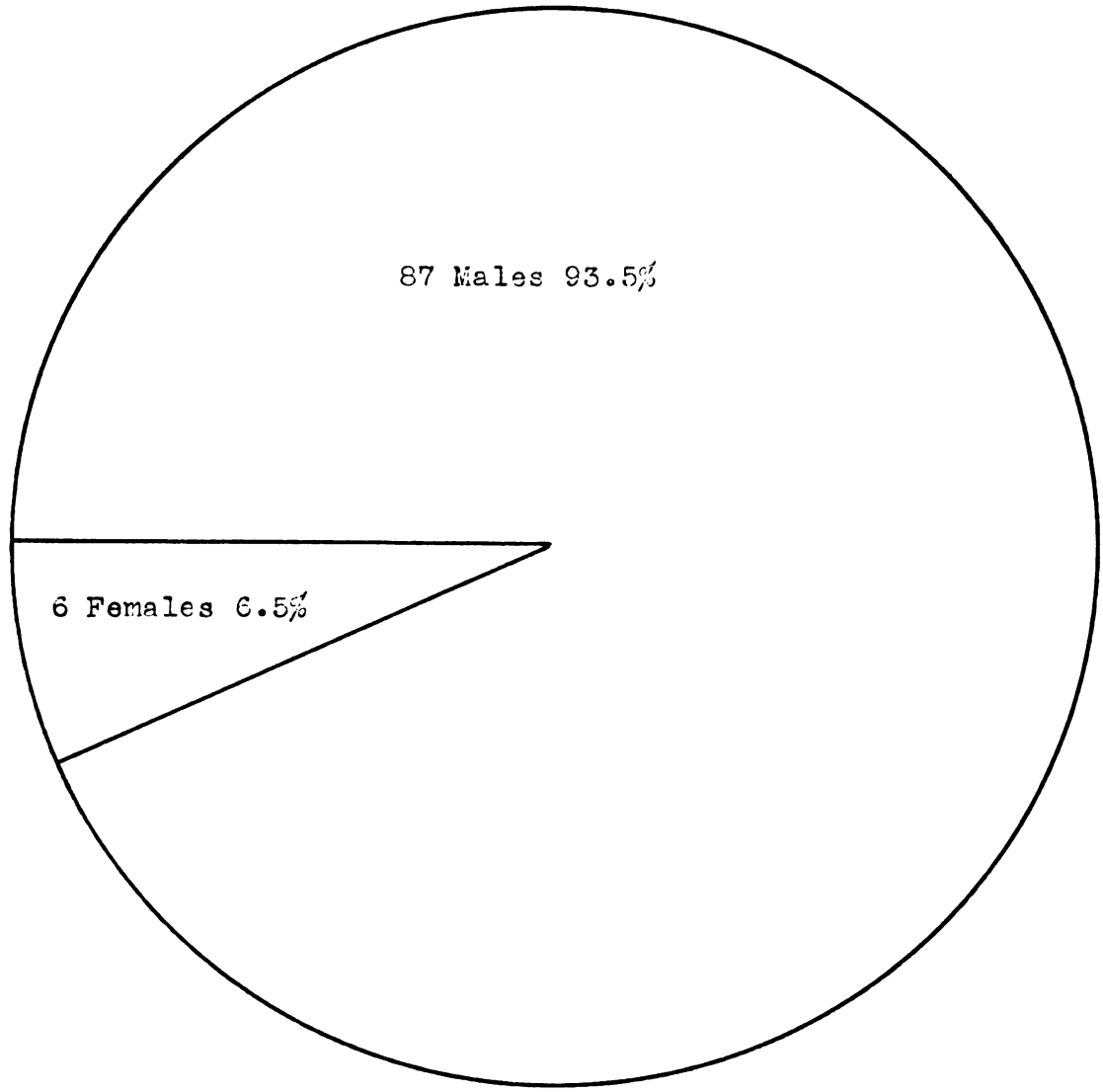
Data from the accident reports (MV 104) relative to the operator, the vehicle, the environment, and the accident pertaining to the population of 93 persons are presented in this section.

Operator

Age and geographical distribution.--The age and geographical distribution of the population were depicted in Table 3.1 and Figure 3.1, respectively. The ages ranged from 8 to 24 years. The mean, median, and mode of the population were 18.6 years, 17.1 years, and 23.3 years respectively. The geographic distribution of the population included the major areas of snowmobile operations which were the northern section of the state, along the Great Lakes, the St. Lawrence River Valley, together with several counties in the central portion of the state.

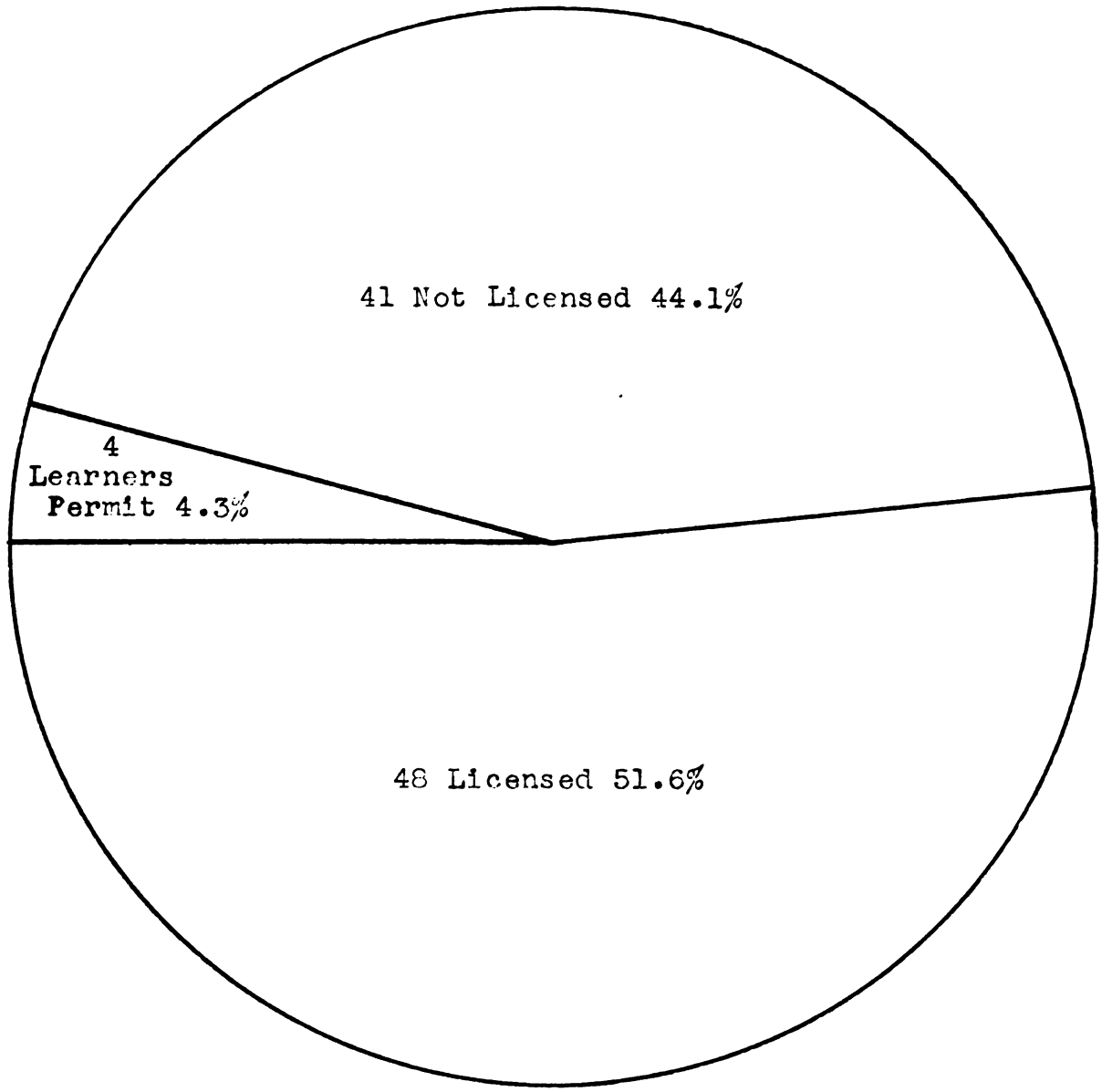
Sex.--The sex of the operator is revealed in Figure 4.1. Only 6.5 per cent of the operators were female, compared with 93.5 per cent males.

License status.--The license status of the population is shown in Figure 4.2. Of the 93 accident-involved operators, only 48 were licensed. However, 52 of the operators had successfully passed a test of the motor vehicle laws, whereas 41 had not.



Total number of operators 93

Figure 4.1.--Snowmobile accident involvement of operators by sex.



Total number of operators 93

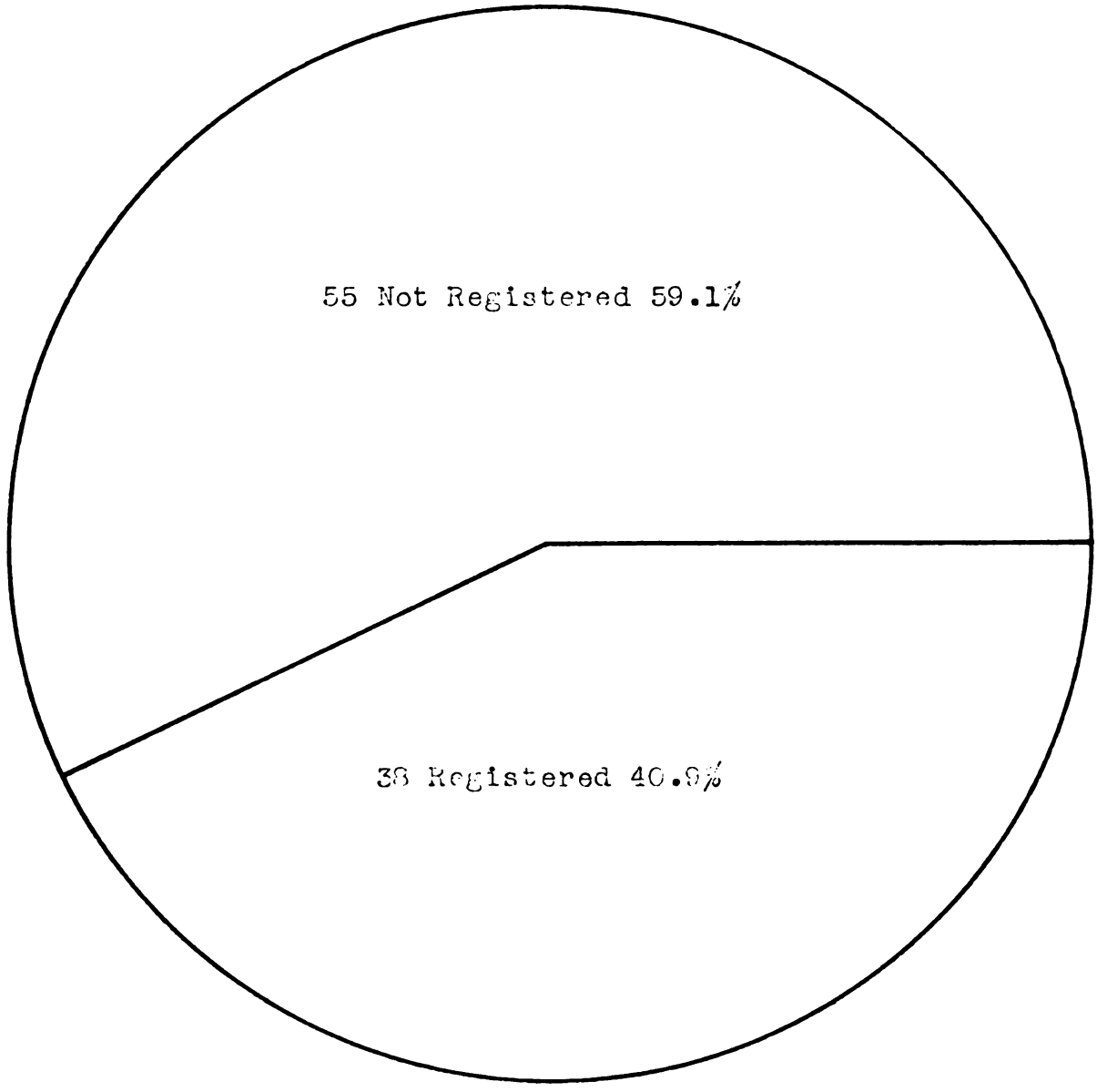
Figure 4.2.--License status of operators involved in snowmobile accidents.

Vehicle

Registration.--Figure 4.3 illustrates the relationship between the registered and non-registered snowmobiles involved in accidents. Thirty-eight of the snowmobiles were registered, representing 40.9 per cent of the total of 93. The majority, 59.1 per cent, were not registered. The vehicle and traffic laws relative to snowmobile registration may be found in Appendix G.

Vehicle make.--Table 4.1 shows that Ski-Doo vehicles accounted for 50.5 per cent of the occurrences, while the next most frequently involved snowmobile, Polaris, was involved in 8.6 per cent. In an attempt to justify the high percentage of involvement by some vehicles, an effort was made to obtain sales totals for the various makes. All the manufacturers and the International Snowmobile Industry Association were contacted to obtain this information. Of the 27 manufacturers contacted, only four responded (Massey-Ferguson, Inc., Moto-Ski, Yamaha Motor Co., and Chaparal Industries, Inc.). Chaparal Industries, Inc., was the only manufacturer to return the sales figures requested.

Horsepower.--The horsepower of 60.2 per cent of the snowmobiles was ascertained. The most commonly occurring horsepower level was from 17 to 18, accounting for 21.5 per cent of the total. As depicted in Table 4.2,



Total number of operators 93

Figure 4.3.--Registered status of snowmobiles.

TABLE 4.1.--Make and frequency of snowmobiles involved in accidents.

Name	Number	Per cent*
Ski-Doo	47	50.5
Polaris	8	8.6
Snow Jet	6	6.5
Moto-Ski	4	4.3
Ski-Daddler	4	4.3
Ski-Roule	4	4.3
Artic-Cat	3	3.2
Scorpion	2	2.2
Fox Track	2	2.2
Rupp	2	2.2
Snow Prince	2	2.2
Evinrude	2	2.2
A M F	1	1.1
Alouette	1	1.1
Boa-Ski	1	1.1
Johnson	1	1.1
Snowbug	1	1.1
Yamaha	1	1.1
Unknown	1	1.1
Total	93	100.4

*Actual computed value rounded to the nearest tenth.

TABLE 4.2.--Horsepower of snowmobiles involved in accidents.

Horsepower	Number	Per cent*
10	2	2.2
12	6	6.5
14-16	4	4.3
17-18	20	21.5
19-21	5	5.4
22-24	8	8.6
25-28	10	10.8
45	1	1.1
Unknown	37	39.8
Total accidents	93	100.2

*Actual computed value rounded to the nearest tenth.

the horsepower of 39.8 per cent of the vehicles remained unknown.

Environment

Location.--Table 4.3 reveals the distribution of accidents by site. The location of 75.3 per cent of the occurrences was the public highway. The next most frequently occurring accident site is shown to be private property, with a rate of 17.2 per cent. Figure 4.4 consolidates and clarifies Table 4.3, in that it combines the off-road accident statistics and shows their occurrence rate to be 24.7 per cent.

Weather.--Table 4.4 shows that the most prevalent weather condition at the time of the accident was clear, in 60.3 per cent of the accidents. However, the reduced visibility of snow, sleet, and fog does represent a factor in excess of 39 per cent.

Light.--Light conditions are revealed in Figure 4.5. Fifty-one and six tenths per cent of the accidents occurred during daylight. All darkness factors, such as dusk-dawn, lighted, and unlighted areas, tabulated to 48.4 per cent. A 29 per cent level of accident involvement was found for the "dark:unlighted area" classification.

TABLE 4.3.--Distribution of accidents by site.

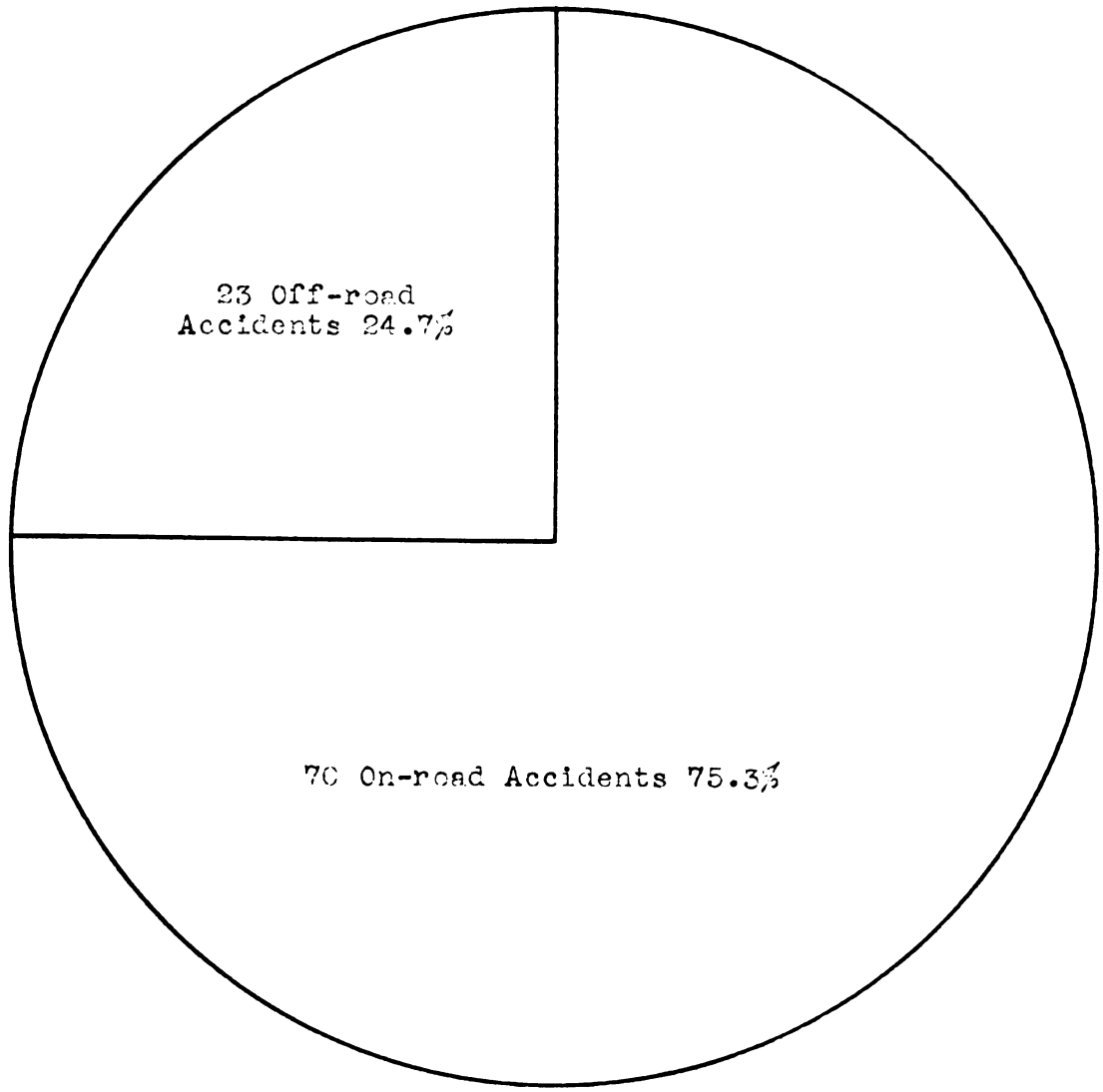
Where	Number	Per cent*
Public Highway	70	75.3
Private Property	16	17.2
Commercial Property	3	3.2
Club Property	2	2.2
Public Property	2	2.2
Total Accidents	93	100.1

*Actual computed value rounded to the nearest tenth.

TABLE 4.4.--Distribution of accidents by weather conditions.

Condition	Number	Per cent*
Clear	56	60.3
Snowing	22	23.7
Sleeting	13	14.0
Fog	2	2.2
Total accidents	93	100.2

*Actual computed value rounded to the nearest tenth.



Total number of accidents 93

Figure 4.4.--Location of snowmobile accidents.

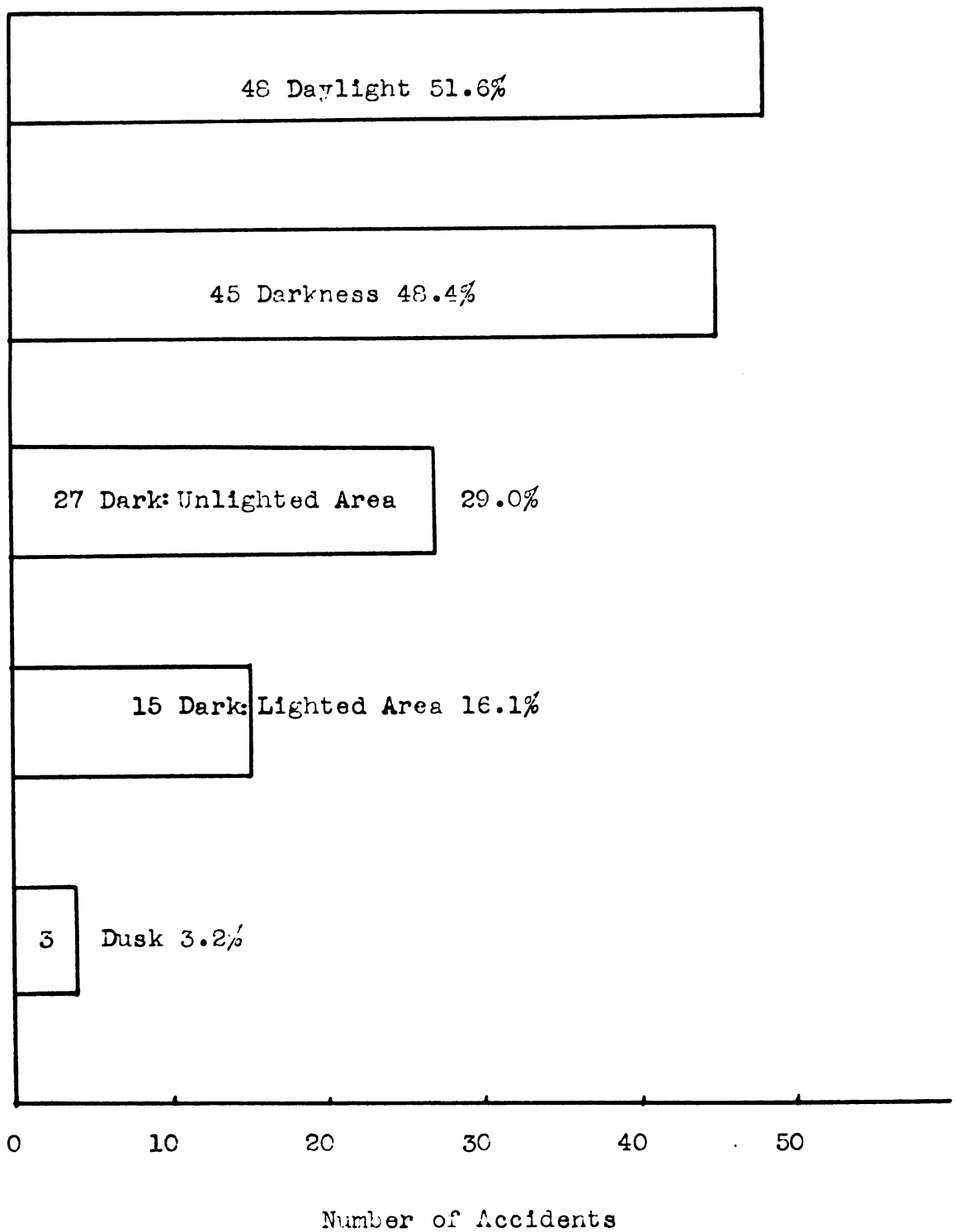


Figure 4.5.--Light conditions at the time of the snowmobile accident.

Accident

Time of day.--The most prevalent time of day for 32.3 per cent of the snowmobile accidents, (Table 4.5), was from 2:01 p.m. to 5:00 p.m. This is the time when daylight fades into dusk and darkness, a time when students are dismissed from school. The time span from 2:01 p.m. to 11:00 p.m., which traverses daylight to darkness, accounted for more than two-thirds of the accidents.

Day of week.--Twenty-nine per cent of the accidents occurred on Sunday, as shown in Table 4.6. The weekends, Friday, Saturday, and Sunday, accounted for 54 per cent of the occurrences. A high level of accident experience on Tuesday and Thursday, combined with the most prevalent hours of occurrences and the population mean age of 18-1/2 years, may be indicative of after-school operation by students.

Week of season.--Table 4.7 shows high occurrence weeks were December 21-27 and December 28-January 3. It was during these weeks that New York received a record snowfall, as well as the fact that the students were on vacation.

