RECREATION IMPACT ON CAMPSITE VEGETATION

by

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B. ENG., MCGILL UNIVERSITY, 1952

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

IN THE DEPARTMENT

OF

FORESTRY

We accept this thesis as conforming to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

APRIL 1975

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ABSTRACT

The study purpose was to determine the occurrence and magnitude of understory vegetation change caused by the occupants of campsites, to determine the magnitude of screening provided by overstory vegetation, to assess quantitatively the reliability of battery operated electromagnetic digital traffic counters, and to correlate permit system data to traffic counter data.

The original study design provided for cross-sectional data from twenty selected campsites within two campgrounds situated within two western Canada National Parks. Lack of visitors at one campground and time constraints at the other necessitated abandonment of fifteen sample campsites. The final field study was concerned with changes in understory vegetation, occupancy and screening of five selected campsites in Wapiti campground of Jasper National Park, the numbers and some characteristics of the parties entering the study area, and the numbers of parties entering the campground.

The study period was July 1 to September 1, 1970. Sixteen sample days were randomly selected to provide double backed days, evenly distributed between weekdays and weekends. Four experimental plots and one control plot, each one square meter in area, were located within each sample campsite. Within these plots understory vegetation change was determined by scanning the vegetation understory through a clear plastic grid at the beginning and end of the study period. Total vegetation cover within the experimental plots was reduced from a mean of 37

percent to 17 percent. Total vegetation within the control plots was reduced from a mean of 46 percent to 35 percent. Statistical analysis revealed a significant reduction of total vegetation within the experimental plots and within the control plots.

Occupancy of the sample campsites was observed each hour from 8:00 a.m. to 8:00 p.m. during the sample days. No correlation could be found between changes in vegetation cover and occupancy of the sample sites.

Overstory vegetation screening between campsites, determined by means of a pantallometer, ranged from 25 to 50 percent.

Electromagnetic digital traffic counters were found to be a reliable and statistically acceptable method of collecting traffic data. Correlation of campground permit sales to traffic entering the campground indicated that each vehicle entered the campground approximately twice daily.

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ACKNOWLEDGEMENTS

I am grateful to Dr. P.J. Dooling, programme advisor, Dr. T.M. Ballard and Dr. L.M. Lavkulich, for their helpful suggestions and advice during the planning of the project and for their excellent critique of the manuscript. Dr. P.J. Dooling arranged for the necessary equipment and funding for the field work. Dr. A. Kozak provided the statistical analysis of the field observations.

I wish to thank Mr. Frank Camp of the National Parks western region administration office, Parks Canada, for expediting approval of the project and the Jasper Park staff for their co-operation. Mrs. Dona Paul and Mrs. Sandra Aspden provided expert secretarial assistance during the preparation of the manuscripts.

Finally I wish to express my gratitude to my wife and daughters. Without their understanding and encouragement the graduate programme would not have been possible.

CHAPTER I

INTRODUCTION

The demand for outdoor recreational opportunities is rising rapidly as a result of increased population, leisure time, disposable income and mobility. The increased number of visitors travelling in private conveyances has imposed increased obligations on park administrations to provide accommodation while at the same time preserving the environment of campgrounds and other park areas to meet the requirements of the dedication clause of The National Parks Act. The Act states in part:

> The parks are hereby dedicated to the people of Canada for their benefit, education, enjoyment...and such parks shall be maintained and made use of so as to leave them unimpaired for the enjoyment of future generations.[1]

Hills acknowledges the obligations of land management when he states that:

> Although man-management may dominate the planning of considerable areas of the national and provincial parks, forest and wild life management must remain the basic management... The maintenance of vegetative cover, even under the strain of dense human occupance, is one of the main objectives of recreational land management.[2]

The allocation of specific areas for camping provides a method for controlling and guiding public use of the outdoors.

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[1]National Parks Act. 1956. Part 1. Canada Department of Northern Affairs and National Resources, Ottawa. Consolidated for office purposes, page 1.