Severity of accident.--Personal injury is the leading type of accident, representing 80.6 per cent of the population as shown in Figure 4.6. Upon more careful examination of the personal injury accidents, it was

TABLE 4.5.--Distribution of snowmobile accidents by time of day.

Time	Number	Per cent*
11:01 p.m.- 2:00 a.m.	7	7.6
2:01 a.m.- 5:00 a.m.	2	2.2
5:01 a.m.- 8:00 a.m.	0	0.0
8:01 a.m.-11:00 a.m.	9	9.7
11:01 a.m.- 2:00 p.m.	12	12.9
2:01 p.m.- 5:00 p.m.	30	32.3
5:01 p.m.- 8:00 p.m.	12	12.9
8:01 p.m.-11:00 p.m.	21	22.6
Total	93	100.2

*Actual computed value rounded to the nearest tenth.

TABLE 4.6.--Distribution of snowmobile accidents by day of week.

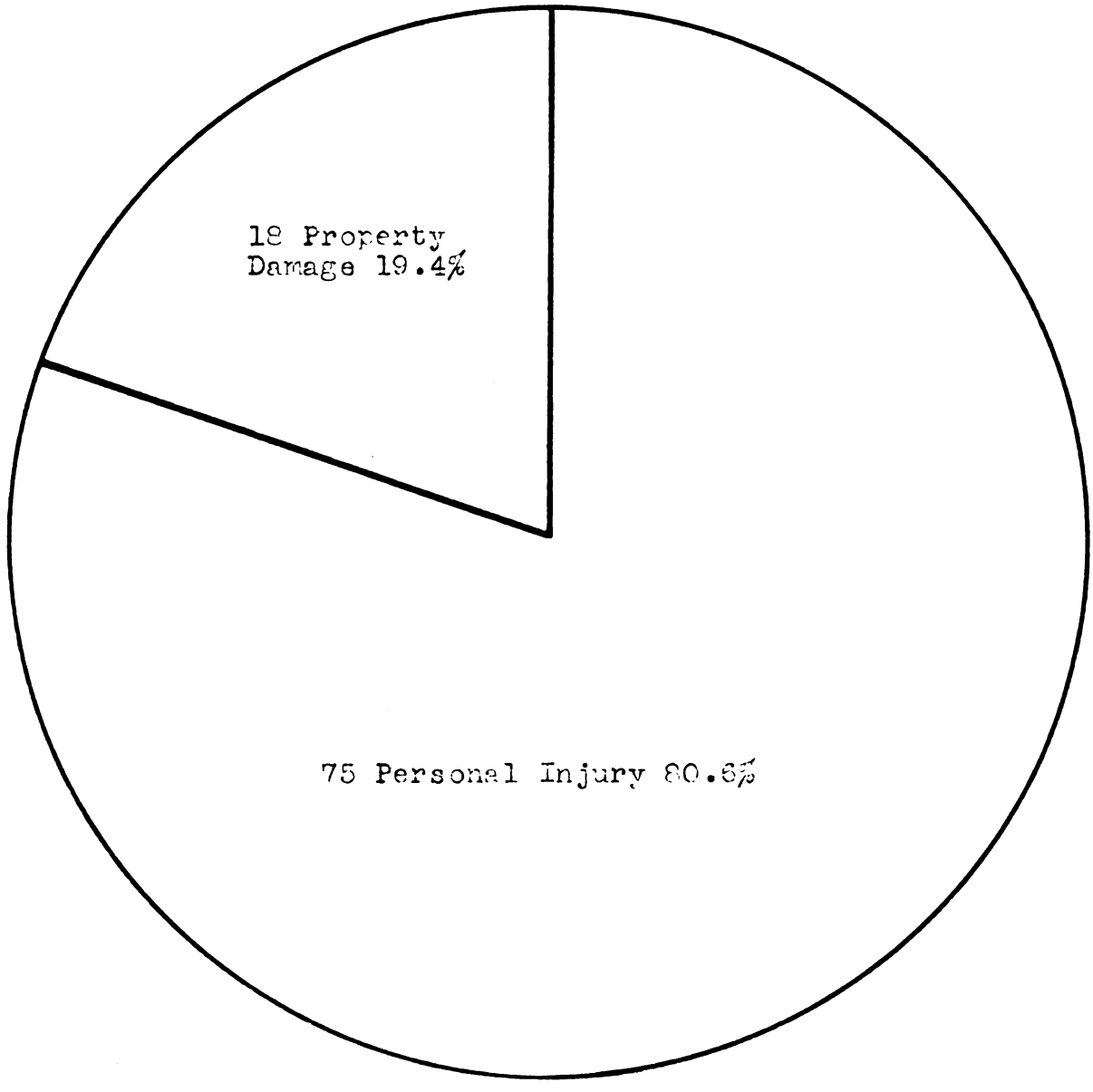
Day	Number	Per cent*
Monday	9	9.7
Tuesday	14	15.1
Wednesday	6	6.5
Thursday	13	14.0
Friday	9	9.7
Saturday	15	16.1
Sunday	27	29.0
Total accidents	93	100.1

*Actual computed value rounded to the nearest tenth.

TABLE 4.7.--Distribution of snowmobile accidents by week of winter season.

Week of Occurrence		Number	Per cent*
11-23	11-29	1	1.1
11-30	12- 6	4	4.3
12- 7	12-13	3	3.2
12-14	12-20	10	10.8
12-21	21-27	18	19.4
12-28	1- 3	20	21.5
1- 4	1-10	4	4.3
1-11	1-17	7	7.5
1-18	1-24	5	5.4
1-25	1-31	8	8.6
2- 1	2- 7	2	2.2
2- 8	2-14	1	1.1
2-15	2-21	3	3.2
2-22	2-28	5	5.4
3- 1	3- 7	2	2.2
Total weeks--15			
Total accidents		93	100.2

*Actual computed value rounded to the nearest tenth.



Total number of accidents 93
Total Victims 98

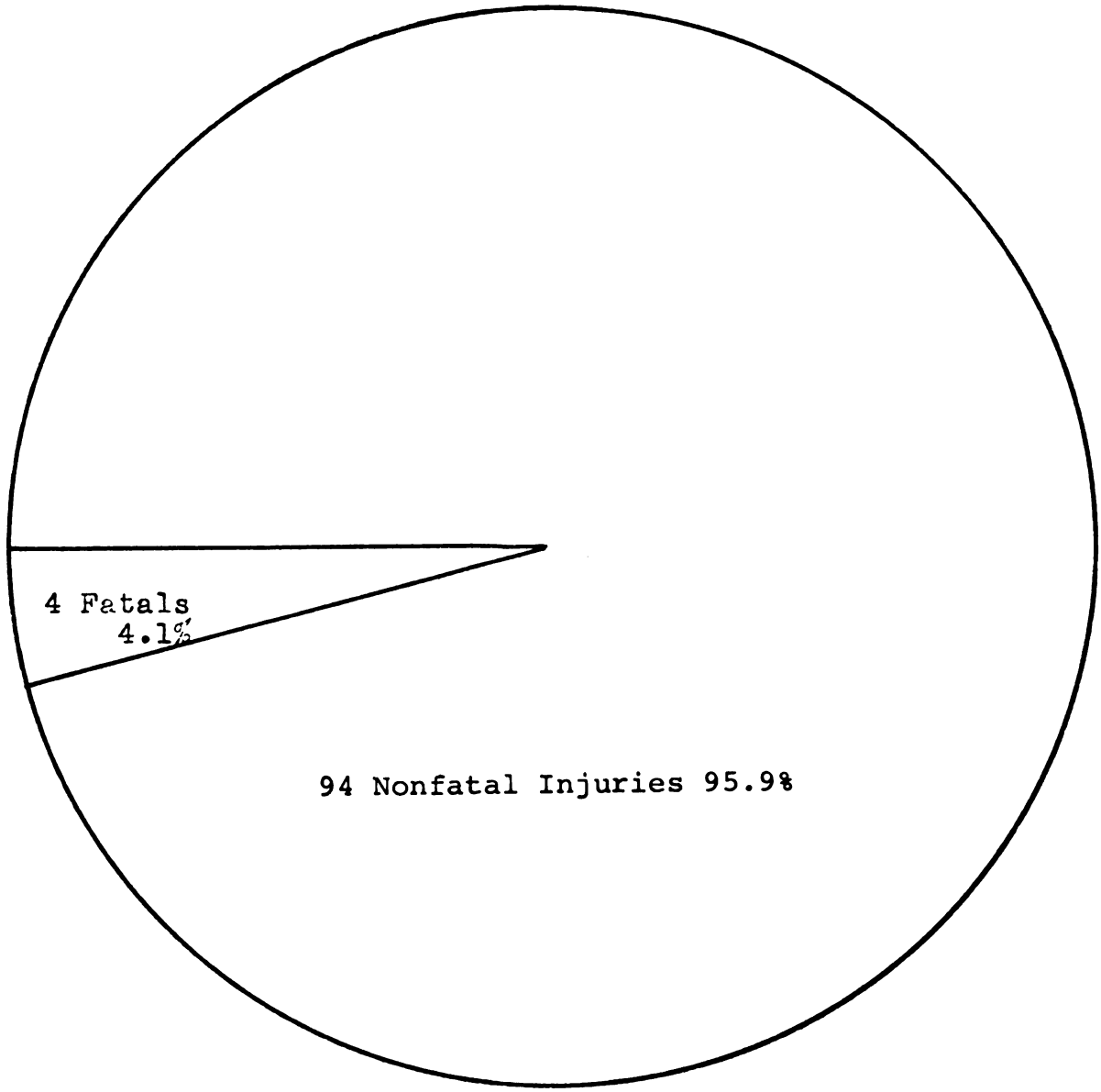
Figure 4.6.--Type of snowmobile accident.

found that 4.1 per cent resulted in fatalities. Figure 4.7 reveals that in 75 occurrences, 98 persons were injured. These figures indicate that the mode would be multiple victims.

Type of accident.--Table 4.8 shows that collision accidents accounted for 92.9 per cent of the occurrences, and that noncollision accidents accounted for 7.5 per cent. The greatest number of collisions, 74.2 per cent, occurred with motor vehicles. The second most common interactor was the pedestrian, in 8.6 per cent of the accidents.

Actions preceding accident.--An examination of actions preceding the accident (Table 4.9) reveals that the most common action was proceeding straight ahead in 47.3 per cent of the cases; the next in frequency of occurrence was crossing the highway, 24.7 per cent. Five and four tenths per cent of the accidents occurred when the snowmobiles were stopped and they were struck by other motor vehicles.

Indicated causes.--The apparent causes of accidents in this study are listed in Table 4.10. Leading the list is failure to yield the right-of-way, at 32.3 per cent. The next most commonly occurring cause is excess speed for conditions, at 25.8 per cent. The category "none evident" included accidents such as colliding with a lone tree in



Total number of personal injury accidents 75

Total number of victims 98

Figure 4.7.--Snowmobile accident victims.

TABLE 4.8.--Distribution of accidents by collision or noncollision type.

	Number	Per cent*
Collision Cause:		
Motor Vehicle	69	74.2
Pedestrians	8	8.6
Fixed Object	6	6.5
Train	2	2.2
Animal	1	1.1
Total Collisions	86	92.9
Noncollision Cause:		
Overturned	4	4.3
Operator fell off	3	3.2
Total Noncollisions	7	7.5
Total Accidents	93	100.4

*Actual computed value rounded to the nearest tenth.

TABLE 4.9.--Distribution of snowmobile accidents by actions preceding the occurrence.

Actions	Number	Percent
Proceeding straight ahead	44	47.3
Crossing highway	23	24.7
Turning left	8	8.6
Overtaking another vehicle	6	6.5
Turning right	4	4.3
Stopped in traffic (nonmoving)	4	4.3
Skidding	3	3.2
Parked (nonmoving)	1	1.1
Total moving accidents	88	94.6
Total nonmoving accidents	5	5.4
Total accidents	93	100.0

TABLE 4.10.--Distribution of snowmobile accidents by apparent cause.

Apparent Cause	Number	Per cent*
Failure to yield the right-of-way	30	32.3
Excess speed for conditions	24	25.8
Defective equipment	11	11.8
Loss of control	9	9.7
Failure to keep right	5	5.4
Unseen obstacle	5	5.4
Following too closely	4	4.3
None evident	3	3.2
Overtaken by other vehicle	2	2.2
Total accidents	93	100.1

*Actual computed value rounded to the nearest tenth.

the middle of an open field in daylight, and hitting a pedestrian in the middle of an open field in daylight.

Operator Variables of the Sample and Selected Case Summaries

Utilizing data obtained from personal interviews, snowmobile accident reports (11/69), abstract of driving records (DS-242), and school record reports, a compilation of operator variables and selected case summaries is presented in this section. The compilation and case summaries relate to the sample of 42 subjects of concern in this study.

Age

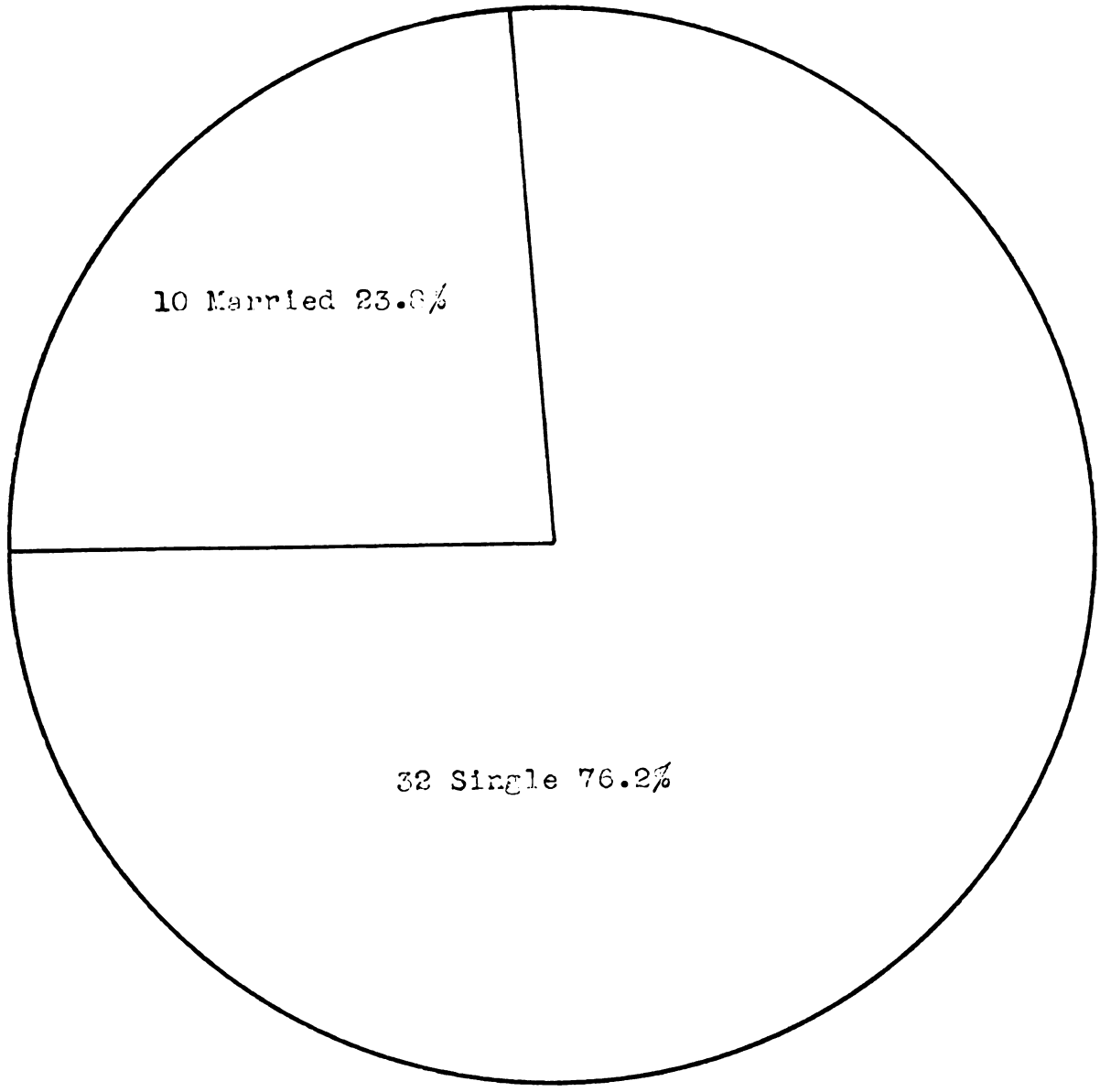
The sample's age distribution was presented in Chapter III and was tabulated in Table 3.2. The age characteristics for the sample are as follows: mean age, 18.9 years; mode age, 23.3 years; and a range from 13 to 24 years. The mean age of the sample differed from the mean age of the population by .3 of a year or 3.6 months.

Sex

Thirty-nine members of the sample were male and three were female. This represented 93 per cent and 7 per cent, respectively. The sample deviated from the population distribution by a plus .5 per cent for females.

Family Life

Ten of the subjects, or nearly 25 per cent, were married (Figure 4.8) and nine had children, for a total



Total number of subjects 42

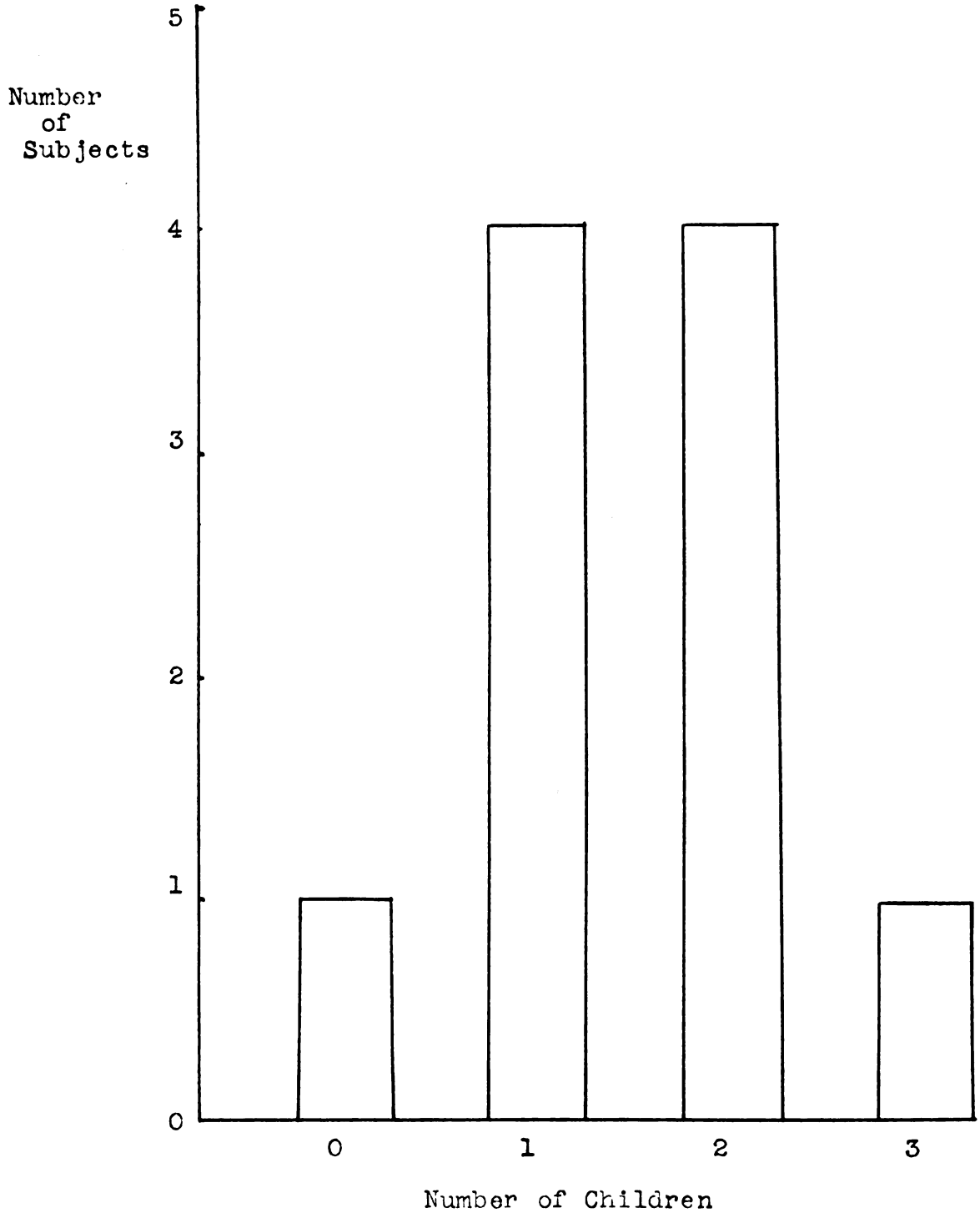
Figure 4.8.--Marital status of subjects.

of 15 children (Figure 4.9). The distribution of the subjects' brothers and sisters is shown in Table 4.11. Totals of 85 brothers and 46 sisters were reported by the sample, for a total of 131 siblings. The filial family had a mean of 3.28 siblings per family. The occupations of the subjects' parents are revealed in Table 4.12. The highest frequency of occupations reported for fathers and mothers, respectively, was semi-skilled and housewife. The high number for the category "not reported" resulted from subjects not knowing or not wishing to state unemployed or an occupation that did not fit their ontology. Four fathers and six mothers of the subjects were deceased. Only two subjects came from homes with separated parents, as shown in Table 4.13.

Thirty-five and seven tenths per cent of the sample felt that their parents granted them freedom, and 9.5 per cent felt that their parents yielded them responsibility (Table 4.14). Table 4.15 shows that only one of the subjects felt he had difficulties with his mother. In excess of 61 per cent had normal difficulties or no difficulties in the home.

Occupation

Table 4.16 exposes the fact that 42 per cent of the subjects didn't really have an occupation, since they were students. Most of the other vocations represented were of the skilled or semi-skilled type, as opposed to



Total number of children 15

Figure 4.9.--Family size of married subjects.

TABLE 4.11.--Distribution of sample by siblings.

Number of Siblings	Number Had Brothers	Number Had Sisters	Totals
None	8	14	22
1	9	10	19
2	12	4	32
3	4	1	15
4	3	2	20
5	2	1	15
6	3	2	30
Not Reported	1	8	9

Total Brothers--85

Total Sisters--46

Total Brothers and Sisters of the sample of 42--131

Mean 3.28 siblings per subject in the filial family.

TABLE 4.12.--Occupation of parents.

Father		Mother	
Occupation	Number	Occupation	Number
Semi-skilled	11	Housewife	11
Unskilled	5	Factory	5
White Collar	5	Professional	4
Unemployed	3	Clerical	2
Blue Collar	2	Unskilled	2
Professional	0	Domestic	1
Not Reported	12	Not Reported	11
Total Fathers	38	Total Mothers	36

TABLE 4.13.--Distribution of sample by existence of parents in the home.

State: Living with	Number	Per cent
Both Parents	29	69.0
Father--Mother Deceased	6	14.3
Mother--Father Deceased	4	9.5
Mother--Parents Separated	2	4.8
Mother--Father Unknown	1	2.4
Total	42	100.0

TABLE 4.14.--Responses to question: "How did your parents generally treat you?"

Treated	Number	Per cent
Granted Freedom	15	35.7
Normal for Age	11	26.2
Strict	8	19.0
Yielded Responsibility	4	9.5
Other	1	2.4
Not Reported	3	7.1
Total	42	99.9

*Actual computed value rounded to the nearest tenth.

TABLE 4.15.--Distribution of sample's difficulties in the home environment.

Difficulties	Number	Per cent
None	14	33.3
Normal	12	28.6
Some	3	7.1
A Lot	1	2.4
Father Only	1	2.4
Mother Only	1	2.4
Not Reported	10	23.8
Total	42	100.0

TABLE 4.16.--Distribution of the sample by vocation.

Vocation	Number	Per cent*
Student	18	42.9
Skilled	4	9.5
Mechanic	4	9.5
Machinist	3	7.1
Unskilled	3	7.1
Farmer	3	7.1
Laborer	3	7.1
Clerical	2	4.8
Professional	1	2.4
Unemployed	1	2.4
Total	42	99.9

*Actual computed value rounded to the nearest tenth.

the professional type. The results of this table were expected because of the 18.9 years mean age of the sample.

Driving Record

Questions relating to the subject's accidents and convictions were selected as verifiers, and inter-item correlations were performed. The subject's interview responses relative to accidents and convictions were correlated against his abstract of driving record (DS-242).

Computation of the Pearson Product-Moment Correlation Coefficient yielded r = .080 and r = .599, respectively, for accidents and convictions (Table 4.17). Many possible reasons exist for the lack of correlation between the abstract of operating record and the interview responses. Because the abstracts were obtained soon after the interview, some accidents and convictions may not have been posted. Perhaps the subjects confused arrests and convictions, and since there is a classic court log-jam of traffic cases, it is likely that they might not have been convicted. Another aspect may have been the subject's confounding any accident with the statute definition of accident, whereas the DS-242 lists only reported statute accidents. Further, the subject's responses would tend to be consistent with his self-concept.

TABLE 4.17.--Distribution of subjects' driving records by accidents and convictions.

	Accidents		Convictions	
Number	Record	Interview	Record	Interview
0	34	26	25	21
1	6	10	6	12
2	2	4	3	3
3	0	1	2	2
4	0	1	3	1
5	0	0	2	2
6	0	0	0	1
7	0	0	1	0
Totals	42	42	42	42
Coefficients	r = .080		r = .599	

Table 4.18 shows the motor vehicle department's administrative actions relative to the subject's driving record. The majority of the sample, 69 per cent, were not subjects of departmental action. Further perusal of the above-mentioned table indicates that of the 24 total actions, some subjects were recipients of more than one action.

Self-Concept As An Operator of Automobiles and Snowmobiles

Information relative to the subject's self-concept as an automobile operator and a snowmobile operator was obtained through the personal interview. A better than average self-concept as an automobile operator was thought to correlate positively with the number of convictions on the subject's abstract of driving record (DS-242).

As shown in Table 4.19, half of the subjects felt they were better than average snowmobile operators, and 45 per cent felt they were better than average automobile operators. There is a correlation of $r = .894$ between the number of convictions shown in Table 4.17 and the number of subjects rating themselves as above average or better

TABLE 4.18.--Distribution of subjects' driving records by departmental administrative action.

Action	Frequency	Per cent
None	29	69.0
Driver Clinic #1	7	16.7
Driver Clinic #2	3	7.1
Suspension #1	1	2.4
Suspensions #2, #3	3	7.1
Revocation	3	7.1
Warning letters #1, #2	3	7.1
Hearing "to show cause"	1	2.4
Total Actions	24	

TABLE 4.19.--Distribution of subject's self-concept as an operator of automobiles and snowmobiles.

Self Rating	Automobile		Snowmobile	
	Number	Per cent*	Number	Per cent*
Superior	3	7.1	2	4.8
Very good	5	11.9	5	11.9
Above Average	11	26.2	14	33.3
Average	12	28.6	17	40.5
Below Average	2	4.8	2	4.8
No Idea	7	16.7	1	2.4
Not Reported	2	4.8	1	2.4
Total	42	100.1	42	100.1

*Actual computed value rounded to the nearest tenth.

automobile operators; this correlation again is indicative of consistency of self-concept.

Automobile and Snowmobile Operation Experience

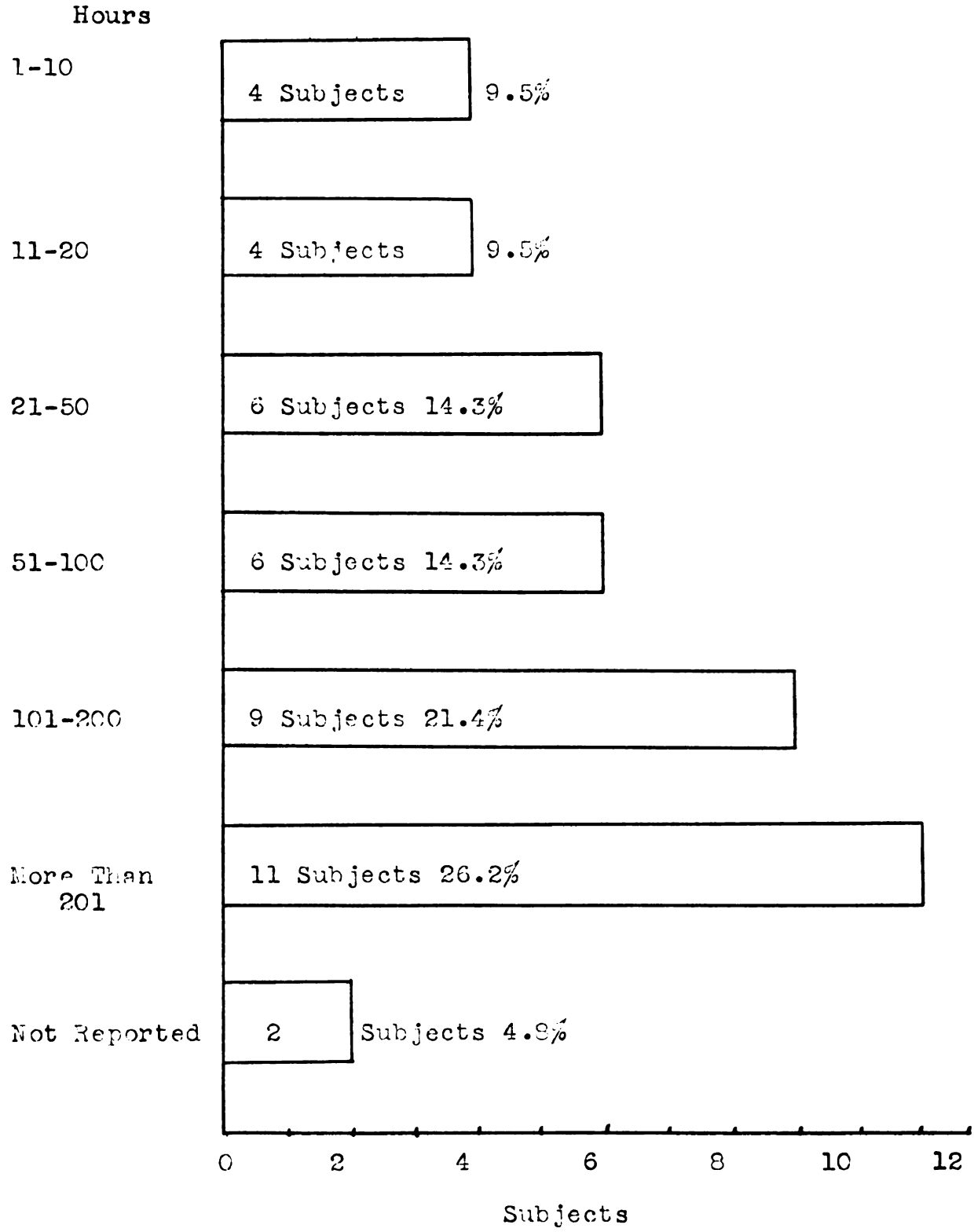
The mean years of experience for snowmobile operation by the subjects was 2.54 years, and 3.39 years for automobile operation, as reported in Table 4.20. The range of automobile operation experience extended from zero to nine years. While 21.4 per cent of the subjects had no years of automobile operating experience, the highest frequency of experience level (33.3 per cent) was five years. The snowmobile operation experience ranged from less than one year to seven years. The less than one year experience category accounted for 16.7 per cent of the sample. The number of years of snowmobile experience with the highest frequency was three years, which accounted for 23.8 per cent of the sample.

The number of hours per year of operation of snowmobiles by the operators is revealed in Figure 4.10. The mean number of hours of operation per year was found to be 106.4 hours. Twenty-six and two tenths per cent of the subjects operated more than 201 hours, and 9.5 per cent operated 10 or less hours per year. Figure 4.11 depicts the total hours of snowmobile operation, with the mean total hours of operation as 284.4 hours for the sample.

TABLE 4.20.--Distribution of sample by years of auto and snowmobile experience.

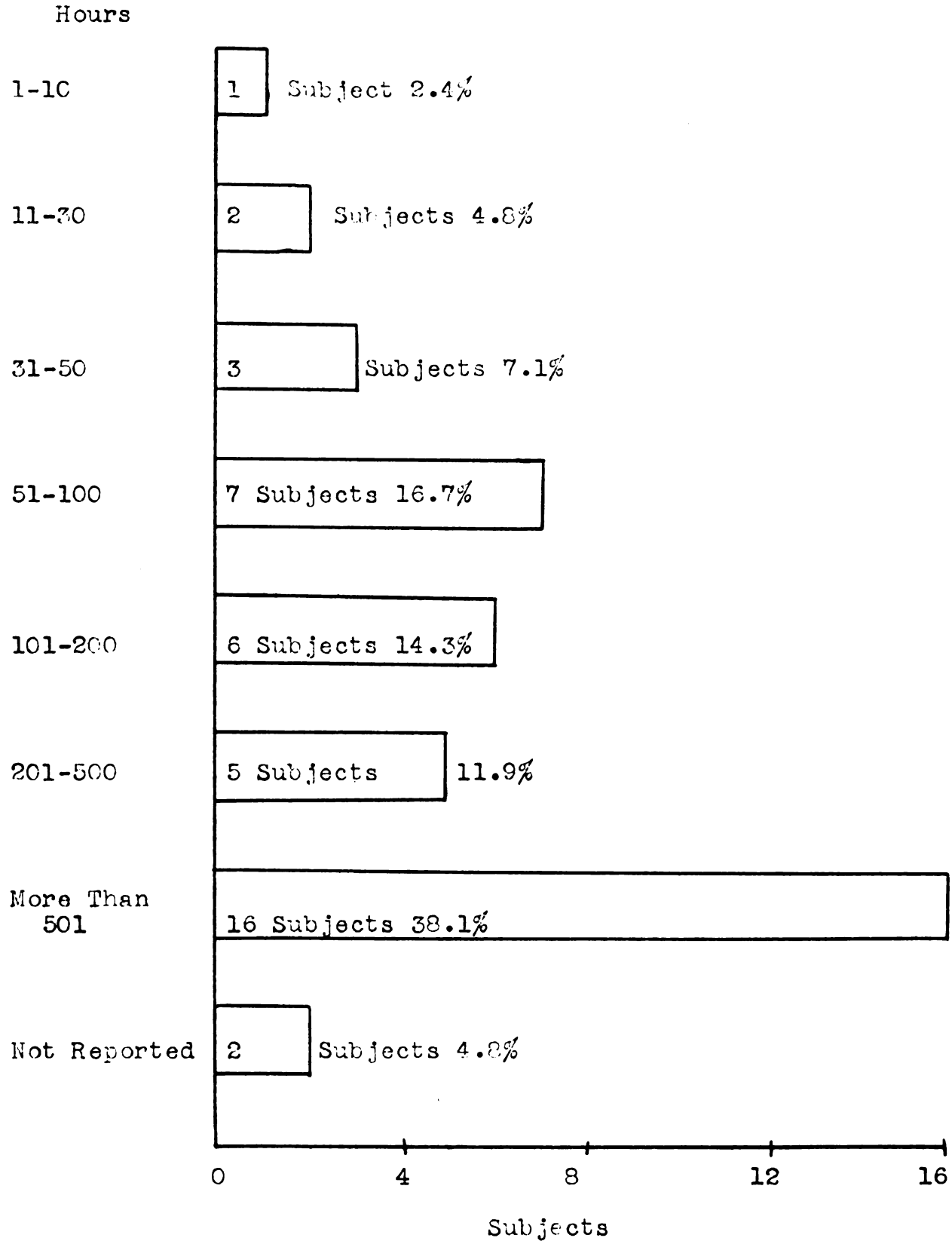
Experience Years	Automobile		Snowmobile	
	Number	Per cent*	Number	Per cent*
0	9	21.4	7	16.7
1	0	0.0	6	14.3
2	4	9.5	7	16.7
3	4	9.5	10	23.8
4	3	7.1	6	14.3
5	14	33.3	4	9.5
6	3	7.1	1	2.4
7	0	0.0	1	2.4
8	0	0.0	0	0.0
9	1	2.4	0	0.0
Not Reported	4	9.5	0	0.0
Total	42	100.0	42	100.1
Mean	3.39 years		2.54 years	

*Actual computed value rounded to the nearest tenth.



Mean Hours per Year 106.4

Figure 4.10.--Hours of snowmobile operation per year by subjects.



Mean of total hours of operation 284.4

Figure 4.11.--Total hours of snowmobile operation by subjects hours.

Physical, Emotional, and Mental State

An attempt was made to gather data relative to the subjects' physical, emotional, and mental state preceding the accident. The sources of this information were the personal interview and the school record report.

Physical and emotional.--The subjects received a mean of eight hours and twenty-seven minutes of sleep the night preceding the accident (Table 4.21). Also, none of the sample had been injured or ill during the 24 hours previous to the occurrence. However, Figure 4.12 reveals that 19 per cent of the subjects were upset, worried, or bothered previous to the accident. Data in Table 4.23 indicate that before the snowmobile accident more than 83 per cent were in a physical or emotional state other than normal. The subject's emotional reactions to the operation of the snowmobile, as shown in Figure 4.13, were positively oriented, indicative of a strong cathexis toward the snowmobile.

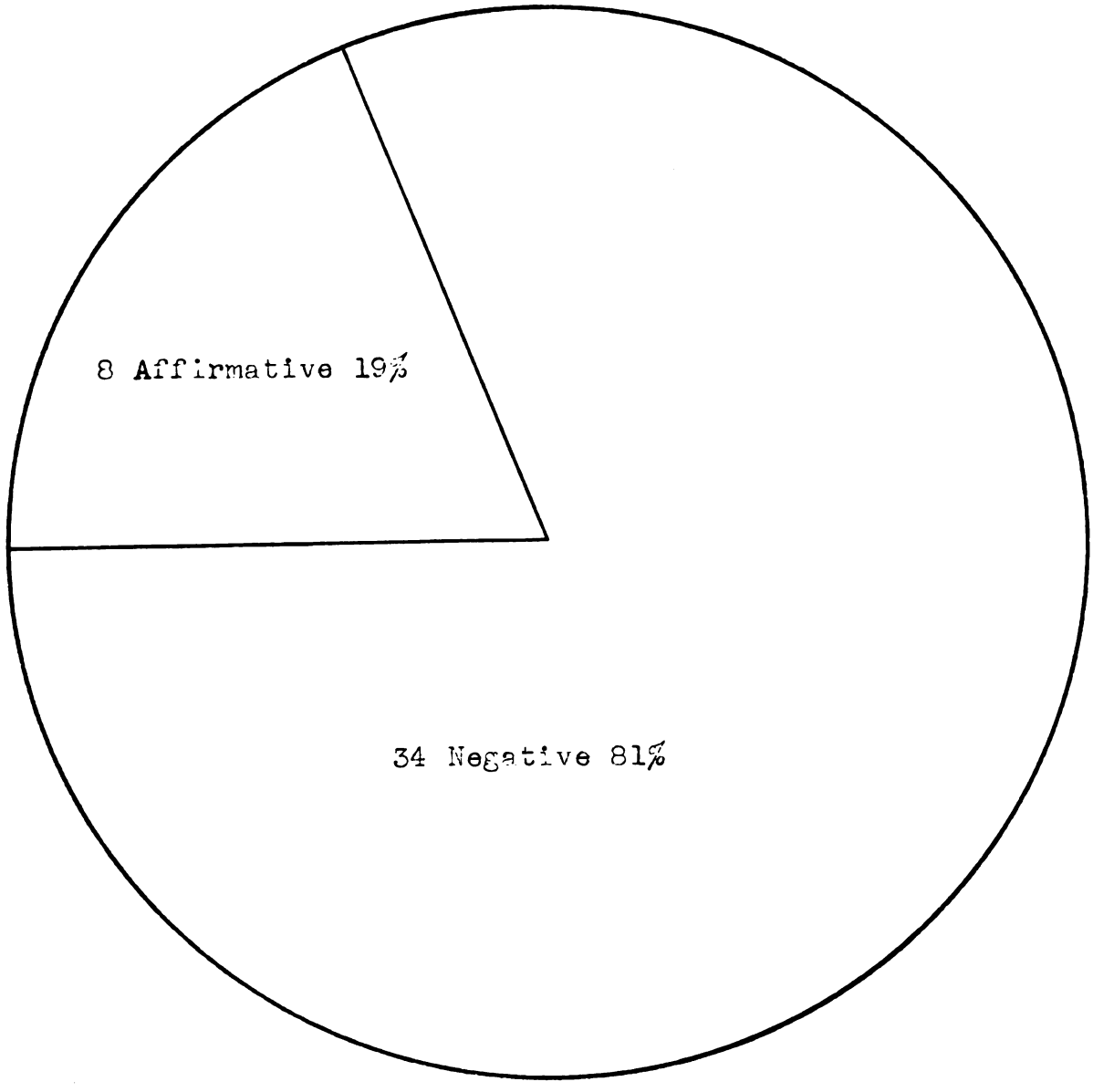
Alcohol.--The use of alcohol is a segment of the life style and frequently has been found to be a factor in accidents. Some of the subjects' beliefs regarding alcohol were probed, as well as the amount of alcohol consumed prior to the accident.

The subjects felt that the ingesting of alcohol did not affect their operation of a snowmobile. Figure 4.14 illustrates that 81 per cent believed this way.

TABLE 4.21.--Distribution of sample by amount of sleep preceding the accident.

Hours of Sleep	Number	Per cent
5	1	2.4
6	0	0.0
7	8	19.0
8	18	42.9
9	5	11.9
10	6	14.3
11	3	7.1
12	1	2.4
Total	42	100.0

Mean--8.45 hours



Total number of subjects 42

Figure 4.12.--Distribution of responses to question relative to being upset, worried, or bothered previous to the accident.

TABLE 4.22.--Distribution of descriptions of physical and emotional feelings previous to accidents of subjects.

Description	Number	Per cent
Normal	7	16.7
Drowsy	1	2.4
Tired	3	7.1
Nervous	1	2.4
Bored	1	2.4
Excited	10	23.8
Angry	3	7.1
Other	16	38.1
Total nonnormal--35		
Total	42	100.0

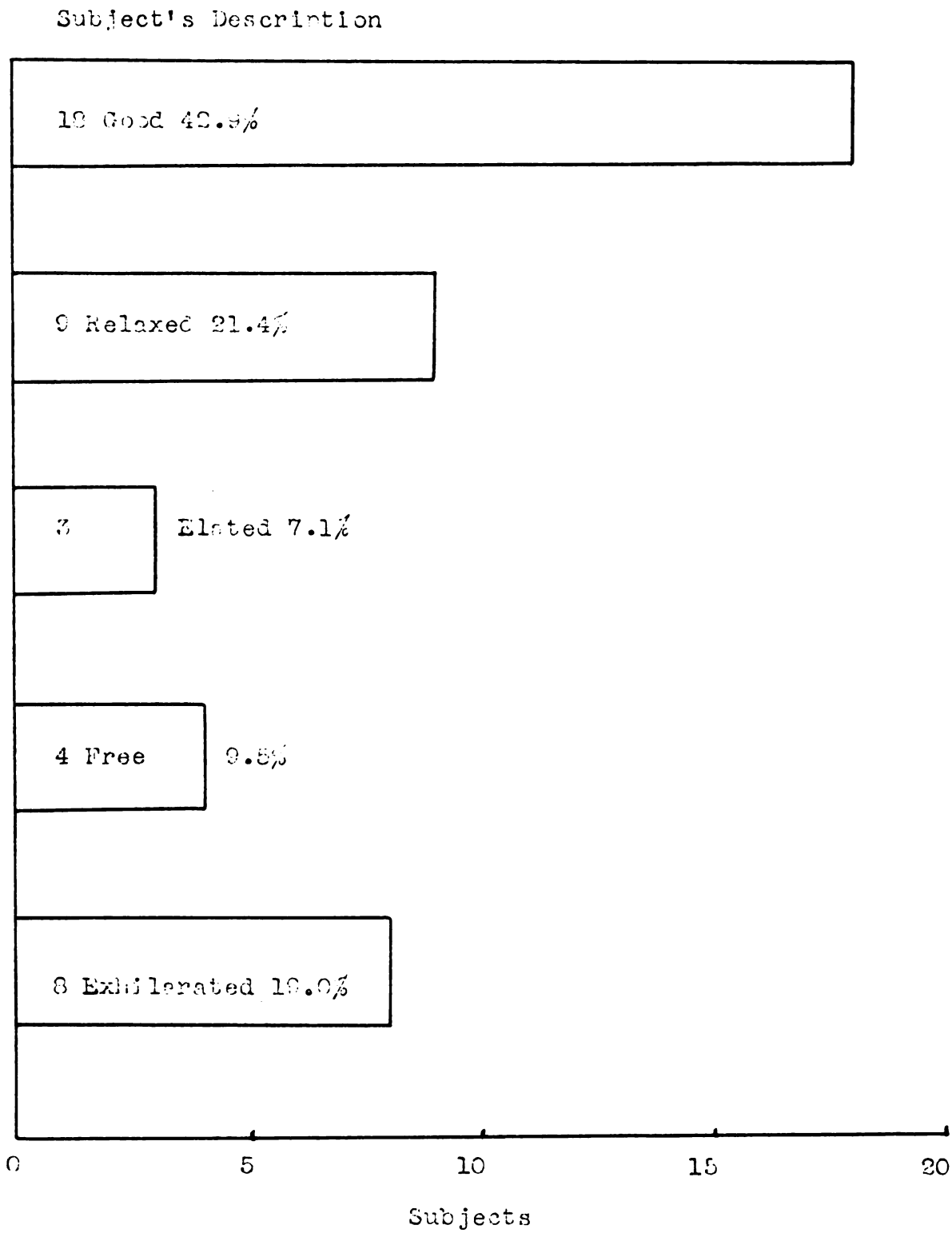
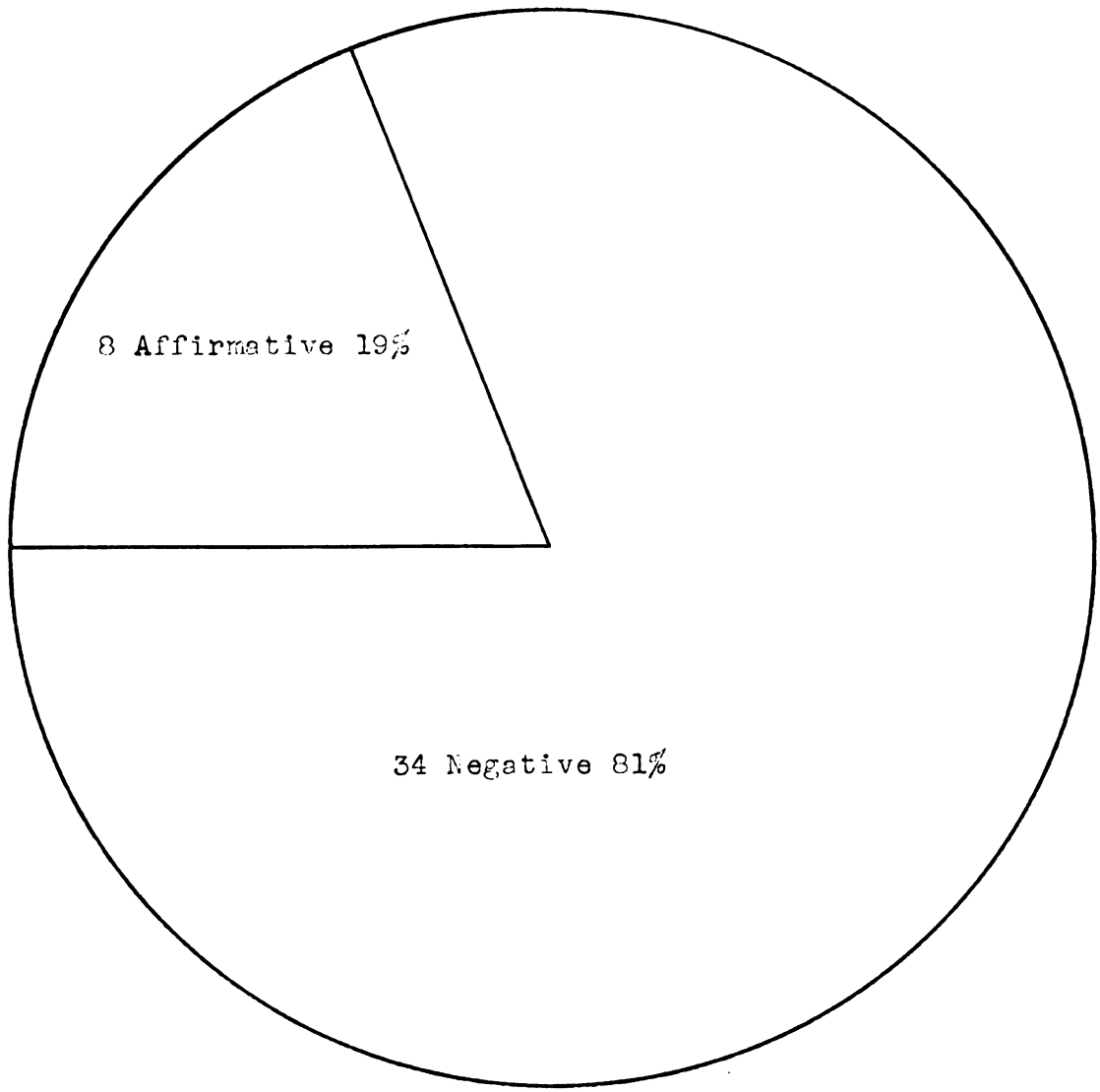


Figure 4.13.--Distribution of emotional reaction to snowmobile operation.