[2]G.H. Hills. 1961. The Ecological Basis for Land-Use Planning. (Research Report No. 46, Ontario Department of Lands and Forests) page 2.

The regulation of use aids in the overall preservation of the attractiveness of recreational lands. It does, however, result in concentration of people on relatively small areas. This tends to impose excessive recreational pressure on the natural vegetation of campgrounds.

Vegetation, as part of the resource attraction conponent of a recreation area, is a primary source of outdoor pleasure. Its contribution to the recreational experience is so subtle that vegetation often goes unnoticed until it has been either degraded or eliminated. Douglass states that "deterioration of the occupied portions is the greatest threat to established recreation areas".[3] According to Brockman[4] destruction of vegetation is one of the first indications of overuse of campgrounds. Excessive wear manifests itself in several ways: reduction of shade due to loss of trees, reduction of screening as shrub cover wears out, denudation of the ground and an increase in dust and dirt.[5]

Statement of the Problem

The park administrator has the difficult task of attaining and maintaining a balance between the goal of pro-

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[3]Robert W. Douglass. 1969. Forest Recreation (Pergamon, Toronto) page 49.

[4]C. Frank Brockman. 1959. Recreational Use of Wild Lands (McGraw-Hill Book Company Inc., New York) page 234.

[5]Read W. Bailey, 1962. Recreation Opportunities and Problems in the National Forests of the Northern and Intermountain Regions (U.S. Department of Agriculture, Intermountain Forest and Range Experiment Station, Forest Service Research Paper 66) page 5.

viding service and satisfaction to visitors and the goal of preserving the natural features of the park. The history of campgrounds indicates that the forest environment cannot be maintained in an acceptable condition indefinitely if subject to very high or rapidly increasing use pressures. Periodic closures of most campgrounds is probable at some future date unless methods can be devised to determine their carrying capacity as a prerequisite to the regulation and control of use intensity within the recovery ability of the vegetation. The most desirable vegetation within the campgrounds of the National Parks of Canada consists of naturally established indigenous plant associations. Under certain conditions the introduction of plants more resistant to the effects of trampling, the application of fertilizer and irrigation may be advantageous.

"Usually ecology is defined as the study of the relation of organisms or groups of organisms to their environment, or the science of the interrelations between living organisms and their environment".[6] In the provision of outdoor recreation opportunities ecological considerations are important. Ecological science should play an important role in the design and operation of parks and the campgrounds constructed within them. For adequate design and operation, information is required related to but not limited to the questions: What

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[6]Eugene P. Odum. 1959. Fundamentals of Ecology (W.B. Saunders Company) page 4.

is the rate of deterioration of campgrounds and can rates of deterioration at varying levels of use intensity be predicted? Can campgrounds be located, designed and constructed so as to provide continuing satisfactory surroundings? Does regulation of use provide a suitable method for prolonging the usefulness of public campgrounds?

Objectives of the Study

There has been little research in general and scarcely none in Canada on the effect of recreation use on campsite vegetation. Information is required as to the effects of different kinds and intensities of recreation use on the different species and amount of vegetative cover within recreation development sites.

The objectives of the study were:

1. To determine the occurrence and magnitude of understory vegetational change in relation to use-intensity of public campsites.
2. To develop relationships of use-intensity to traffic by employing visual and traffic counter survey techniques.
3. To assess quantitatively the reliability of battery-operated electromagnetic digital traffic counters.
4. To relate permit system visitor data to traffic counter data.

The hypothesis of the study was that: The greater the recreational use of campsites, the greater is the reduction in the abundance of low-growing understory vegetation.

The research project was undertaken to develop a direct method of determining low-growing plant response within campsites to various levels of occupancy. In the long run

factors useful to park management for predicting rates of vegetative change are to be developed. The use-vegetation impact relationships will contribute to the criteria employed in the selection and design of campsites in similar ecosystems. They will provide the means for predicting maintenance and rehabilitation requirements of existing campsites at varying levels of occupancy.