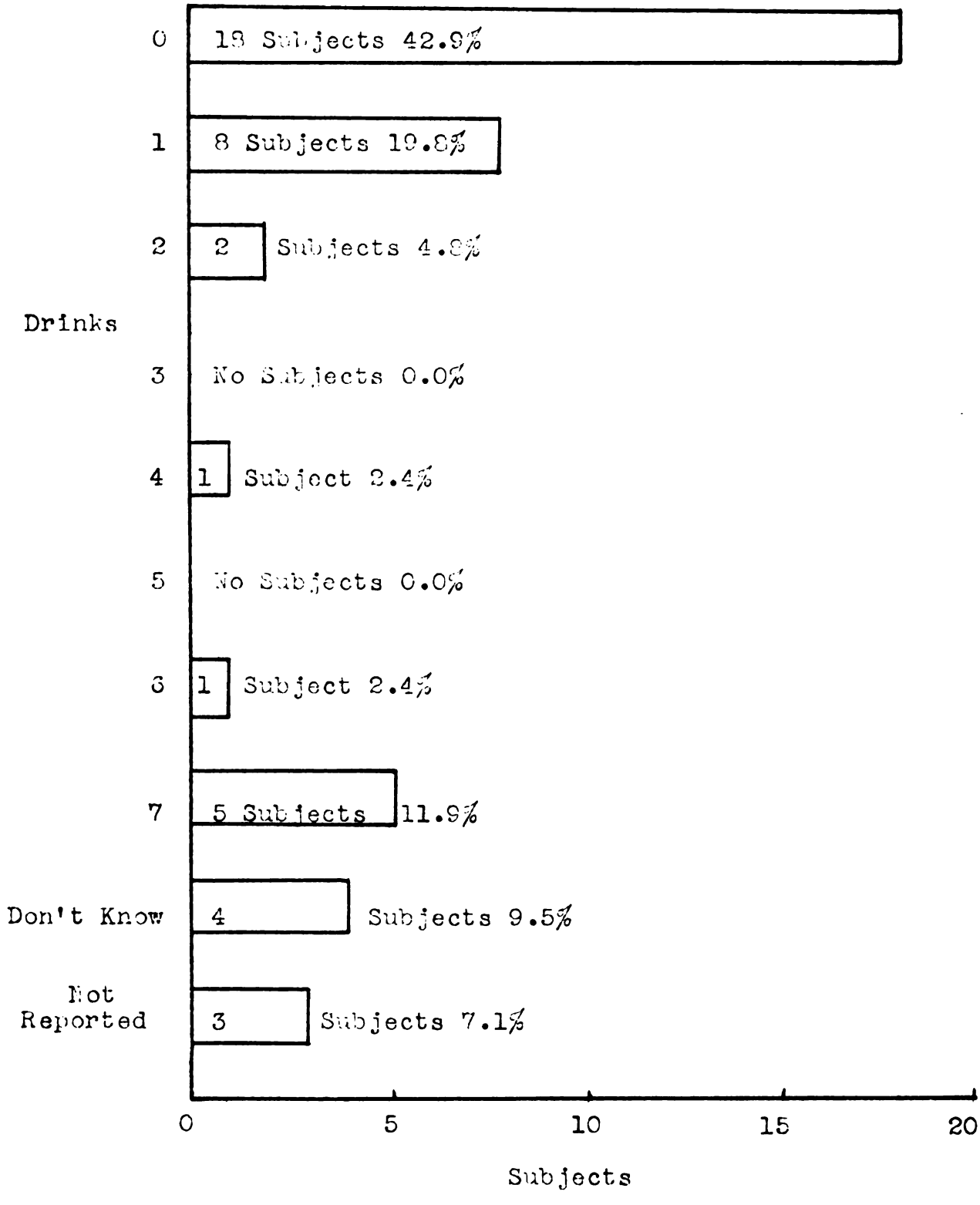
Total number of subjects 42

Figure 4.14.--Distribution of responses to question relative to whether your snowmobiling is affected by alcohol.

Seventeen subjects reported they had consumed alcoholic beverages within six hours of the accident. Based on the reported data in Figure 4.15, those who reported drinking had a mean in excess of three drinks prior to the accident. As indicated in Figure 4.16, 35 answered in some form of the affirmative relative to alcohol being a prodrome to an occurrence.

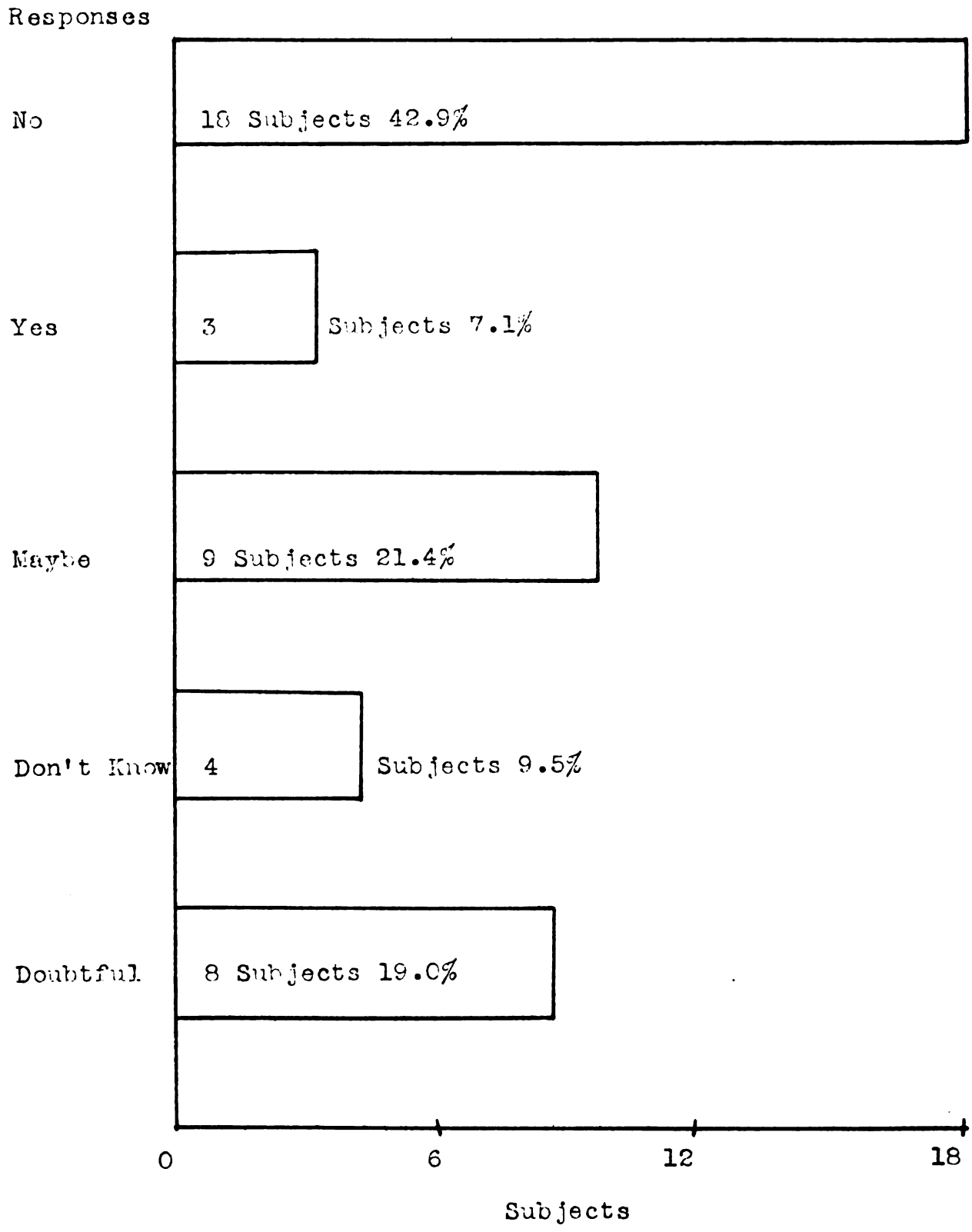
Speed.--Table 4.23 indicates the mean estimated speed prior to the accident was 24.8 miles per hour. Speeds reported by the subjects ranged from 1 to 5 miles per hour by 2.4 per cent of the sample, to 46 to 50 miles per hour by 2.4 per cent of the sample. The most frequently occurring speed interval was 26 to 30 miles per hour by 19 per cent of the sample.

Hypothermia.--The mean reported temperature by the sample was plus 15°F. Combining the mean temperature of plus 15°F with the mean estimated speed of 24.8 miles per hour, and consulting Siple's windchill index yielded an estimated mean windchill of -33°F. Siple's windchill index may be found in Appendix H. The windchill element, when considered in relation to the data contained in Figure 4.17, that only 57.1 per cent of the subjects used protective clothing, may lead the reader to conclude that an early stage of hypothermia was a contributing factor in 42.9 per cent of the accidents.



Mean number of drinks 3.41

Figure 4.15.--Distribution of number of drinks consumed by subjects within six hours of the snowmobile accident.



Total number of subjects 42

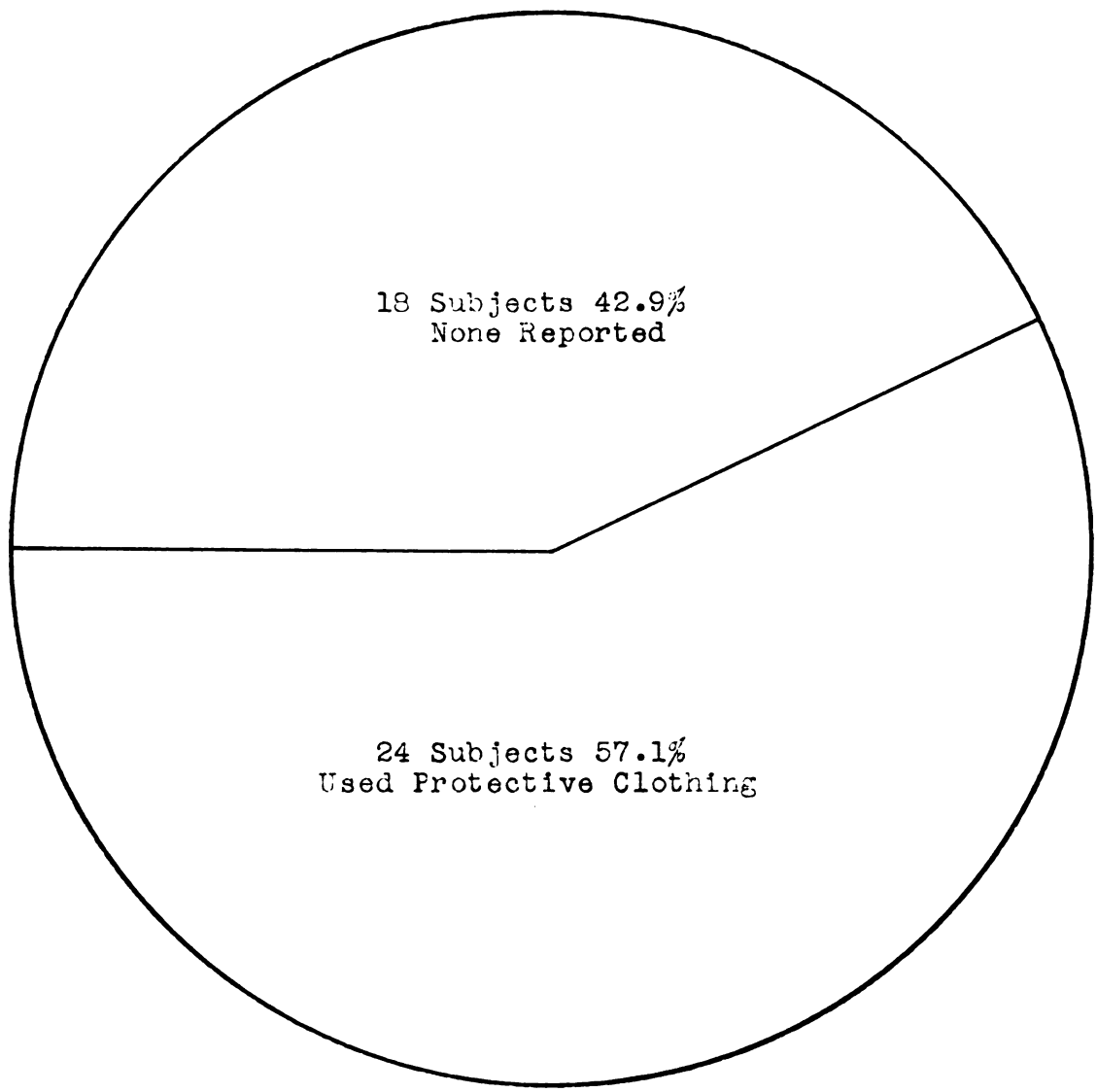
Figure 4.16.--Distribution of responses relative to alcohol being a factor in the accident.

TABLE 4.23.--Distribution of estimated speed of snowmobile by operator prior to the accident.

Speed (MPH)	Number	Per cent
Not reported	5	11.9
1 - 5	1	2.4
6 - 10	2	4.8
11 - 15	4	9.5
16 - 20	5	11.9
21 - 25	6	14.3
26 - 30	8	19.0
31 - 35	5	11.9
36 - 40	4	9.5
41 - 45	1	2.4
46 - 50	1	2.4
Total	42	100.0

Mean estimated speed--24.8 MPH

Total estimates--37



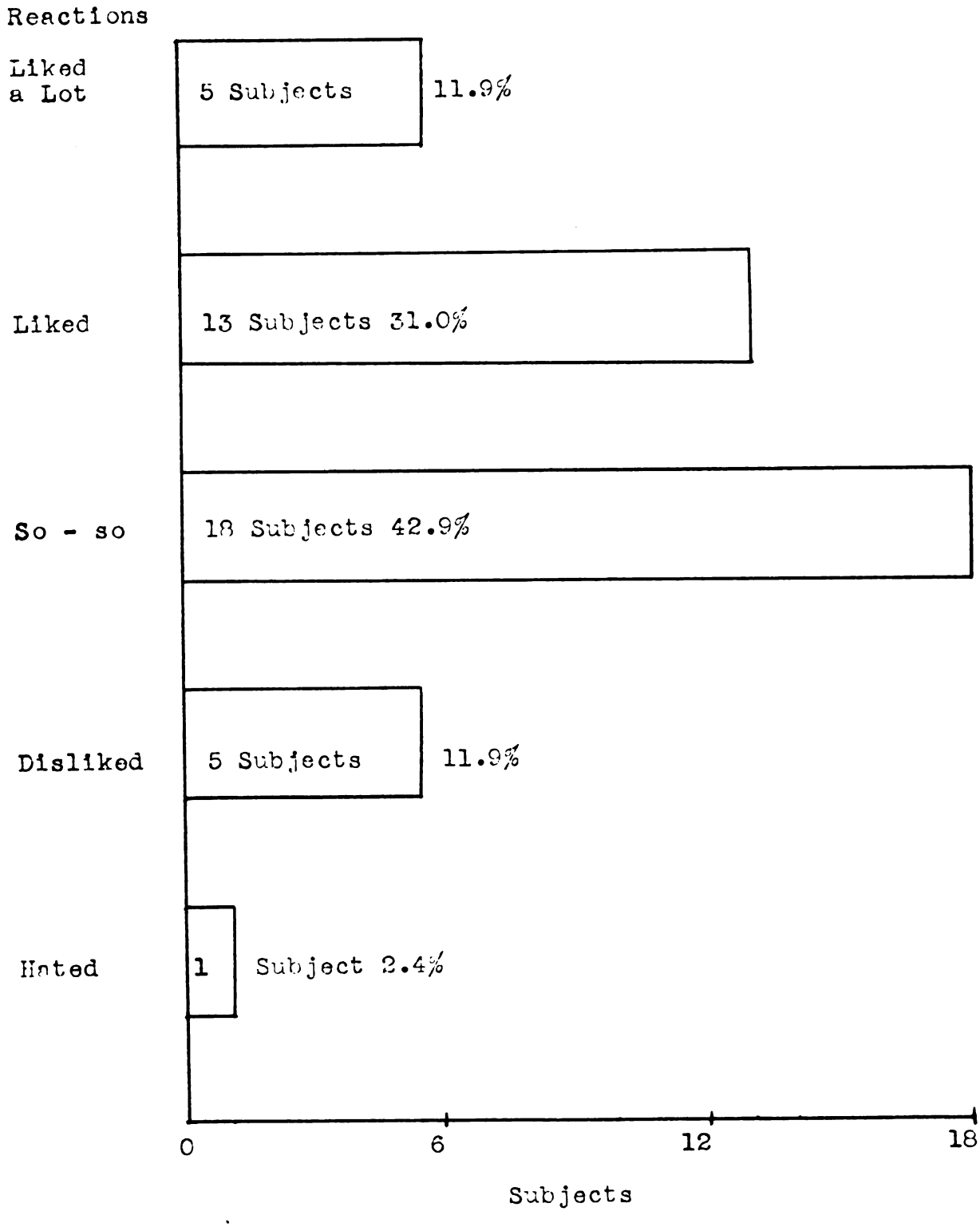
Total number of subjects 42

Figure 4.17.--Distribution of reported incidence of use of protective clothing by subjects.

School relationship and mental state.--The subjects' reactions to school are depicted in Figure 4.18. These data indicated a tacit approval of school by 85.7 per cent, and a rejection of school by 14.3 per cent of the sample. Table 4.24 shows that 26.2 per cent of the subjects had a history of repeated problems, and 42.9 per cent of the subjects were below average in their social relationships. Table 4.24 further shows that while 14.3 per cent of the subjects were above average in ability, only 9.5 per cent had above average achievement. Conversely, while only 19 per cent of the subjects were below average in ability, 47.6 per cent had below average achievement.

Table 4.25 reveals that 57.1 per cent of the subjects would have enrolled in a snowmobile educational program prior to the accident if the program had been available. Only 38.1 per cent of the sample stated they would not have participated in such a program. Table 4.26 further shows that 45.2 per cent of the subjects would presently enroll in a snowmobile operation and maintenance program if it were available.

Operator suggestions.--Table 4.26 shows the subjects' responses to the question: Do you have any suggestions on how we can make snowmobiling in New York State safer? The subjects' suggestions are divided into the



Total number of subjects 42

Figure 4.18.--Distribution of subjects' reactions to the school environment.

TABLE 4.24.--Distribution of subjects' school record reports by qualities.

Quality	Above Average		Average		Below Average		Total	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Ability	6	14.3	28	66.7	8	19.0	42	100.0
Achievement	4	9.5	18	42.9	20	47.6	42	100.0
Social Relationships	1	2.4	23	54.7	18	42.9	42	100.0
Repeated Problems	11	26.2	24	57.1	7	16.7	42	100.0
Mean	5.5		23.3		13.2			

TABLE 4.25.--Distribution of sample by expressed interest in a snowmobile operation and maintenance educational program.

	Would Have Enrolled		Would Enroll Now	
Response	Number	Per cent	Number	Per cent
Positive	24	57.1	19	45.2
Undecided	2	4.8	2	4.8
Negative	16	38.1	21	50.0
Total	42	100.0	42	100.0

TABLE 26.--Distribution of subjects' responses to the question: Do you have any suggestions on how we can make snowmobiling in New York State safer?

Suggestions	Number	Per cent of Sample
Operator		
Age Limits	20	47.6
Require helmets	14	33.3
Courses	10	23.8
Operational tests	8	19.0
Written tests	7	16.7
Licensing	5	11.9
Vehicle		
Registration	31	73.8
Limit Horsepower	6	14.3
Inspection	5	11.9
Equipment standards	5	11.9
Insurance	3	7.1
Environment		
Public Information Programs	23	54.8
Ban highway operation	10	23.8
Crossing warning signs	7	16.7
Provide more off-road areas	7	16.7
None	2	4.8
Total Responses	163	
Mean Responses per subject	3.88	

following response areas: the operator, the vehicle, and the environment. The mean response per subject was 3.88, which indicates that the average subject made nearly four suggestions.

The sample's suggestions relative to the operator were age limits, require helmets, and courses, which accounted for 47.6 per cent, 33.3 per cent, and 23.8 per cent of the sample, respectively. Other operator-related suggestions were operational testing, written tests, and licensing, comprising 19.0 per cent, 16.7 per cent, and 11.9 per cent of the sample, respectively.

In the area of suggestions concerning the vehicle, a majority of the subjects (73.8 per cent) stated the need for snowmobile registration. Vehicle insurance was the recommendation of only 7.1 per cent of the subjects. The subjects made three suggestions that dealt directly with the vehicle. These suggestions, limit horsepower, by 14.3 per cent; inspection, by 11.9 per cent; and equipment standards, by 11.9 per cent, reflected the concern of 16 of the subjects.

Even though the area of environment received the least attention by the subjects, it contained their second most frequently occurring response, public information programs (54.8 per cent). Many of the subjects were concerned about the interaction between the snowmobile and other highway vehicles, as evidenced by 23.8 per cent of the subjects' suggestions to ban highway operation of

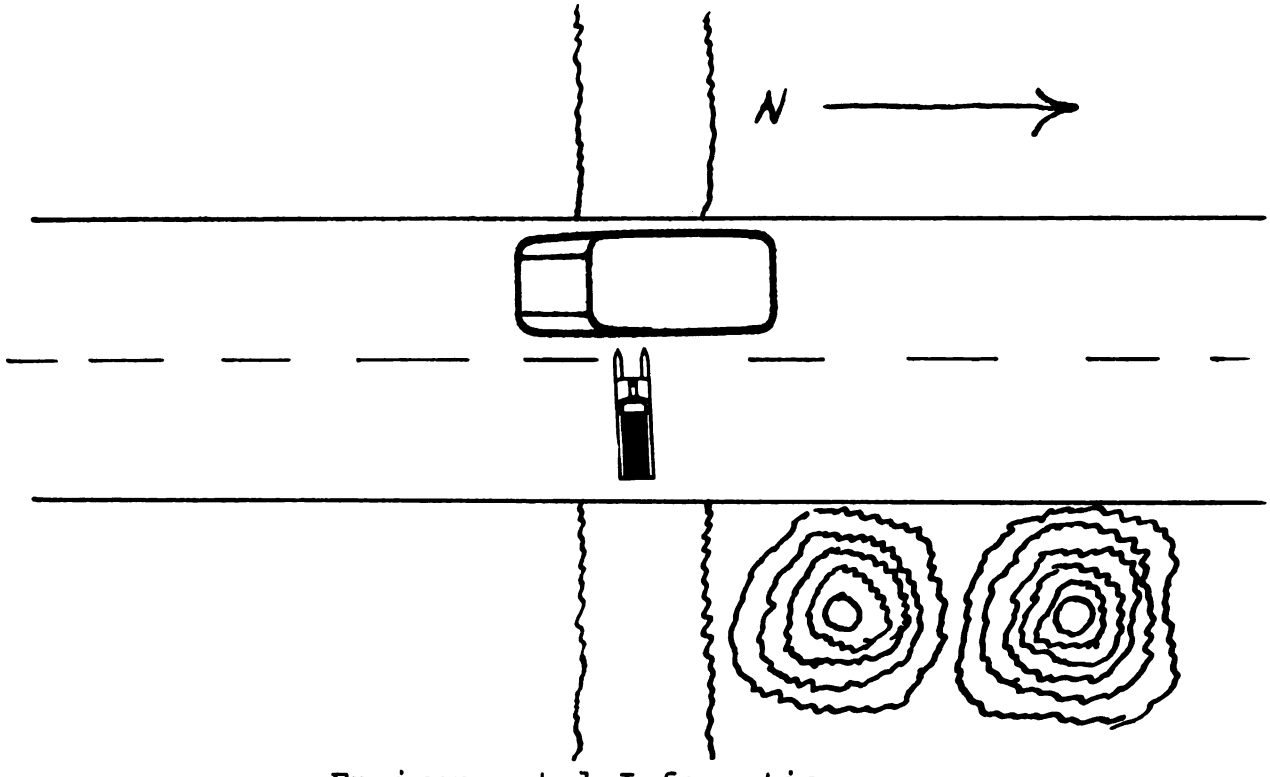
snowmobiles and 16.7 per cent of the subjects wanting crossing warning signs. Seven of the subjects felt a need for more off-road areas. Only two of the subjects had no suggestions.

Selected Case Summaries

Summarized on the following pages are four cases which were selected to provide examples of the most common types of snowmobile accident occurrences.

Crossing the Highway

Sample Case #1



Environmental Information

Roadway
- Type: Two lanes, dirt road
- Surface: Ice--Snow
- Character: Straight with up-grade
- Condition: No defects

Trail
- Type: One lane, temporary
- Surface: Ice--Snow
- Character: Straight with down-grade
- Condition: No defects

Time: 3:30 p.m., Sunday
Light: Daylight
Weather: Clear, 25°F

Factors: Tree on subject's right obscured view of highway, Sun in subject's eyes

Vehicle Information

Registered: No
Make: Polaris Colt 1968
Horsepower: 14
Equipment: Headlight, tail light, windscreen, repair kit
Components: All functioning properly
Maintenance: One week ago
Speed: 25 mph

Operator Information

Age: 24 years
Sex: Male, 5 ft. 7 in., 140 lbs., married
Family: 2 brothers, 2 sisters, father and mother living, one child age 2
Occupation: Laborer (highway construction)
Life goal: Heavy equipment operator
Driving record: Subject claimed 1 accident, 2 convictions
M.V.D. shows 3 accidents, 7 convictions, 2 hearings, 2 suspensions
Self-concept: As auto operator--above average, snowmobile operator--above average
Experience: Auto--8 years
Snowmobile--2 years
Mental, emotional, physical state: Good health, no medication, sufficient sleep, three bottles of beer consumed before accident, possible alcohol level of .06 per cent, preoccupied about being late for Sunday dinner
School record: Ability--average
Achivement--academic "none"
Social relationships--with problem students
History of repeated problems--discipline problem, expelled twice for smoking
Interview: Became uneasy when questioned about parental home environment
Protective clothing: None
Familiarity with terrain: Subject originally broke trail
Subject's statement: "I was heading home on the trail, late for dinner. Going down slight hill with trees blocking view of road. I automatically entered the road, saw a vehicle, and turned a sharp left, too late."
Factors: Preoccupied, late for dinner
Impairment, three bottles of beer

Variations

1. Operator starting snowmobile in driveway, throttle frozen, snowmobile unoccupied proceeds out into road and is struck or strikes an auto in either the right or left lane.

2. Snowmobile operator starting from driveway, vision obscured by snowbanks, proceeds out into highway, and either strikes auto or is struck by auto.

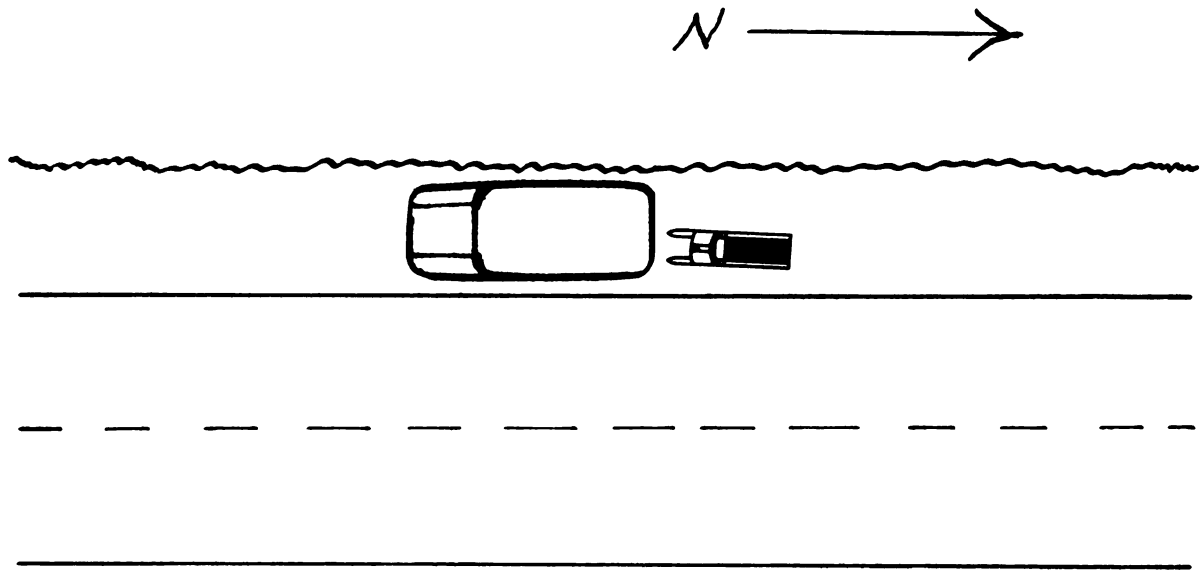
3. Snowmobile operator attempts to stop on snowbank before entering highway, cannot stop in time, and is either struck by auto or strikes auto.

4. Snowmobile operator attempts to beat traffic while crossing, highway bare and dry, or operator loses control on striking opposite snowbank and as snowmobile re-enters highway is either struck by auto or strikes auto or rolls over.

Number of cases--population 23, sample 13, one fatal.

The Parked Vehicle

Sample Case #2



Environmental Information

Roadway
- Type: Two lanes, blacktop
- Surface: Dry
- Character: Straight and level
- Conditions: No defects

Shoulder
- Type: Eight feet wide, plowed
- Surface: Ice-snow
- Character: Straight and level
- Conditions: No defects

Time: 4:00 a.m., Thursday, New Year's Day
Light: Dark, road unlighted
Weather: Clear, -30°F.

Factors: Automobile parked without lights, Temperature -30°F.

Vehicle Information

Registered: Yes
Make: Evinrude "Bobcat" 1969
Horsepower: 23
Equipment: Headlight, tail light, (lights used), windscreen, repair kit, first aid kit
Components: All functioning properly
Maintenance: Don't know
Speed: 25 mph

Operator Information

Age: 23 years
Sex: Male, 5 ft. 9 in., 185 lbs., single
Family: No siblings, father and mother living
Occupation: Warehouse man
Life goal: Undecided
Driving record: subject claimed no accidents and convictions; M.V.D. shows no accidents and convictions
Self-concept: As auto operator--average
Snowmobile operator--average
Experience: Auto--7 years
Snowmobile--3 years
Mental, emotional, physical state: Good health, no medication, fatigued from late hour, five bottles of beer consumed before accident, possible alcohol level of .08 per cent.
School record: Ability--below average
Achievement--average
Social relationships--below average
History of repeated problems--"none"
Interview: Cooperative, concerned, straight forward
Protective clothing: Suit, boots, face mask, goggles, gauntlet mittens
Familiarity with terrain: Subject so stated
Subject's statement: " I was proceeding south running on the shoulder of the roadway. It was real cold and very dark. I came upon an unlighted parked car, swerved to miss the car, fell off the snowmobile and passenger and I hit the car minus the snowmobile."
Factors: Physical, the late hour
Impairment--five bottles of beer.

Variations

1. Auto parked partially in a driveway and on roadway, collided with by snowmobile.

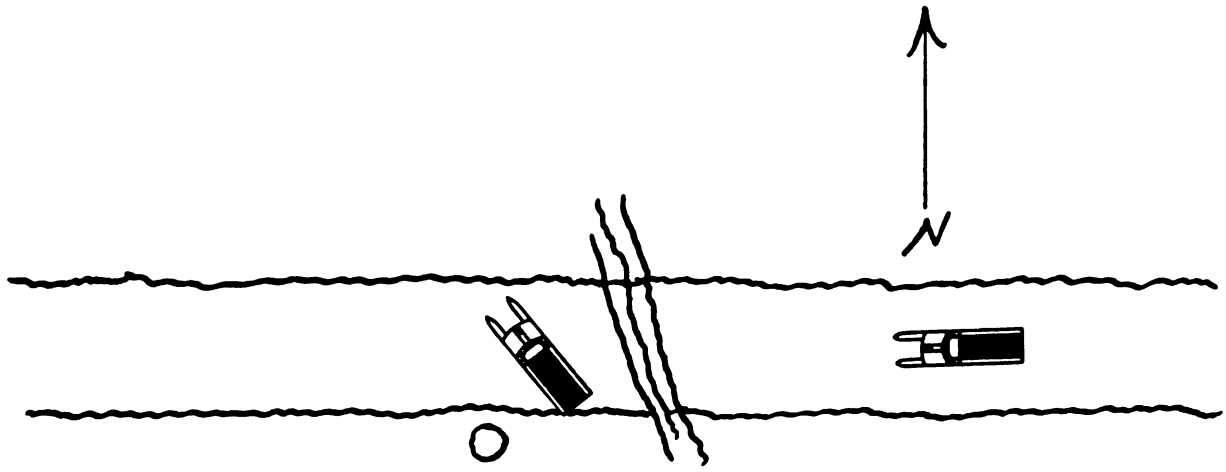
2. Truck or snowmobile parked on shoulder without lights, collided with by snowmobile.

3. Two or more snowmobiles proceeding on the shoulder of the road and colliding with autos with and without lights parked facing either direction.

Number of cases--population 12, sample 5, 1 fatal.

The Unseen Obstruction

Sample Case #3



Environmental Information

Trail
- Type: Eighteen feet wide
- Surface: Packed snow
- Character: Straight and down-grade
- Condition: Average for snow trail

Time: 1:30 p.m., Sunday
Light: Daylight
Weather: Cloudy, 30°F

Factors: Obstruction, unknown and unnoticed by operator.

Vehicle Information

Registered: No
Make: Fox Track Futura 1969
Horsepower: 20-1/2
Equipment: Headlight, tail light, windscreen
Components: All functioning properly
Maintenance: Unknown
Speed: 20 mph

Operator Information

Age: 24 years
Sex: Male, 5 ft. 10 in., 135 lbs., married
Family: 1 sister, father and mother living, one child
Occupation: Graduate assistant
Life goal: College professor
Driving record: Subject claimed no accidents and 3 convictions; M.V.D. shows no accidents and 3 convictions
Self-concept: As auto operator--average
Snowmobile operator--poor
Experience: Auto--5 years
Snowmobile--first drive
Mental, emotional, physical state: Good health, no medication, sufficient sleep, no alcohol consumed, having a good time on his first snowmobile drive
School record: Ability--above average
Achievement--above average
Social relationships--above average
History of repeated problems--below average
Interview: Responsive, cooperative, interested
Protective clothing: Suits and helmets
Familiarity with terrain: none
Subject's statement: " I was on my first snowmobile drive proceeding down hill on the trail designated by the rental agency when the snowmobile hit a rut. The snowmobile canted to the left throwing the operator and passenger off. I struck a stump and dislocated my left shoulder. I have stopped operating snowmobiles forever."
Factors: Operator, inexperience

Variations

1. Snowmobile struck obstruction, ejected passenger who was struck by following snowmobile.

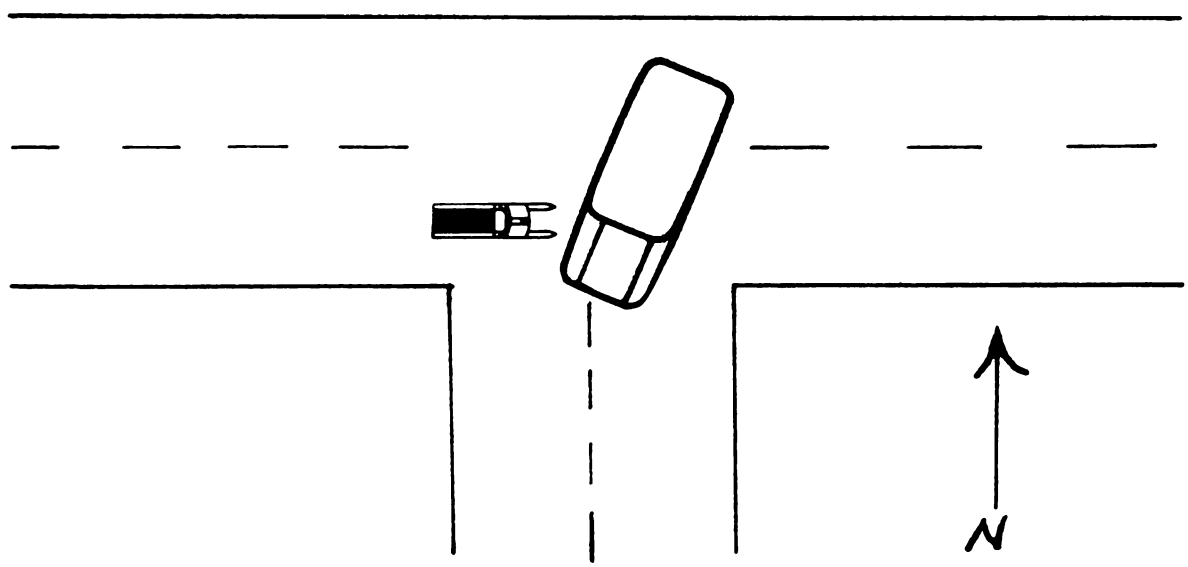
2. Snowmobile struck obstruction and overturned.

3. Snowmobile struck obstruction, operator lost control, vehicle continued on and struck: tree, pedestrian, or another vehicle.

Number of cases--population 7, sample 3, no fatals.

The Unseen Snowmobile

Sample Case #4



Environmental Information

Roadway
- Type: Two lanes, blacktop
- Surface: Ice--snow
- Character: Straight and level
- Condition: No defects

Time: 3:15 p.m., Sunday
Light: Daylight
Weather: Cloudy, 30°F
Factors: Surface, ice-snow

Vehicle Information

Registered: Yes
Make: Ski-Doo Super Olympic 1969
Horsepower: 18
Equipment: Headlight, tail light, windscreen, repair kit, survival equipment
Components: All functioning properly
Maintenance: Unknown
Speed: 30 mph

Operator Information

Age: 22 years
Sex: Male, 5 ft. 7 in., 145 lbs., single
Family: 3 brothers, 1 sister, father and mother living
Occupation: Unemployed
Life goal: Electronics
Driving record: Subject claimed 2 accidents and 2 convictions; M.V.D. shows 2 accidents and 2 convictions
Self-concept: As auto operator--very good
Snowmobile operator--excellent
Experience: Auto--5 years
Snowmobile--5 years
Mental, emotional, physical state: Good health, no medication, sufficient sleep, no alcohol consumed, elated about his ride
School record: Ability--average
Achievement--below average
Social relationships--below average
History of repeated problems--average
Interview: Cooperative, helpful
Protective clothing: Suit, helmet, goggles
Familiarity with terrain: subject so stated
Subject's statement: " I was going to the race track when a car in the middle of the road swerved to his left. Seeing that collision was coming, I locked the brakes and jumped off before hitting."
Factors: Operator, lack of anticipation of auto operator's actions; Auto operator, lack of perception of the snowmobile.

1. Auto turning left into driveway at night in front of snowmobile with lights on.

2. Auto backing out of driveway day or night into path of or side of snowmobile.

3. Auto passing a stop sign into the path of or side of snowmobile.

4. Auto striking snowmobile from behind at traffic signal.

5. Auto backing into parked snowmobile.

Number of cases--population 6, sample 3, no fatals.

Vehicle Variables of the Sample

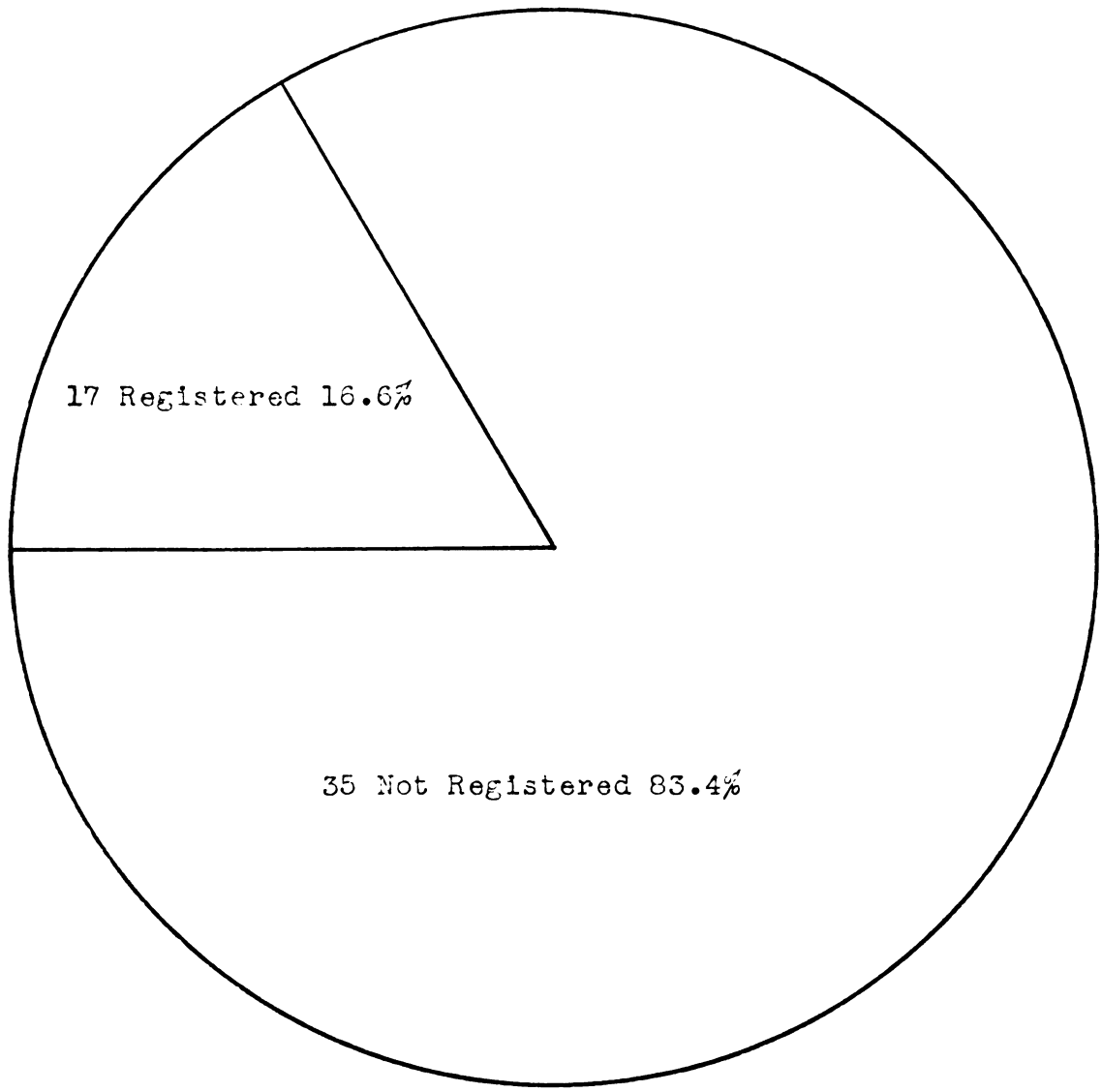
Data concerning vehicles, obtained from the snowmobile accident reports (11/69) and the personal interviews with the 42 subjects constituting the sample of this study, were organized into the categories of registration, vehicle conditions, extra equipment, and vehicle deficiencies. These data are presented in this section.

Registration

The majority of the subjects' snowmobiles were not registered. As snown in Figure 4.19, 35 (83.4 per cent) were not registered; the remaining 17 (16.6 per cent) of the 42 snowmobiles were registered. This shows a significant deviation from the entire population, which had 59.1 per cent and 40.9 per cent, respectively, for not registered and registered vehicles.

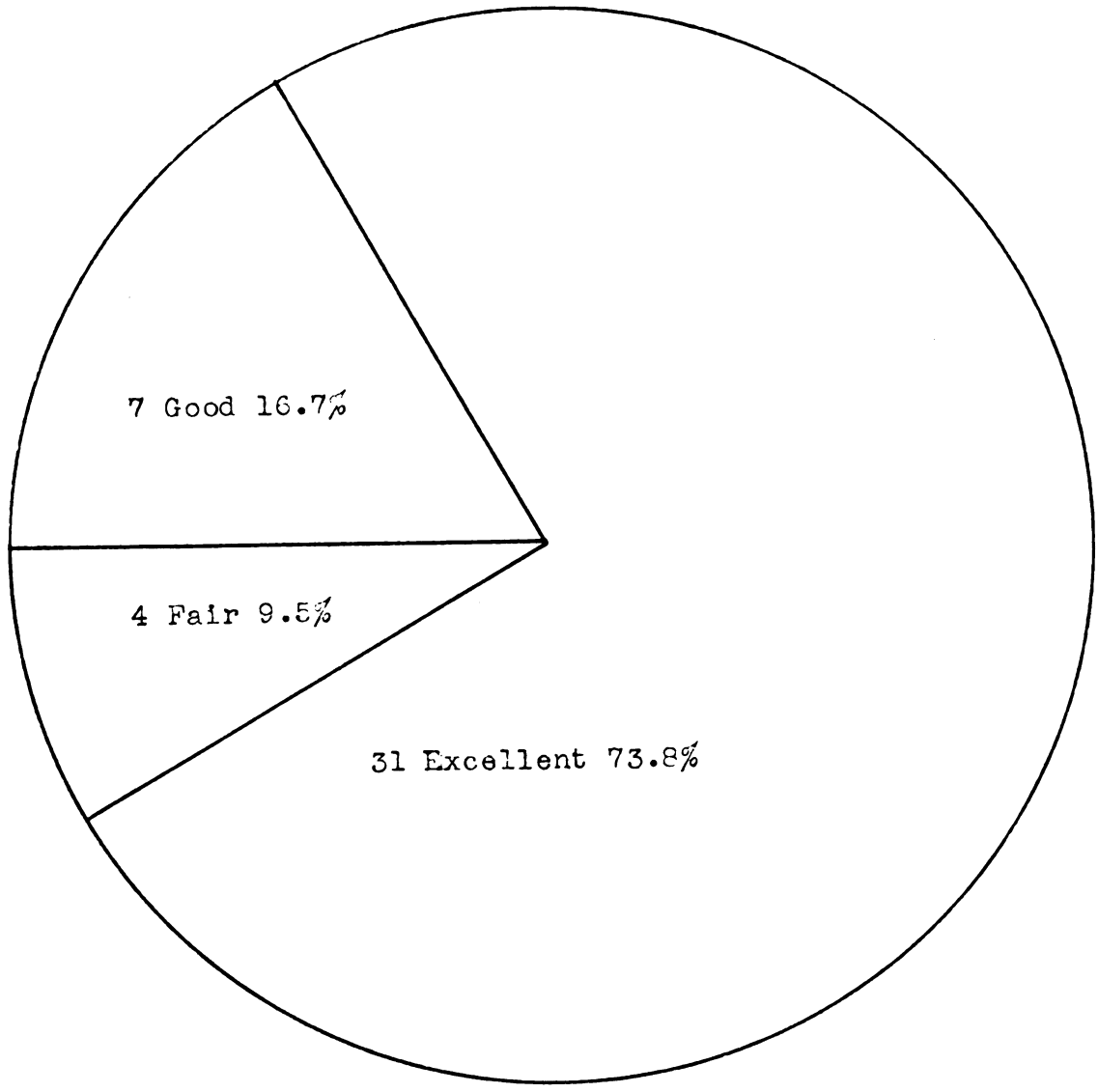
Vehicle Condition

Figure 4.20 shows that the subjects predominantly felt their snowmobiles were in excellent condition. Only 9.5 per cent rated the general condition of their snowmobiles as fair, while 16.7 per cent and 73.8 per cent rated them as good and excellent, respectively. However, when questioned directly about the components for seeing, steering, and stopping, 75 per cent of the sample rated those critical components only fair (Table 4.27). Brakes, steering, lights, and windshields were rated by the subjects as: excellent by .8 per cent, good by 17.6 per cent, and poor by 6.6 per cent.



Total number of snowmobiles 42

Figure 4.19.--Distribution of the registration status of subject's snowmobile.



Total number of subjects 42

Figure 4.20.--Distribution of operators' opinion of the general condition of the snowmobile.

TABLE 4.27.--Distribution of subjects' responses to the condition of the vehicle components.

	Brakes		Steering		Lights		Windshield		Total	
Condition	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Excellent	0	0.0	0	0.0	0	0.0	2	4.8	2	.8
Good	7	16.7	9	21.4	7	16.7	6	14.3	29	17.6
Fair	28	66.6	32	76.2	32	76.2	34	80.9	126	75.0
Poor	7	16.7	1	2.4	3	7.1	0	0.0	11	6.6
Total	42	100.0	42	100.0	42	100.0	42	100.0	168	100.0

Table 4.28 reveals a definite lack of routine maintenance. The most outstanding message is that 78.5 per cent of the subjects either "don't know" or "never" have performed any vehicle maintenance. The lone "other" response was from a subject who raced his machine and prior to any competition, he had the vehicle meticulously inspected and serviced.