Limitations of the Study

This study was considered to be the first stage of a three stage undertaking. The data analysis are not expected to be conclusive until the three stage study is complete. The study was limited to the effects of recreational use intensity of campsite areas to the denudation of the ground. Adequate data was obtained to provide the changes in vegetation cover during one camping season. Adequate traffic data was obtained to illustrate that electromagnetic digital traffic counters provide a reliable method of determining traffic levels automatically. Future stages will require only that vegetative cover readings and traffic counter readings be recorded at the beginning and at the end of the camping season, providing no major changes occur in the campground or park which would affect visitation distribution.

From his studies it became evident to Wagar "...that recreational carrying capacity is a complex matter that requires difficult value judgements and must draw on rather complete statements of the desires of recreationists and

the ecology of biotic communities".[7] He concluded that "...the production of recreation values depends not only on the condition of the resource but upon the psychology of recreationists".[8] This study was concerned only with changes in the understory vegetation associated with developed public campgrounds and limited to cross-sectional data for the summer study period, 1970.

Although the user's attitudes towards satisfaction and acceptance of his surroundings are important factors in determining carrying capacity, only physical factors of low growth vegetation and screening provided by trees were considered. The effect of changes in low growth vegetation on the attitudes of campers towards acceptance of the campground environment were not considered.

To overcome the disadvantage of detailed and accurate information not being available as to conditions and use in previous years, only sites recently placed in service in the National Parks of the Western region were selected.

Definition of Study Terms

For convenience and ready reference, definitions pertinent to the thesis are listed in Appendix A. The reader's

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[7] J. Alan Wagar. 1964. The Carrying Capacity of Wild Lands for Recreation (Forest Science Monograph 7) page 20.

[8] Ibid, page 21.

attention is directed to the following terms which have particular reference to the identification and analysis of data.

Study Period - the interval of time between the initial and final observations (8:00 a.m. July 1st to 8:00 a.m. September 1st, 1970.)

Sample Period - the 48 hour time interval of two back to back sample days from 8:00 a.m. the first day to 8:00 a.m. the third day.

Observation Period - a 12 hour time interval from 8:00 a.m. to 8:00 p.m. during back to back sample days.

Vegetation Cover - the vertical projection of low growing plant life forms consisting of graminoids, forbs, lichens and mosses.

Impact - that portion of the change in vegetation cover attributable to occupancy of a campsite.

Occupancy - the length of stay in a campsite to which a party is entitled by the purchase of a campsite permit.

CHAPTER II

LITERATURE REVIEW

The determination of the carrying capacity of recreational land involves, in terms of its biotic component, the determination of changes in vegetation and changes in soils as a result of different levels of recreation use. The concept that the carrying capacity of different sites for different recreational uses is comparable to that of sustained yield in timber management, was first suggested by Dana.[1] He outlined the necessity of determining capacity as a basis for adjusting recreation use to reduce the degradation of the resource.

It is generally conceded that ecological degradation of a recreation microsite is an obvious feature of the landscape which is difficult to assess quantitatively. This problem was recognized by LaPage when he stated that:

> Although the aesthetic deterioration of a recreation site is oftentimes readily apparent, it becomes quite difficult to arrive at a satisfactory qualitative or quantitative measure of this deterioration in terms of biotic characteristics.[2]

Many natural attributes such as climate, topography and scenery determine the value of a recreation site. The

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[1] S.T. Dana. 1957. Problem Analysis: Research in Forest Recreation (U.S. Department of Agriculture, U.S. Forest Service, Washington) pages 22-23.

[2] Wilbur F. LaPage. 1962. Recreation and the Forest Site (Journal of Forestry, Volume 60) page 320.

aesthetic value of an intensively used recreation microsite is determined largely by the plant population and its condition. The plant population, especially that of the low growing species which form the ground cover, is dependent on the ability of the native plant associations to withstand trampling. Heavy use imposes unfavourable influences on the health and reproduction of ground cover grasses, forbs, lichens and mosses, understory shrubs and overstory trees. Litter cover and depth, screening cover[3] and soil properties are also unfavourably affected.