Extra Equipment

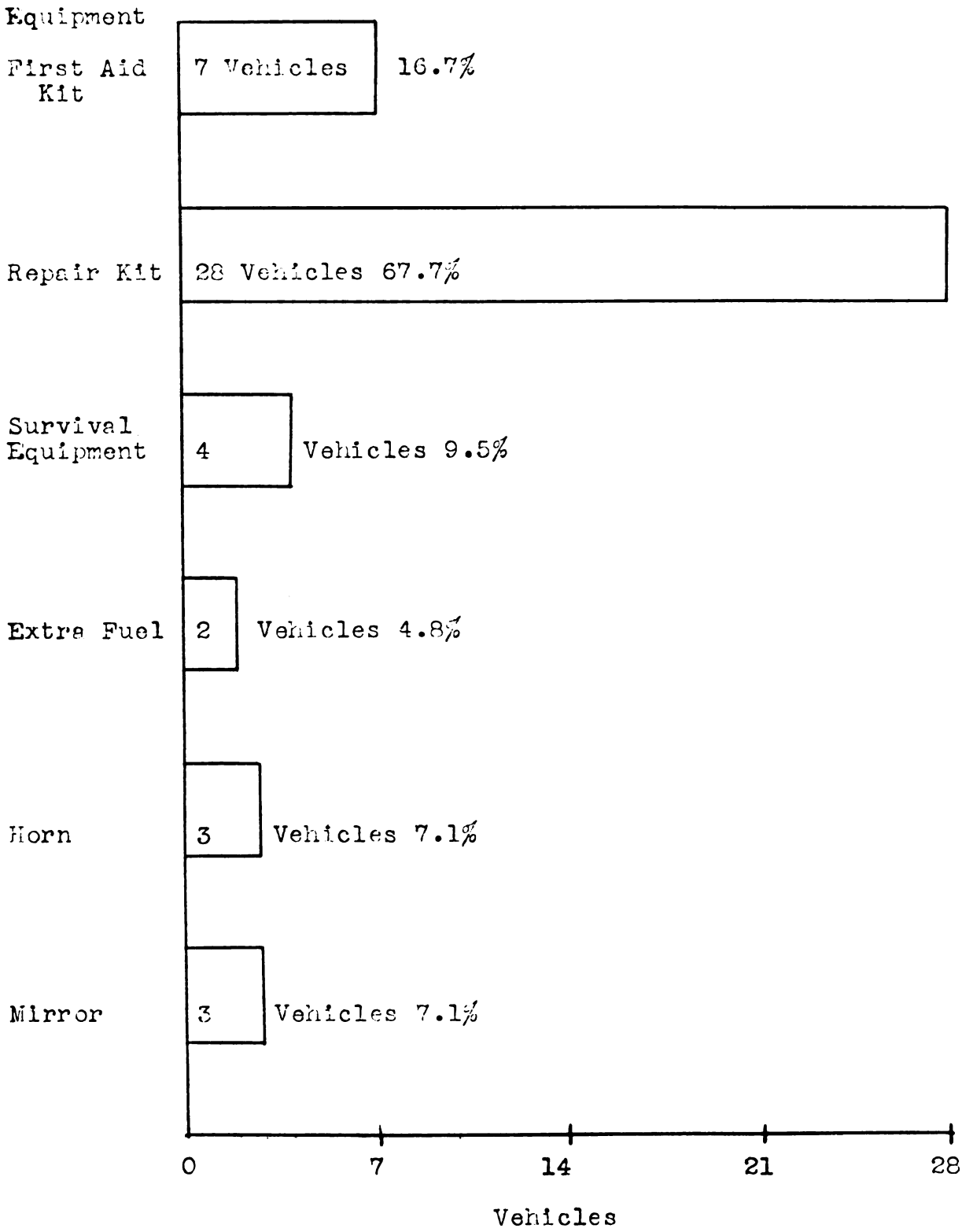
Shown in Figure 4.21 is a distribution of the extra vehicle equipment on the subjects' snowmobiles. It is encouraging to note that all of the snowmobiles had some extra equipment, and some had more than one item. Of the vehicles in the sample, 67.7 per cent had a repair kit, which was the most frequently occurring item of extra equipment. The least frequently mentioned item was extra fuel, with only 4.8 per cent of the responses. However, only 7.1 per cent of the snowmobiles were equipped with a horn, which is required for registration.

Vehicle Deficiencies

From the sample of 42 subjects, 38.1 per cent reported more than one vehicle deficiency. Table 4.29 further states that 59.1 per cent felt the steering on snowmobiles was inadequate. However, 21.4 per cent of the subjects selected because of snowmobile accident involvement felt there was nothing that makes snowmobiles difficult to operate or might make snowmobiles cause an

TABLE 4.28.--Distribution of subjects' responses to vehicle maintenance frequency.

Performed when	Number	Per cent
Never	3	7.1
2 months	1	2.4
Monthly	4	9.5
Weekly	1	2.4
Daily	2	4.8
Other	1	2.4
Don't Know	30	71.4
Total	42	100.0



Some vehicles had more than one item of extra equipment.

Figure 4.21.--Distribution of extra vehicle equipment.

TABLE 4.29.--Distribution of subjects' responses to question: "Can you think of anything about snowmobiles that makes them difficult to operate or might cause an accident?"

Deficiency or Condition	Number	Per cent*
Steering	25	59.5
Nothing	9	21.4
Brakes	7	16.7
Lights	7	16.7
Unstability	5	11.9
Frozen throttle	2	4.8
Speed and H.P.	2	4.8
Visibility	1	2.4
Total	42	

*16 subjects, 38.1%, responded to more than one deficiency or conditon.

accident. The lowest response item for vehicle deficiencies was visibility, reported by only 2.4 per cent of the subjects.

Environmental Variables of the Sample

Data from the personal interviews and the snowmobile accident reports (11/69) relative to environmental variables are presented in this section. The data obtained on the 42 subjects constituting the sample for this investigation are organized under the headings of surface, topography, location, and choice of route.

Surface

Sixty-four and three tenths per cent of the subjects reported the surface condition at the accident site (Table 4.30) was hard-packed snow. The surface was reported by 19 per cent of the subjects as smooth, and as rough by 4.8 per cent. Only 11.9 per cent of the subjects reported the surface as a road or trail.

Topography

The topography of the accident site is reported in Table 4.31). Nearly 60 per cent of the subjects described the accident site as level. The next most frequently occurring topographical condition present was "slight grade," with a subject response of 21.4 per cent. The two subjects who responded "other" were involved in accidents on frozen lakes.

TABLE 4.30.--Surface conditions at accident site as reported by subjects.

Surface	Number	Per cent
Hard-packed snow	27	64.3
Road or trail	5	11.9
Smooth surface	8	19.0
Rough surface	2	4.8
Total	42	100.0

TABLE 4.31.--Topography at accident site as reported by subjects.

Condition	Number	Per cent
Level	25	59.5
Slight grade	9	21.4
Steep grade	2	4.8
Hillcrest	1	2.4
Dip	3	7.1
Other	2	4.8
Total	42	100.0

Location

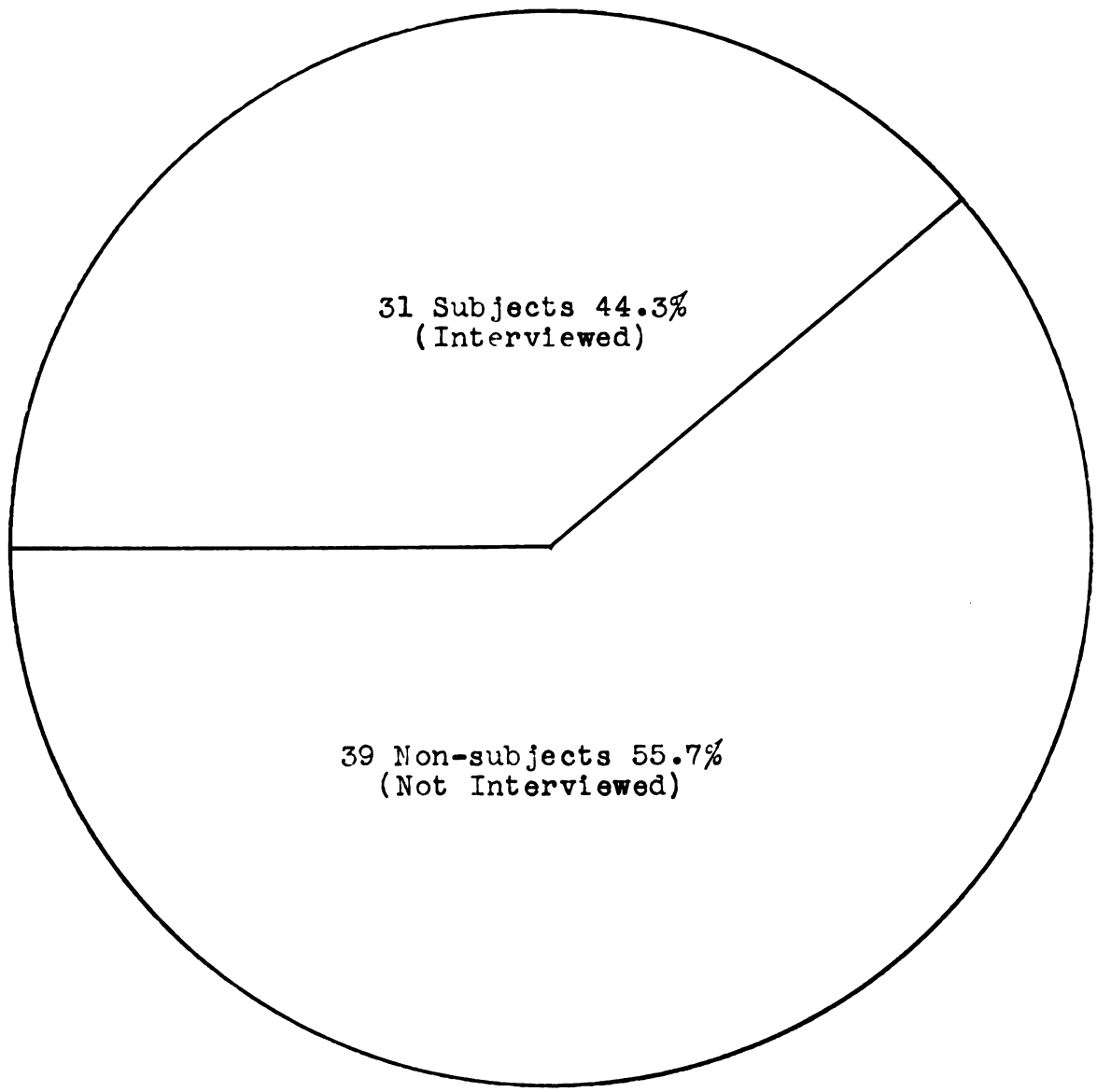
Figures 4.22 and 4.23 show the distributions of subjects interviewed in relation to the population, for on-road and off-road accidents. The sample was truly representative of the population from the aspect of location. A mere 4.4 per cent difference between the sample and population for off-road accidents and a variation of only 11.4 per cent for on-road accidents attests to the representativeness of the sample. Figure 4.24 shows that 73.8 per cent of the accidents of the sample occurred on-road, while 26.2 per cent occurred off-road.

Choice of Route

The choice of route or subject's selection of environment is reported in Figure 4.25. Only 45.2 per cent of the subjects were familiar with the terrain. The most frequent response from subjects unfamiliar with the terrain was "expediency" (33.3 per cent), while 7.1 per cent of the subjects stated they had been exploring. Fourteen and three tenths per cent responded that they really did not know why they chose to pass that way.

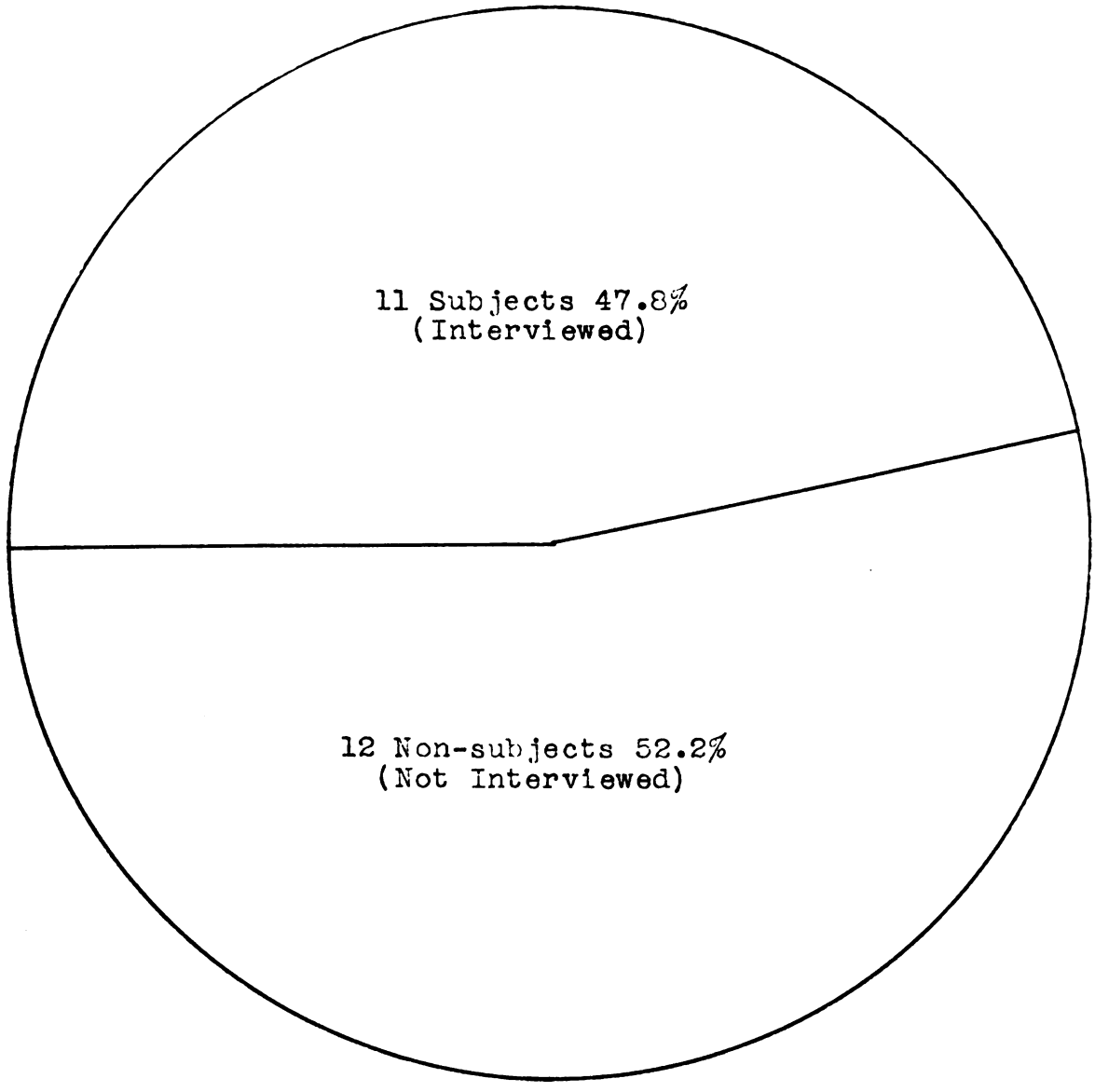
Summary

Chapter IV presented an analysis of data collected from the accident reports of 93 members of the population. Further analysis was exhibited relative to the sample of 42 subjects. The sources of the data for the sample were: accident report forms, snowmobile accident report forms,



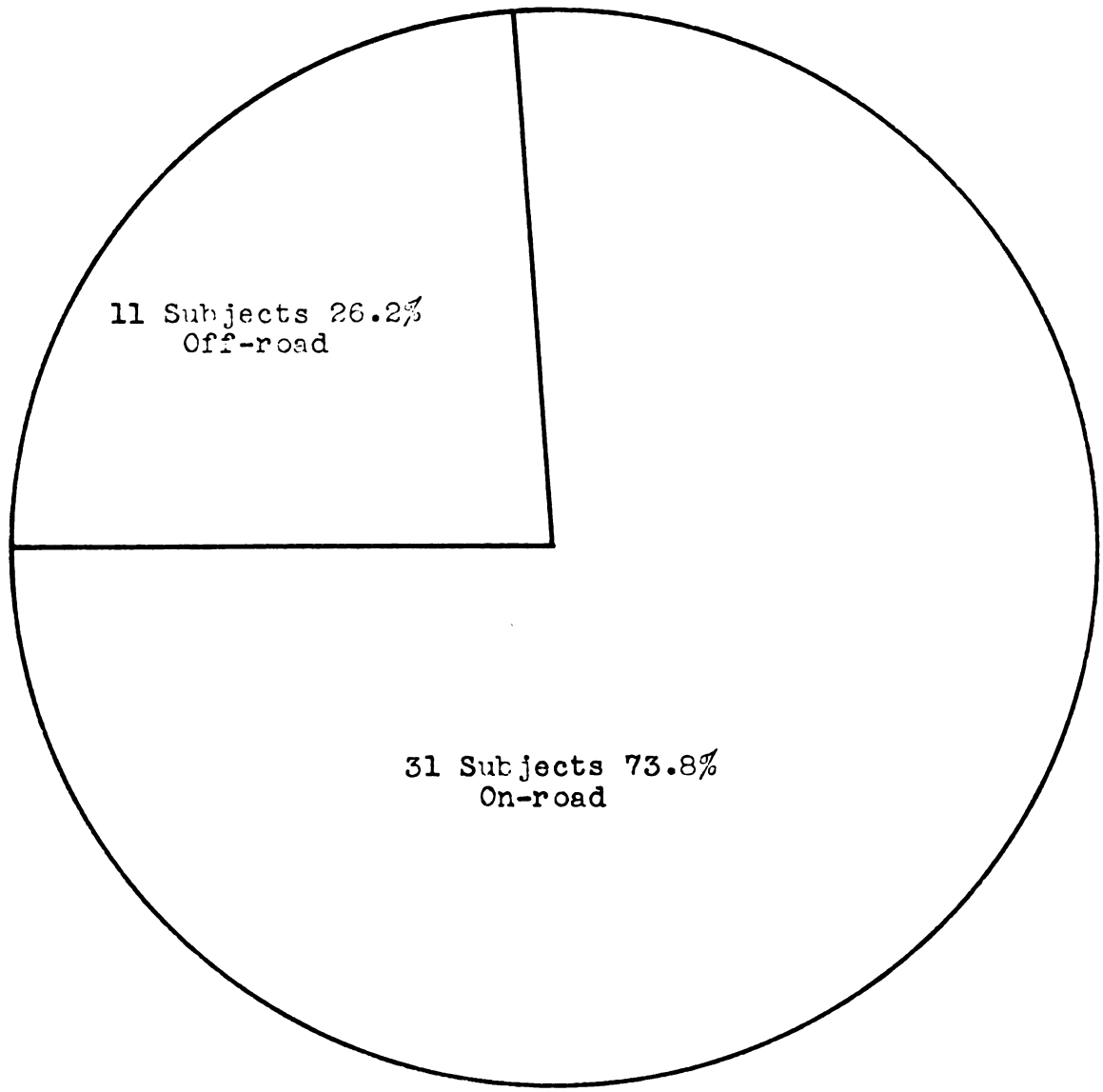
Total number of on-road accidents of population 70

Figure 4.22.--On-road snowmobile accidents distribution by subjects and non-subjects.



Total number of off-road accidents of population 23

Figure 4.23.--Off-road snowmobile accidents distribution by subjects and non-subjects.



Total number of accidents 42

Figure 4.24.--Distribution of accidents for sample by location.

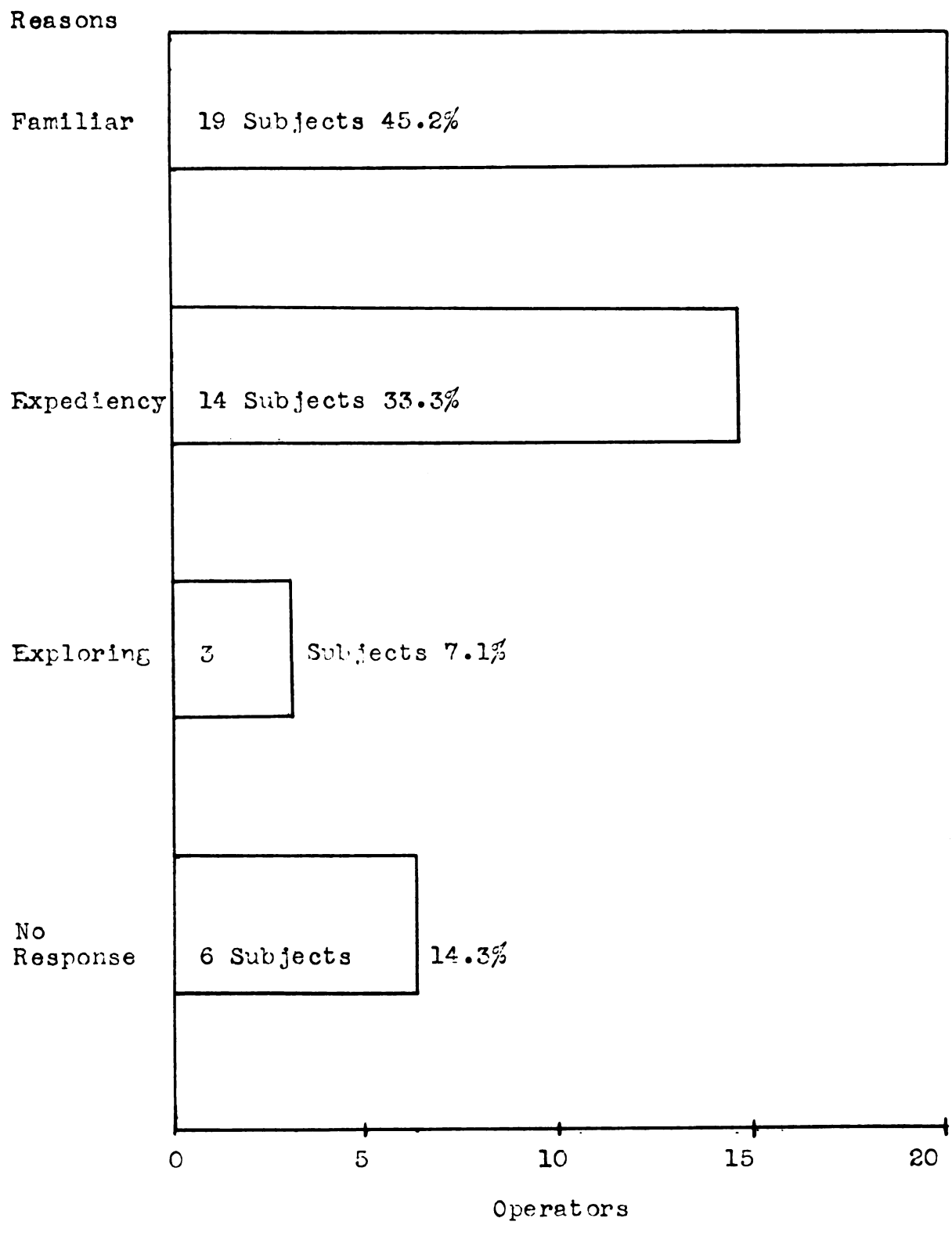


Figure 4.25.--Distribution of operator's reasons for the choice of the route on which the snowmobile accident occurred.

personal interviews, abstracts of driving records, and school record reports.

The chapter was structured into four parts: (1) commonalities of accident data of the population; (2) operator variables and selected case summaries; (3) vehicle variables; and (4) environmental variables.

Circle graphs, tables, and histograms were composed to clarify the relationships and proportions for the reader.

Chapter V will include a summary, conclusions, discussion, and recommendations for further study.

CHAPTER V

SUMMARY, CONCLUSIONS AND DISCUSSION, AND RECOMMENDATIONS

The analysis of the data collected was presented in Chapter IV. This chapter contains a summary, conclusions and discussion, recommendations, and recommendations for further study.

Summary

The purpose of this study was to identify the snowmobile accident commonalities involving young operators in the state of New York during the 1969-1970 winter season. Data were collected on both the population and the sample for this study, and dealt with the most prevalent factors in the areas of the operator, the vehicle, and the environment.

The data for 89 nonfatal and four fatal accidents were extracted from accident reports and analyzed. Forty-two personal interviews were completed, and these data, augmented by school records, driving records, and snowmobile accident report forms, were tabulated and analyzed.

Summary of the Major Findings

Summary of Demographic Data of the Population

1. Personal Injury accidents accounted for 80.6 per cent of the accidents and 98 victims, of whom four were fatally injured.
2. In 74.2 per cent of the accidents studied, the snowmobile was in collision with another motor vehicle; in 47.3 per cent of the cases the snowmobile was proceeding straight ahead.
3. The apparent cause of 32.3 per cent of the accidents was failure to yield the right of way.

Summary of Operator Variables

1. While 32 of the persons in the sample were unmarried, the 10 married subjects had a total of 15 children.
2. Sixty-nine per cent of the subjects in the sample lived with both their parents and had a mean of 3.28 siblings.
3. Sixty-six and seven tenths per cent of the subjects in the sample reported varying degrees of difficulty in the home environment or did not report, however, the highest frequency (33.3 per cent) reported no difficulties in the home environment. Thirty-five and seven tenths per cent of the sample subjects felt that they were granted freedom by their parents.
4. The driving records of the 24 persons in the sample who had a record revealed a total of 8 accidents, 7 convictions, and 24 motor vehicle department actions. The

coefficient between the subject's stated number of accidents and the number evidenced on his driving record was r = .080; the coefficient between the subject's stated number of convictions and the number in evidence on his driving record was r = .599.

5. Forty-five and two tenths per cent of the sample subjects regarded themselves as better than average automobile operators; there was a coefficient of r = .894 between the better than average automobile operator self-concept and the number of convictions on the subjects' driving records.
6. The mean hours per year of snowmobile operation for the sample subjects was 106.4 hours; the mean total hours of snowmobile operation was 284.4 hours.
7. Eighty-one per cent of the sample subjects responded that alcohol did not affect their snowmobile operation. Prior to the accident, however, they had ingested a mean of 3.41 drinks of alcoholic beverage, and only 42.9 per cent stated that alcohol was not a factor in the accident.
8. While 85.8 per cent of the sample subjects approved of school, only 14.3 per cent had above average ability as reported by their school records; 55.4 per cent were average students in all aspects.
9. Prior to the accident, 57.1 per cent of the sample subjects would have enrolled in a snowmobile educational

program; however, after the accident 45.2 per cent of the subjects would still enroll.

10. The sample subjects' most frequent suggestions to make snowmobiling safer were to register snowmobiles, 73.8 per cent; to provide public information programs; 54.8 per cent; and to establish age limits, 47.6 per cent.

Summary of Vehicle Variables

1. Only 16.6 per cent of the sample subjects' snowmobiles and 40.9 per cent of the population's snowmobiles were registered.
2. While 73.8 per cent of the sample subjects rated the general condition of their snowmobiles as excellent, only .8 per cent of them rated the critical components of brakes, steering, lights, and windscreens as excellent.
3. Seventy-eight and five tenths per cent of the persons in the sample could not state when their snowmobiles had last been serviced.
4. All sample subjects reported having some additional equipment for their snowmobiles.
5. Steering was cited as a vehicle deficiency by 59.1 per cent of the persons in the sample; 38.1 per cent reported more than one snowmobile deficiency.

Summary of Environmental Variables

1. The surface condition at the accident site was reported as hard-packed snow by 64.3 per cent of the subjects in the sample.
2. Fifty-nine and five tenths per cent of the sample subjects reported the topography of the accident site was level.
3. The site of 75.3 per cent of the accidents of the population was on-road; the site of 24.7 per cent was off-road. Of the subjects interviewed, 73.8 per cent were accident involved at an on-road site and 26.2 per cent were accident involved at an off-road site.
4. Only 45.2 per cent of the subjects in the sample were familiar with the accident site.
5. The weather was clear in 60.3 per cent of the population accidents, and 51.6 per cent of the population accidents occurred in daylight.
6. The time, day, and week of season of highest accident frequencies of the population were from 2:01 p.m. to 5:00 p.m. (32.3 per cent), Sunday (29.0 per cent), and the week of December 28 (21.5 per cent).

Conclusions and Discussion

1. Alcohol was a possible contributing factor in half of the 42 snowmobile accidents studied.

Figure 4.14 showed that 81 per cent of the subjects felt the consumption of alcoholic beverages did not affect

their operation of the snowmobile. Figure 4.15 revealed a mean number of 3.41 alcoholic drinks had been consumed by the subjects prior to the accident. Figure 4.16 depicted that only 42.9 per cent of the subjects stated that alcohol was not a factor in the accident. The remaining 57.1 per cent of the subjects responded in some form of the affirmative, that alcohol was a factor in the accident.

2. It would be desirable for a course in snowmobile operation and maintenance to be available to interested persons.

Figure 4.10 showed the mean number of hours per year of snowmobile operation of the subjects in the sample was 106.4. Further, Table 4.20 revealed that 21.4 per cent of the sample had no years of automobile operation experience and 16.7 per cent of the sample had no years of snowmobile operation experience. Table 4.20 also showed the mean number of years operation to be 3.39 and 2.54 for automobiles and snowmobiles respectively. When the low levels of experience are considered in light of Tables 4.9 and 4.10, which revealed that before the accident 47.3 per cent of the subjects were proceeding straight ahead and that the apparent cause of accident was failure to yield the right of way, it becomes clearer that inexperience may have been a factor. Further, Table 4.25 showed that 45.2 per cent of the sample would presently enroll in a snowmobile operation and maintenance course and previous to the accident 57.1 per cent

of the subjects would have enrolled. Hopefully, such a course would deal effectively with the following operator shortcomings: failure to perceive the traffic scene; failure to anticipate actions of other highway users; inability to judge their own stopping distance and turning radius; inability to cope with vehicle malfunctions such as sticking throttles; and inability to anticipate hazards in the off-road environment. The course mentioned above was apparently desired by some people who realized their deficiencies in the snowmobile area.

3. The vehicle design needs to be modified to provide a safer vehicle.

The apparent cause of 11.8 per cent of the population snowmobile accidents was defective equipment (Table 4.10). The 11 defective equipment accidents accounted for the four fatal accidents, six personal injury accidents, and one property damage accident. Table 4.29 showed that 59.1 per cent of the sample subjects felt the steering was deficient. Further shown in Table 4.29 was that 38.1 per cent of the sample reported more than one deficiency. Brakes and lights were cited as deficient by 16.7 per cent of the subjects. Selected case summaries numbers one, two and four illustrated the vehicle deficiency factors of ineffectual throttles, lighting, and brakes. Appendix F, containing specific accident case information, showed that maintenance by dealers was not adequate to remedy malfunctions in

manufacture. The findings of this study coincide with findings of previous studies in the area of vehicle design.

4. Snowmobiles should not operate along the highway right of way.

As shown in Table 4.3, the site of 75.3 per cent of the population accidents was on the public highway. Table 4.8 revealed that 74.2 per cent of these collisions were with another motor vehicle and Table 4.9 revealed that 47.3 per cent of the operators were proceeding straight ahead prior to the accident. Data on the subjects in the sample revealed that the surface condition was hard-packed snow in 64.3 per cent of the accidents (Table 4.30). The snowmobile as presently manufactured does not possess the prerequisite control, visibility, or warning characteristics necessary for effective interaction with other highway users. Further, as shown in Table 4.26, 23.8 per cent of the subjects in the sample felt that snowmobiles should be banned from the highway.

5. Permanent snowmobile highway crossings should be established.

Table 4.9 showed that 24.7 per cent of the population accidents occurred while crossing the highway. When this fact is viewed in relation to the most common apparent cause of accidents as shown in Table 4.10, failure to yield the right of way, it becomes apparent that the assignment of right of way has not been clearly established. Selected case summary number one illustrates the snowmobile's failure

to yield to a vehicle on the roadway. Had the motorist and the snowmobiler been warned by appropriate signing, perhaps this occurrence could have been averted. Table 4.26 showed that 16.7 per cent of the sample subjects advocated crossing warning signs, which was compatible with recommendations made at the three international snowmobile conferences.

Discussion of Feelings Not Supported by the Data

High noise levels have been found by industries to produce fatigue and higher numbers of otherwise avoidable accidents. Prolonged operation of snowmobiles that emit a decibel rating above the threshold level of damage to human hearing has adverse effects on the operator, one of which is a sense of fatigue. The fatigue engendered by the noise and vibration level seems to have been a contributing factor in the accidents studied. Also, the sound of the snowmobile's power plant drowns out most of the desirable audible warnings, such as train whistles and automobile horns.

The early symptoms of hypothermia are similar to fatigue in many respects. Modifiers to the diagnosis of hypothermia are the effectiveness of the windshielding and the size of the operator, which would determine the amount of body exposure to the relative wind. As 42.9 per cent of the sample wore no protective clothing, probably the element of windchill was a contributing factor in the accidents.

The operators' deficiencies would seem to be related to inexperience relative to the variety of situations and settings. It was felt that the operator had the following shortcomings: failure to perceive the traffic scene; failure to anticipate actions of other highway and nonhighway users; inability to judge their own stopping distance and turning radius; inability to cope with vehicle malfunctions, such as sticking throttles; and inability to anticipate hazards in the off-street environment.

The vehicle produced today is not too dissimilar from the snowmobiles operated in 1960. The latter vehicles possessed inadequate lighting, no brakes, and ineffectual steering. However, the 1960 model was superior to the present-day models in the areas of sonic and atmospheric and vibration levels because of the use of a four-stroke cycle power plant. In 12 years of snowmobile manufacture, the industry has been unable to correct the problems of steering, stopping, seeing, and shielding. The industry solved the early problem of low sales by using a high horsepower, two-stroke cycle engine. The high power to weight ratio has precipitated additional vehicle problems: high vibration levels, noise, and unburned hydrocarbon exhaust emissions. Even metal fatigue has been noted in steering components, which was caused by a combination of high vibration and low temperatures.

The environmental shortcomings, such as a snow bank, an ice patch, or a blinding snow storm, are generally short-lived. Most of the traffic conflicts occur when snowmobiles cross the highway. To date there is no legislation which forbids crossing the highway by snowmobiles.

Recommendations

1. That the state statutes be searched to ascertain their applicability to snowmobiles prior to enactment of new snowmobile legislation.
2. That the states earmark funds from snowmobile registration for: the development of trails and areas for public snowmobile use, the dissemination of public safety information through the media, and the enforcement of existing applicable statutes.
3. That the states commence a public education program to inform snowmobilers and nonsnowmobilers of laws and regulations, safe and unsafe operation practices, visibility problems, the results of accident-injury studies, and vehicle limitations via the public school driver education and safety education programs, "live and learn" programs, and driver clinics by the Motor Vehicle Department.
4. That consideration of the snowmobile as a hazard to the highway user be included as a part of every secondary school driver education program.

5. That snowmobile operation and maintenance programs be available, through the secondary school districts, to students and nonstudents in the "snow" states.
6. That there be established "Safe Snowmobile Operation Road-E-O's."
7. That all of the snow-belt states cooperate in the development of a uniform accident reporting instrument and that these states report collected data prior to the onset of the next snowmobiling season so that accident experience may be used in public education programs.
8. That a uniformly accepted sign be developed and posted on highways to alert motorists to the location of snowmobile crossings.

Recommendations for Further Study

1. A study of the use of alcohol and its relationship to snowmobile accidents.
2. A study of the effect of restrictive snowmobile legislation upon the frequency and severity of accidents.
3. A study of the effect of required snowmobile operator training courses on the frequency and severity of accidents of subjects so trained.
4. A study of the effect of operator position, standing, kneeling, sitting, on the type and severity of accidents.
5. A study to determine the accident rate per mile or per hour of snowmobile operation.

6. A dynamic study of vehicle motion characteristics on typical surfaces encountered by snowmobile operators.
7. A crash test study with sensing manikins on typical operational surfaces.
8. A study to establish standards regarding the vehicle and components, specifically in the areas of steering, throttle control, brakes, lighting, sonic and exhaust emissions, shock absorbency of occupant seating, shock dissipation, protection for passenger compartment including windscreen, protective shielding of moving parts, and contrasting colors.
9. A study of the high decibel emissions of snowmobiles and levels and ranges of temporary and permanent hearing loss that are directly related.
10. A comparative study of the characteristics of snowmobiles who have accidents versus snowmobile operators who do not have accidents.

BIBLIOGRAPHY

BIBLIOGRAPHY

Books

Baker, Stannard J. and William R. Stebbins, Jr. Dictionary of Highway Traffic. Evanston, Illinois: Northwestern University, 1960.

Peterson, A. P. and E. E. Gross. Handbook of Noise Measurement. West Concord, Mass.: General Radio Company, 1967.

Plouffe, J. P. Snowmobiling the In Thing. Toronto: Charles J. Mason, Limited, 1969.

Sax, Gilbert. Empirical Foundations of Educational Research. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1968.

Tuite, James J. Snowmobiles and Snowmobiling. New York: Cowles Book Company, 1969.

Publications of the Government and Other Organizations

Baker, J. S. "Experimental Case Studies of Traffic Accidents." The Traffic Institute, Northwestern University, Evanston, Illinois, 1960.

Baker, J. S. "Problems of Determining Causes of Specific Accidents." The Traffic Institute, Northwestern University, Evanston, Illinois, 1963.

Baker, J. S. and L. R. Horn. "An Inventory of Factors Suggested as Contributing to Traffic Accidents." The Traffic Institute, Northwestern University, Evanston, Illinois, 1960.

Baker, J. S. and L. H. Ross. "Concepts and Classifications of Traffic Accident Causes." The Traffic Institute, Northwestern University, Evanston, Illinois, 1960.

Briggs, Stephen A., II. "Snowmobile History." National Safety Congress Proceedings, 26:40, 1965.

Harris, J. L., et al. "An Act to Amend the Vehicle and Traffic Law and Conversation Law in Relation to Registration, Operation, and Control of Snowmobiles." The Assembly of the State of New York, No. 4862-A, February, 1970.

National Safety Council. "Manual on Classification of Motor Vehicle Accidents." Chicago, Illinois: National Safety Council, 1962.

National Safety Council. "Play Safe for More Winter Fun." Chicago, Illinois: National Safety Council, 1968.

National Safety Council. "Snowmobiles." Safety Education Data Sheet, Number 100. Chicago, Illinois: National Safety Council, 1969.

Negri, Barry D. Snowmobile Accidents--A Detailed Investigation. Albany: New York Department of Motor Vehicles, Division of Research and Development, No. 1970-2, December, 1970.

Negri, D. B. Accidents Involving Snowmobiles--A Preliminary Review. Albany: New York State Department of Motor Vehicles, Division of Research and Development, No. 1970-1, February, 1970.

O'Dell, Raymond T. "Report on Oversnow Vehicles." United States Department of the Interior, National Park Service, June, 1968.

Ontario Department of Transport. "Snowmobile Collisions on Highways and Roads in Ontario." Toronto, Ontario: The Department of Research Section, February, 1970.

"Snowmobile Accidents in Canada Winter of 1969-1970." Ottawa: Canada Safety Council, October, 1970.

"Snowmobile Accident Summary 1969-1970 Winter Season." Chicago, Illinois: Public Safety Department, National Safety Council, August, 1970.

"Snowmobile Survey." Chicago, Illinois: Research Committee, Public Utilities Section, National Safety Council, August, 1969.

Sturgis, R. C., et al. "Ergonomic Study of Snowmobiles." A study made at the Highway Safety Research Institute, Ann Arbor, Michigan: Supported in part by an Exploratory Research Grant from the National Safety Council, Chicago, Illinois, June 30, 1970.

United States Department of Interior, Bureau of Outdoor Recreation. Proceedings of the International Snowmobile Conference. Duluth, Minnesota, February, 1970.

United States Department of Interior, Bureau of Outdoor Recreation. Proceedings of the International Snowmobile Conference. New York State Conservation Commission, May, 1969.

"Vehicle and Traffic Law." Albany: New York Department of Motor Vehicles, September, 1969.

Periodicals

Baker, W. J. "Discussion." The American Journal of Surgery. Vol. 119 (April, 1970), p. 486.

Bell, D. "The Move to Harness the Snowmobiliacs." Maclean's. Vol. 80:4 (April, 1967), p. 3.

Castor, William and Hugh McIntyre. "Snowmobile Accidents." Canadian Medical Association Journal. Vol. 102:421 (February 28, 1970), p. 421.

Chism, Stanley E. and A. Bradley Soule. "Snowmobile Injuries: Hazards from a Popular New Winter Sport." Journal of American Medical Association. Vol. 209, No. 11 (September 15, 1969), pp. 1672-74.

Colby, C. B. "Getting the Picture." Outdoor Life, November, 1969, pp. 2-10.

Dominici, R. H. and E. H. Drake. "Speed on Snow--The Motorized Sled." The American Journal of Surgery. Vol. 119 (April, 1970), pp. 483-485.

Forestry Worktools. "Snowmobile Injuries--Maine." April, 1970, p. 116.

Garrison, C. E. "Maine Safety Report." Recreational Industry, November, 1969, p. 13.

Heath, Joel. "Winter Fun Vehicle--The Snowmobile." Consumer Bulletin (March, 1968), pp. 31-35.

Layne, Elizabeth N. "Abominable Snowmen." American Heritage, Vol. 21:113 (February, 1970), p. 113.

Martyn, J. W. "Snowmobile Accidents." Canadian Medical Association Journal. Vol. 101:770-72 (September 15, 1969), pp. 35-37.

National Safety Council. "Meet the Snowmobile." Family Safety. Vol. 26:4 (Winter, 1967), pp. 12-14. National Safety Council, Chicago, Illinois.

National Safety Council. "The Alluring but Alarming Snowmobile." Family Safety. Vol. 28:4 (Winter, 1969), pp. 4-7. National Safety Council, Chicago, Illinois.

Olson, Jack. "Bad Show Out in the Cold Snow." Sports Illustrated. Vol. 32:11 (March 17, 1970), pp. 28-35. Time Inc., New York.

"Russians Develop Propeller-Driven Sleds." Aviation Week and Space Technology, Vol. 87 (December, 1967), pp. 53-4.

Schiller, Ronald. "The Cat that Conquered Winter." Rod and Gun in Canada, 70:10 (November, 1968), pp. 10-14.

Snook, P. A. "Snowmobiling." National Wildlife, Vol. 7 (December-January, 1969), pp. 42-46.

"Snow Vehicles." Machine Design. 38:138 (January, 1966), pp. 138-143.

The First Snowmobiles." Yankee (January, 1971), p. 74-79.

Winter's Horseless Sleigh: New State Law--Proposed Local Regulations of Snowmobiles. Municipality. Vol. 65:30 (February, 1970), pp. 30-43.

"With an Earsplitting Roar Comes the Marvelous Menace." Life, 66:60 (January 31, 1969), p. 60.

Withington, R. L. and L. W. Hall. "Snowmobile Accidents: A Review of Injuries Sustained in the Use of Snowmobiles in Northern New England During the 1967-1969 Season." Journal of Trauma, Vol. 10 (September, 1970), pp. 760-763.

Unpublished Materials

Bishop, Richard W. "Case Studies of One Car Accidents Involving Young Drivers." Unpublished Ed.D. dissertation, New York University, 1961.

Gayle, J. H. and R. G. Titemore. "Accelerations of a Snowmobile Determined by High Speed Photography." Unpublished Thesis--Bachelor of Science in Mechanical Engineering to the University of Vermont, April, 1969.

Howe, H. K. "Snowmobile Industry Sales." International Snowmobile Industry Association, Washington, D.C., June, 1970.

King, Alfred S. "A Study of Selected Factors Related to Snowmobile Traffic Accidents in the State of Michigan." Unpublished Ph.D. dissertation, Michigan State University, 1971.

Johnson, Duane R. "A Case Study Analysis of Motorcycle Accidents in Three Illinois Counties." Unpublished Ed.D. dissertation, Michigan State University, 1968.

Newspapers

"It Had to Come." The Christian Science Monitor, February 18, 1970, p. 15.

Lansing, Diane. "Snowmobiles Push Farther Afield." The Christian Science Monitor, November 25, 1969, p. 6.

APPENDICES

APPENDIX A

MOTOR VEHICLE ACCIDENT REPORT

FORM MV 104

NEW YORK STATE POLICE

POLICE ACCIDENT REPORT

IF MORE THAN 2 VEHICLES WERE INVOLVED OR MORE THAN 4 PERSONS INJURED, ATTACH ADDITIONAL FORMS.

1. **ACCIDENT INVOLVED** ☐ Property Damage No. Killed _____ No. Injured _____ No. of Vehicles Involved _____

2. TIME — Date of Accident Mo. Day Year | Day of Week | Hour _____ ☐ A.M. ☐ P.M. | Investigated at Scene ☐ YES ☐ NO

3. LOCATION
- County In | ☐ City ☐ Village ☐ Township Give Name of City, Village or Township | MILEPOINT MARKER NEAREST ACCIDENT
- Give Name of Road, Street or Route No. On | Intersecting Street or Highway Number At
- If not at Intersection _____ Feet or Miles North ☐ S ☐ E ☐ W ☐ of | Show nearest intersecting Street or Highway, Mile post or Landmark
- Give Nearest Pole Number _____ | Check Box if Accident Occurred at: ☐ Underpass ☐ R.R. Crossing ☐ Bridge

4. VEHICLE No. 1
- Driver | Age | DRIVER INFORMATION: Date of Birth Mo. Day Yr. | Sex ☐ Male ☐ Female
- Address
- Owner
- Address
- State of License: ☐ N.Y. State ☐ Other _____ Give State | ☐ Unlicensed ☐ N.Y. Learner's Permit ☐ N.Y. Interim Permit | License Ident. No.

VEHICLE YEAR	MAKE	BODY TYPE	PLATE NO.	STATE OF REG.	EXPIRATION MO. YR.

- Seat Belts Installed? ☐ Yes ☐ Front ☐ Rear ☐ No
- Circle Positions of Uninjured Wearing Seat Belts → (1 2 3 / 4 5 6)
- Circle Positions of Uninjured Not Wearing Seat Belts → (1 2 3 / 4 5 6)
- Apparent Condition of Driver: ☐ Ill ☐ Physical Defect ☐ Normal ☐ Fell Asleep ☐ Had Been Drinking
- Vehicle was Damaged ☐ Left Front ☐ Left Rear ☐ Left Side ☐ Right Front ☐ Right Rear ☐ Right Side ☐ Other
- Vehicle Towed Away? ☐ Yes ☐ No | By Whom?

5. VEHICLE No. 2
- Driver | Age | DRIVER INFORMATION: Date of Birth Mo. Day Yr. | Sex ☐ Male ☐ Female
- Address
- Owner
- Address
- State of License: ☐ N.Y. State ☐ Other _____ Give State | ☐ Unlicensed ☐ N.Y. Learner's Permit ☐ N.Y. Interim Permit | License Ident. No.

VEHICLE YEAR	MAKE	BODY TYPE	PLATE NO.	STATE OF REG.	EXPIRATION MO. YR.

- Seat Belts Installed? ☐ Yes ☐ Front ☐ Rear ☐ No
- Circle Positions of Uninjured Wearing Seat Belts → (1 2 3 / 4 5 6)
- Circle Positions of Uninjured Not Wearing Seat Belts → (1 2 3 / 4 5 6)
- Apparent Condition of Driver: ☐ Ill ☐ Physical Defect ☐ Normal ☐ Fell Asleep ☐ Had Been Drinking
- Vehicle was Damaged ☐ Left Front ☐ Left Rear ☐ Left Side ☐ Right Front ☐ Right Rear ☐ Right Side ☐ Other
- Vehicle Towed Away? ☐ Yes ☐ No | By Whom?

6. KILLED OR INJURED

	Name / Address	Sex / Age / Injury	Position in Vehicle (1 2 3 / 4 5 6)
1	Nature of Injuries; Date of Death	In Vehicle Number _____	☐ Pedestrian ☐ Bicyclist
	Person Wearing Seat Belt? ☐ Yes ☐ No; Injured Taken To Hospital? ☐ Yes ☐ No; Name of Hospital; Was Person Ejected? ☐ Yes ☐ No		
2	Name / Address; Nature of Injuries; Date of Death	Sex / Age / Injury; In Vehicle Number _____	(1 2 3 / 4 5 6); ☐ Pedestrian ☐ Bicyclist
	Person Wearing Seat Belt? ☐ Yes ☐ No; Injured Taken To Hospital? ☐ Yes ☐ No; Name of Hospital; Was Person Ejected? ☐ Yes ☐ No		
3	Name / Address; Nature of Injuries; Date of Death	Sex / Age / Injury; In Vehicle Number _____	(1 2 3 / 4 5 6); ☐ Pedestrian ☐ Bicyclist
	Person Wearing Seat Belt? ☐ Yes ☐ No; Injured Taken To Hospital? ☐ Yes ☐ No; Name of Hospital; Was Person Ejected? ☐ Yes ☐ No		
4	Name / Address; Nature of Injuries; Date of Death	Sex / Age / Injury; In Vehicle Number _____	(1 2 3 / 4 5 6); ☐ Pedestrian ☐ Bicyclist
	Person Wearing Seat Belt? ☐ Yes ☐ No; Injured Taken To Hospital? ☐ Yes ☐ No; Name of Hospital; Was Person Ejected? ☐ Yes ☐ No		

MV-104A (3/63)

DIVISION OF RESEARCH AND DEVELOPMENT

SNOWMOBILE ACCIDENT REPORT

I Environment

1. Place of accident: (Check one)
   - a. Private property ___
   - b. Public property ___
   - c. Club property ___
   - d. Commercial property ___
   - e. Public highway ___
   - f. Other: specify _____

2. Reason for trip at time of accident: (Check one)
   - a. Pleasure ___
   - b. Rescue mission ___
   - c. Hunting or fishing ___
   - d. Business ___
   - e. Other: specify _____

3. Trespass at time of accident: YES___ NO___

4. Topography: (Check one)
   - a. Paved road ___
   - b. Unpaved road ___
   - c. Open field ___
   - d. Wooded area ___
   - e. Lake ___
   - f. Trail ___
   - g. Other: specify _____

5. Direction of Snowmobile Travel:
   - A. 1. Turning Left ___
     2. Turning Right ___
     3. Going Straight ___
   - B. 1. Going Uphill ___
     2. Going Downhill ___
     3. Going Level ___
   - C. Jumping YES___ NO___

II Snowmobile Vehicle Involved (If more than one snowmobile involved use additional forms.)

VEHICLE #1

1. Make and Model _____
2. Year _____
3. Horsepower _____
4. Horn YES ___ NO___
5. Lights:
   - a. Headlight YES ___ NO ___
   - b. Side or Tail Light YES ___ NO ___
   - c. Lights Used YES ___ NO ___
6. Windscreen: YES ___ NO ___
7. Number of Tracks _____
8. Registered: YES ___ NO ___
9. Towing a Trailer YES ___ NO ___

III Operator

1. Name: _____
2. Sex: MALE___ FEMALE___
3. Height: _____ Weight_____
4. Any apparent physical defects (Specify) _____
   _____
5. Operator License: (Check one)
   - a. Not licensed ___
   - b. Operator license ___
   - c. Chauffer license ___
   - d. Licensed for motorcycle operation ___
6. License Restrictions (If licensed)
   - a. Corrective lenses ___
   - b. Other:specify _____
   - c. None ___
7. Occupation: _____
8. Number of Years driving a motor vehicle _____
9. Number of Years driving a snowmobile _____
10. Relationship to Owner of snowmobile _____

APPENDIX B

SNOWMOBILE ACCIDENT REPORT

FORM 11/69

7. **ARRESTS** Name of Person Charge

Name and Address of Magistrate

8. Give names and addresses of uninjured persons involved or witnesses; specify which (attach separate sheet, if necessary).

9. **TYPE OF ACCIDENT COLLISION WITH:**
- [ ] 1. Pedestrian
- [ ] 2. Other Motor Vehicle
- [ ] 3. Other MV and Pedestrian
- [ ] 4. Railroad Train
- [ ] 5. Animal or Animal Drawn Vehicle
- [ ] 6. Fixed Object
- [ ] 7. Bicycle
- [ ] 8. Other Object
- [ ] 9. Motorcycle
- [ ] 10. Overturned in Road
- [ ] 11. Ran Off Road
- [ ] 12. Other

10. **TRAFFIC CONTROL**
- ☐ 1. None
- ☐ 2. Police Officer*
- ☐ 3. Signal Light in Operation
- ☐ 4. Signal Light Not in Operation
- ☐ 5. Flashing Light
- ☐ 6. Stop Sign
- ☐ 7. Caution Sign
- ☐ 8. Yield Sign
- ☐ 9. Other (Includes R.R. Crossing)
- ☐ 10. School Crossing Guard*

* Badge or Shield No. _____

11. **LIGHT CONDITION**
- ☐ 1. Daylight
- ☐ 2. Dawn
- ☐ 3. Dusk
- ☐ 4. Dark, Road Lighted
- ☐ 5. Dark, Road Unlighted

12. **WEATHER CONDITION**
- ☐ 1. Clear
- ☐ 2. Cloudy
- ☐ 3. Rain
- ☐ 4. Snow
- ☐ 5. Sleet
- ☐ 6. Fog

13. **ROAD CONDITION**
- ☐ 1. Dry
- ☐ 2. Wet
- ☐ 3. Ice-Snow
- ☐ 4. Muddy

14. **ROAD CHARACTER**
- ☐ 1. Straight and Level
- ☐ 2. Straight with Grade
- ☐ 3. Straight at Hillcrest
- ☐ 4. Curve and Level
- ☐ 5. Curve with Grade
- ☐ 6. Curve at Hillcrest

15. **ROAD SURFACE**
- ☐ 1. Concrete
- ☐ 2. Blacktop
- ☐ 3. Brick or Block
- ☐ 4. Gravel
- ☐ 5. Dirt or Sand
- ☐ 6. Other Material

16. **ROAD TYPE**
- ☐ 1. 1 Lane
- ☐ 2. 2 Lane
- ☐ 3. 3 Lane
- ☐ 4. 4 Lane
- ☐ 5. 4 Lane Divided
- ☐ 6. 6 Lane
- ☐ 7. 6 Lane Divided
- ☐ 8. One Way Street
- ☐ 9. Unpaved Road
- ☐ 10. Other

17. **PAVEMENT MARKINGS** ☐ 1. Lanes Marked ☐ 2. Lanes Unmarked

Opposing Lanes Separated by:
- ☐ 3. Curb
- ☐ 4. Mall
- ☐ 5. Double Line

18. **APPARENT CONTRIBUTING CIRCUMSTANCES**
(Check One Box below for each Vehicle)

1	2		1	2	
☐	☐	1. Speed Too Fast for Conditions	☐	☐	12. Failing to Signal
☐	☐	2. Failing to Keep Right	☐	☐	13. Unattended, Rolling Down Hill
☐	☐	3. Failing to Yield Right of Way to Vehicle	☐	☐	14. Failing to Obey Signal
			☐	☐	15. Disregarded Stop Sign
☐	☐	4. Failing to Yield Right of Way to Pedestrian	☐	☐	16. Dazzling, Improper or No Lights
			☐	☐	17. Wrong Way, One-Way Thoroughfare
☐	☐	5. Following Too Closely	☐	☐	18. Defective Brakes
☐	☐	6. Backing Unsafely	☐	☐	19. Improper Parking
☐	☐	7. Reckless Driving	☐	☐	20. Animal on Highway
☐	☐	8. Driving While Intoxicated	☐	☐	21. Driving Through Play Street
☐	☐	9. Driving While Ability is Impaired	☐	☐	22. Pedestrian's Actions
☐	☐	10. Improper Passing	☐	☐	23. Unsafe Equipment
☐	☐	11. Improper Turning	☐	☐	24. Other
			☐	☐	25. None

19. **ACTIONS OF VEHICLE BEFORE ACCIDENT**
(Check One Box below for each Vehicle)

1	2	
☐	☐	1. Going Straight Ahead
☐	☐	2. Overtaking
☐	☐	3. Making Right Turn
☐	☐	4. Making Left Turn
☐	☐	5. Making a "U" Turn
☐	☐	6. Backing
☐	☐	7. Starting in Traffic Lane
☐	☐	8. Stopped in Traffic Lane
☐	☐	9. Starting from Parking
☐	☐	10. Slowing or Stopping
☐	☐	11. Skidding
☐	☐	12. Parked

20. **ACTION OF PEDESTRIAN CROSSING AT INTERSECTION**
- [ ] 1. With Signal
- [ ] 2. Against Signal
- [ ] 3. No Signal
- [ ] 4. Diagonally

21. **ACTION OF PEDESTRIAN CROSSING NOT AT INTERSECTION**
- ☐ 1. Walking in road with traffic
- ☐ 2. Walking in road against traffic
- ☐ 3. Standing or Playing in roadway
- ☐ 4. Coming from behind parked vehicle
- ☐ 5. Getting in or off other vehicle
- ☐ 6. Pushing or working on vehicle in roadway
- ☐ 7. Other working in roadway
- ☐ 8. Lying in roadway
- ☐ 9. Not in Trafficway
- ☐ 10. Other

22. **DIAGRAM OF ACCIDENT**

Use solid line to show path of vehicle before accident ⟶ Dotted after Accident - - - - - - - - - -
Number each vehicle. Show direction by arrow ⟶ ① ② ⟵ Show pedestrian by O. Railroad 1-1-1-

Direction of Travel	N	S	E	W
Vehicle 1	☐	☐	☐	☐
Vehicle 2	☐	☐	☐	☐

Indicate North by Arrow

23. **DESCRIPTION OF ACCIDENT**

24. SIGN Officer's Rank and Name Badge No. Troop Initials of Approving Officer

IV Owner of Snowmobile

1. Name _____

2. Ownership (if other than operator) : (Check one)

   a. Private ____

   b. Rental ____

   c. Other: Specify _____

3. Number of Units Owned: _____

4. Principle Business of Owner if other than operator _____

V. Occupants

(Total number: including trailer occupants _____)

(Was snowmobile overloaded? YES___ NO ___)

1. Operator:

   a. Injured: YES___ NO___

   b. Wearing Helmet: YES___ NO___

2. Passenger: Occupant of: Snowmobile ___ Trailer___

   a. Name _____

   b. Age _____

   c. Sex: Male___ Female___

   d. Wearing Helmet: YES___ NO___

   e. Injured: YES___ NO___

3. Passenger: Occupant of: Snowmobile___ Trailer___

   a. Name _____

   b. Age _____

   c. Sex: Male___ Female___

   d. Wearing Helmet: YES___ NO___

   e. Injured: YES___ NO___

4. Passenger: Occupant of: Snowmobile___ Trailer___

   a. Name_____

   b. Age_____

   c. Sex: Male___ Female___

   d. Wearing Helmet: YES___ NO___

   e. Injured: YES___ NO___

5. Passenger: Occupant of: Snowmobile___ Trailer___

   a. Name_____

   b. Age_____

   c. Sex: Male___ Female___

   d. Wearing Helmet: YES___ NO___

   e. Injured: YES___ NO___

VI Description of Accident (Include such factors as estimated speed, probable cause, and any pertinent information)

_____

_____

_____

_____

_____

_____

_____

_____

_____

APPENDIX C

INTERVIEW INSTRUMENT

Interviewer . . . INTERVIEW QUESTIONS . . . . I.D. No.

School Experience:
How far did you go in school? Name and address of the school you last attended. How did (do) you like school?
Are you now: married, single, divorced, other, military veteran?
If married: number of children, ages of children.
Number of brothers and sisters.
Employment history:
Present occupation. Briefly explain what you do. How long have you had this job? How many different employers have you had during the last five years?
What is your career goal or amibition?
What is your favorite recreation?
How did you learn to drive? Taught by member of family or friend. Taught through a driver education course. Taught myself. Other (describe).
How did you learn to operate a snowmobile? Taught by member of family or friend. Taught through a snowmobile course. Taught myself. Other. (describe).
Driving Experience: How many years have you been driving? How many miles per year do you drive? Total mileage driven?
Snowmobile experience: How many years have you been driving? How many hours per year do you drive? Total hours driven?
Tell me in your own words how this accident happened, beginning a few minutes before the accident happened.
Describe the terrain approaching and at the accident scene: level, slight grade, steep grade, hill crest, dip.
What was the approximate temperature at the time of the accident?
On this diagram show me the position of your snowmobile when you first realized that you were in trouble.
How could you tell that you were in a tight spot?
At what speed were you traveling at this point?
Were you at a: constant speed, slowing down, speeding up?
Exactly what did you do to avoid the accident when you realized you were in an emergency situation?

Then what happened?
Do you feel that a different reaction on your part could have prevented or reduced the severity of the accident?
What were you thinking about just before you saw that you were in trouble?
Were there any passengers on the snowmobile or in the sled when the accident happened? If so, what was their relationship to you?
Do you recall any distractions on the snowmobile or in the sled that contributed to the accident? Explain.
Was there anything such as wild game, other snowmobiles, pretty girls, that took your attention away from operating just before the accident happened? If so, explain.
Did any environmental conditions (shoulder, trees, ditches, other) aggravate the seriousness of the accident after the point of no escape? If so, explain.
Was your visability reduced in any way just before the accident happened? If so, explain.
Was your view of the road and surrounding area blocked in any way just before the accident happened? If your view was blocked, explain.
Did the lack of appropriate signs, signals or highway markings help to cause the accident? Explain how.
What was the legal speed limit at the location of the accident?
What happened next?
Are you still operating a snowmobile? Did you stop? If so, how long?
Are you operating any differently as a result of this accident? In what way?
What advice do you have for operators to prevent this type of accident?
Where did your trip originate? home, school, work, other.
What was your destination and reason for the trip?
Did you make any stops on this trip?
How long did you operate before the accident happened? Overall. Since the last trip stop?
How many miles did you operate before the accident happened? (since you began the trip that day)
About what speed were you traveling during most of your trip?
Was this your own snowmobile? If not, how many times have you driven this snowmobile in the past year? Do you think the accident would have happened if you had been driving your own snowmobile?
What in your opinion was the general condition of the snowmobile you were driving? excellent, good, fair, poor.
How were your: brakes; steering mechanism; lights; windshield? When was this machine last serviced?

Were you wearing any special clothing? If so, what?
Did the snowmobile have: first aid kit; repair kit; survival equipment; extra fuel; other.
Why did you choose this route?
Did anything happen that upset, worried, or bothered you on this trip. ("Close calls," or near accidents, behavior of another operator, argument with passenger, etc.)? yes, no. If so, tell me about it.
Describe how you felt within an hour before the accident (physically and emotionally). drowsy, tired, nervous or upset, bored, excited, elated, angry, dejected (down in the dumps), in a hurry, other. Why?
How many hours of sleep did you have the night before making the trip?
Describe generally what you did on the day of the accident from the time you arose to the time you started on the trip that resulted in the accident.
Was there anything unusual about this routine?
In thinking back to the day of this trip, was there anything "on your mind" which worried you or caused you to be anxious or nervous, etc.? This could have been something that happened a few days before the trip, that day, or perhaps was going to happen in a day or two.
Were you sick or injured within twenty-four hours before making this trip? If so, tell me about it.
Tell me about any close calls or near accidents you have had since the accident under discussion.
Are you bothered by any of the following: dizzy spells; nervous spells; hard of hearing; severe headaches; poor eyesight (no glasses); seizures of any sort; heart ailment; diabetes; anything else. Describe.
When was the last time you had a physical examination by a physician?
Did you take any of the following on the day of the accident? insulin; antihistamines; barbituates; benzedrine, tranquilizers; other.
What were you treating? Was this treatment prescribed by a doctor?
Did you have wine, beer, whiskey, or other alcoholic beverages within six hours before the accident? How much? Did this have anything to do with the accident? How much beer or whiskey can you drink before it bothers your operation? How is your operation affected if you have more?
How do you feel about drinking and operating a snowmobile?
How do you think this accident might have been prevented?
Before you had this accident did you ever think you would be in an accident?
Do you think now, after having an accident, that you could have another? Why?

What type and amount of insurance did you have on your snowmobile (if it was the operator's snowmobile) at the time of this accident? If not insured, why not?

In how many accidents including this one have you been involved as a driver in an auto: How many of these were the other driver's fault? In how many of these were you convicted for a violation?

How many times have you been convicted for moving violations?

How do you feel about driving an automobile?

How do you feel about operating a snowmobile?

How do you feel when operating a snowmobile? (Physically and emotionally.)

How good a driver do you think you are compared to other drivers?

How good an operator do you think you are compared to other snowmobile operators?

What do you believe are your best traits as a snowmobile operator? Your worst traits?

What do you think safe snowmobiling is?

What do you believe are your best traits as a driver? Your worst traits?

What do you think safe driving is?

Please tell me if you: agree; disagree; or are undecided about the following sentence:

> "Good operators can overcome almost any hazardous situation presented by surface and vehicle conditions or by other operators."

Why do you feel this way?

Have you ever had any real close one (near accidents) while operating a snowmobile? Can you think of anything that you did that kept you from having an accident at that time?

Do you have any suggestions on how we can make snowmobiling in New York State safer? Age limits? Restrictions on operation?

Can you think of anything about snowmobiles that make them difficult to operate or might cause an accident?

How do you feel about registering your snowmobile?

What irritates you most about other snowmobile operators?

What techniques (newspaper and magazine articles, radio and TV programs, posters, etc.) designed to promote safety affect your thinking and behavior?

If you had driver education, do you think the course helped you become a better driver? How?

How could the course have been improved?

If you did not have driver education, do you think that you would benefit by taking a course now? Why?

Would you have attended a course in snowmobile operation and maintenance if it had been available? Why?

Do you think that you would benefit from participation in a snowmobile course now? Why?

What accidents, other than snowmobiles, have you been involved in?
Is there anything more you'd like to say about your accident?
Is there anything more you'd like to say about the snowmobile problem?
Is your father living? What does he do? Is your mother living? What, if any, work does she do outside of the house?
Did your parents live together all of your life? If not, could you tell me why?
Did you have any difficulties getting along with your parents? Will you tell me about it?
How did your parents generally treat you? strict, easy, other.
Do both your parents drive? Are they (either one) good drivers? Why do you say that?
Do both your parents snowmobile? Are they (either one) good operators? Why do you say that?
What do your parents, wife or girl friend, or friends think of your driving?
What do your parents, wife or girl friend, or friends think of your snowmobiling?
Tell me how you feel about this interview.
Interviewer's impression of subject's attitude and behavior during the interview.

APPENDIX D

SUBJECT CONTACT LETTER

Date

Subject's Name
Subject's Street Address
Subject's City and State and Zip

Dear Mr. or Miss _____:

The traffic safety students of the State University of New York at Oswego in cooperation with the Department of Motor Vehicles and the Department of Conservation are conducting research studies concerning the causes of snowmobile accidents.

We are seeking your cooperation for additional information about the causes of snowmobile accidents through a personal interview. No names will be used in recording the information. The information obtained in the interview will be analyzed by a computer to determine the common conditions surrounding snowmobile accidents.

Based on your experiences and information provided, perhaps effective measures for preventing snowmobile accidents may be found.

You will be contacted to arrange for an interview at a time and place convenient for you.

We appreciate your cooperation and participation in this effort to improve the snowmobiling situation in New York.

Sincerely,

Theodore Hinckley, Assistant Professor
Department of Industrial Arts and Technology

TH/mjd

APPENDIX E

SCHOOL RECORD REQUEST LETTER

Date

Director, Pupil Personnel Services
(Name of) High School
Street Address
City, State, and Zip

Dear Sir:

In cooperation with the New York Department of Motor Vehicles we are attempting to research the snowmobile accident problem via the case study method. No names will be used except as identification to gather data. The data gathered will be analyzed by a computer to determine the commonalities.

I would suggest that this communications might be separated between the subject's name and identification number and that you might respond by checking the response that applies.

I appreciate your cooperation in this endeavor.

Sincerely,

Theodore Hinckley, Assistant Professor
Department of Industrial Arts and Technology

TH/mjd

Subject: Name Date of Birth

Identification Number: Date of Birth

	Above	Average	Below
1. Ability	_____	_____	_____
2. Achievement	_____	_____	_____
3. Social relationship: (participation in clubs, sports, and social organizations)	_____	_____	_____
4. History of related problems: (Health, absenteeism)	_____	_____	_____

Please return to: Theodore Hinckley, Assistant Professor
Department of Industrial Arts and Technology
State University College at Oswego
Oswego, New York 13126

APPENDIX F

SPECIFIC ACCIDENT CASE INFORMATION

SPECIFIC ACCIDENT CASE INFORMATION

Type: Personal Injury
Oswego County, December, Friday, 8:15 p.m.
Weather--clear--5°F, private property,
returning from dealer's.

Vehicle: 1969 Moto-Ski, not registered, 18 h.p.,
equipment--headlight, tail light, lights
used.

Occupant: Operator--age 20, male, licensed, 5 ft. 10 in.,
185 lbs., clerical worker, 7 years operating a
snowmobile, helmet and boots worn.

Description: Snowmobile proceeding through a field adjacent
to highway at 45-50 mph struck car parked in
driveway.

Operator's
Statement: "After dinner I went to get my snowmobile
from the dealer's where it had been serviced.
The snowmobile had been inside where it was
warm. On my way home the throttle began to
bind, it finally froze full open. I saw the
parked car but was too close to avoid it."

Injury: Fracture of the right femur, operator removed
by ambulance, taken to hospital.

APPENDIX G

VEHICLE AND TRAFFIC LAWS RELATIVE TO SNOWMOBILES IN EFFECT DURING THE STUDY

VEHICLE AND TRAFFIC LAWS RELATIVE TO SNOWMOBILES IN EFFECT DURING THE STUDY

375-a. Equipment for snowmobiles and snow travellers. It shall be unlawful to operate on any public highway in this state any snowmobile or snow traveller unless it is equipped with a suitable braking device or system, a suitable horn or other device for signaling, a red reflector approved by the commissioner attached to the rear, and if operated on a public highway during the period from one-half hour after sunset to one-half hour before sunrise, one white or amber lighted lamp approved by the commissioner in front, one lighted red lamp on the rear and a light illuminating the number plate carried on the rear.

410. Registration of motorcycles, snowmobiles and snow travellers; fees; renewals. No motorcycles, snowmobiles or snow travellers shall be operated or driven upon the public highways of this state without first being registered in accordance with provisions of this article, except as otherwise expressly provided in this chapter.

Every owner of a motorcycle, snowmobile or snow traveller which shall be operated or driven upon the public highways of this state shall, except as otherwise expressly provided, cause to be filed, by mail or otherwise, in the office or a branch office of the commissioner, or with an agent of the commissioner, constituted as provided in this chapter, an application for registration, addressed to the commissioner, and on a blank to be prepared under the direction of and furnished by the commissioner for that purpose, containing: (a) a brief description of the motorcycle to be registered, including the name of the manufacturer and factory number of such vehicle; (b) the name, residence, including county and business address of the owner of such motorcycle, snowmobile or snow traveller.

2. Registration record. Upon the receipt of a sufficient application for registeration, as provided in this article, the commissioner or agent receiving it shall register such motorcycle, snowmobile or snow traveller, and maintain a record of the registration of such motorcycle, snowmobile or snow traveller under the distinctive number assigned to such motorcycle, snowmobile or snow traveller, as provided in this section, and the information in such record may be obtained upon payment of the fees specified in section two hundred two of this chapter.

3. Certificate of registration. Upon the filing of such application and the payment of the fee hereinafter provided, the commissioner shall assign to such motorcycle, snowmobile or snow traveller, a distinctive number and, without expense to the applicant, issue and deliver in such manner as the commissioner may select to the owner a certificate of registration in such form as the commissioner may prescribe, and a number plate at a place within the state of New York named by the applicant in his application. A certificate of registration shall not be valid unless it is signed by the person who signed the application for registration. In the event of the loss, mutilation or destruction of any certificate of registration or number plate, the owner of a registered vehicle may file such statement and proof of the facts as the commissioner shall require, with a fee of one dollar, in the office of the commissioner, or, unless and until the commissioner shall otherwise direct, in the office of the agent who issued the certificate or plate and the commissioner or his agent, as the case may be, shall issue a duplicate or substitute.

4. Times for registration and reregistration. Registration applied for and certificates issued under any application shall expire on a date determined by the commissioner. Registration shall be renewed periodically in the same manner and upon payment of the same annual fee as provided in this section for registration, to take

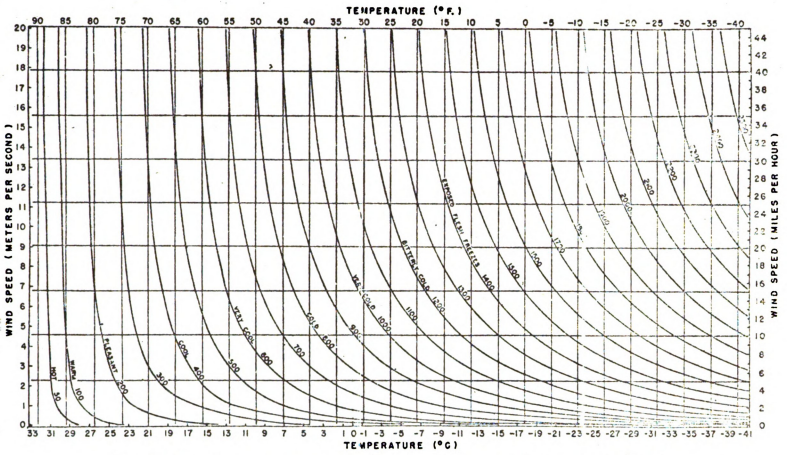
effect and to expire on dates to be determined by the commissioner. Provided, however, that the commissioner shall have authority to fix the length of time for which any such vehicle which is registered without fee shall be registered. Provided further, however, that renewal of a registration may be used during the thirty day period immediately preceding the expiration date of such registration including such expiration date. Provided, however, that when a registration or renewal thereof is made for a period of more or less than one calendar year, the annual fees as provided in this section shall be increased or reduced proportionately on a monthly computation basis.

5. Registration fees. The following fees shall be paid to the commissioner or agent upon the registration or reregistration of a motorcycle, or snowmobile or snow traveller in accordance with the provisions of this article: If the weight of the motorcycle, snowmobile or snow traveller fully equipped be two hundred pounds or less, two dollars, if such weight be more than two hundred pounds, and not more than five hundred fifty pounds, five dollars and if such weight be more than five hundred fifty pounds, one dollar for each one hundred pounds or major fraction thereof.

9. "Snowmobile" and "snow traveller" as used in this section shall mean a vehicle designed for travel over snow or ice, supported by skis or runners and propelled by a traction wheel or belt.

APPENDIX H

PAUL SIPLE'S WINDCHILL INDEX



SOURCE: Based on nomogram originally prepared by the Climatic Research Unit Office Of The Quartermaster General, January 1943.

Paul Siple's Windchill Index