Vegetation

Ground Cover Some of the most obvious and undesirable results of recreation activity on forest sites are the changes in the natural vegetation which lead to a reduction in the aesthetic attraction of the site. In his studies of the effect of tourist travel on the California Redwood Parks, Meinecke[4] attributed the dying out of plants forming the ground cover to bruising, trampling down and to packing of the soil.

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[3] "Screening cover" is defined as the percent of the surrounding terrain which is obscured, or nearly so, when viewed parallel to the prevailing ground surface. (Eamor Nord and Arthur W. Magill. 1963. A Device for Gaging Campground Screening Cover. (Journal of Forestry, Volume 61) page 450-451.

[4] E.P. Meinecke. 1929. THe Effect of Excessive Tourist Travel on the California Redwood Parks (California Department of Natural Resources, Sacramento) 20 pages.

Bates[5] reported that in England bare ground occurred where treading was most severe and that distinct plant zonation was evident from the bare ground outward to the surrounding areas.

Leaf size has a bearing on the ability of a plant to withstand trampling. Grasses were found to be more resistant to trampling than broad leaved herbs, by Bates[5], Wagar[6] and LaPage[7].

With the prime objective of identifying and describing the general relations between the physical and biological properties of developed sites, use loads and degrees of site degradation, Ripley, using multivariate analysis, found that "the most important relations were those associated with bare ground, erosion, and tree damage".[8] The more fertile sites

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[5]G.H. Bates. 1935. Vegetation of Footpaths, Sidewalks, Carttracks and Gateways (Journal of Ecology, Volume 23) pages 470-487.

[6]J. Alan Wagar. 1964. The Carrying Capacity of Wild Lands for Recreation (Forest Science Monograph 7) page 19.

[7]Wilbur F. LaPage. 1964. A Study of Ground Cover Under the Camper's Feet (American Recreation Journal, Volume 5) pages 103-104.

[8]Thomas H. Ripley. 1962. Recreation Impact on Southern Appalachian Campgrounds and Picnic Sites (U.S. Forest Service, S-E Forest Experimental Station Paper 153) page 13.

withstood recreational use and maintained vegetation better than nutrient deficient sites[9]. Severe crown closure of the high canopy limited the amount of understory from which it was inferred "... that for most areas canopy reduction could produce important regrowth..."[10]

Grasses, Forbs, Lichens and Mosses Grasses, forbs, lichens and mosses are low-growing plants which are primarily responsible for the provision of ground cover. They provide a naturally attractive mat having high water infiltration rates which prevents the formation of dust and mud. They bind the soil surface against erosion by wind and water and at the same time aid in maintaining the soil humus in a permeable, compaction-resistant condition.

From studies of 137 California campgrounds and picnic sites, Magill and Nord reported that:

> Grass and forbs were abundant only on about half of the campgrounds--those situated along the foothills at lower elevations or on riparian sites where grasses and forbs usually predominate. Elsewhere, these plants were scarce in about 60 percent of all campgrounds, and entirely absent on 95 percent of the individual family units.[11]

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[9] Ibid, page 12.

[10] Ibid, page 19.

[11] Arthur W. Magill and Eamor C. Nord. 1963. An Evaluation of Campground Conditions and Needs for Research (U.S. Forest Service Research Note PSW-4) page 5.

Ehrenreich[12] reported that when competition for solar energy occurs, opening up tree crown closure increased ground cover vegetation. Wagar[13] reported that survival of vegetation decreased as the amount of use increased, with plants located in shaded areas surviving better than those in sunny sites. He concluded that the increased survival of vegetation in the shaded areas was due to greater moisture retention of the shaded soil. Wagar reconciled his findings with the divergent findings of Ehrenreich by suggesting that the ground cover would be most durable where a few trees are arranged to cast the greatest possible amount of shade. In such an arrangement, ground cover would be shaded for protection against excessive drying, but competition from trees would be held to a minimum.

On areas where use was sufficient to have caused initial damage to the ground cover, Wagar[14] and Frissell and Duncan[15] found that additional large increases in use caused only small increases in additional vegetation damage.

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[12]T.H. Ehrenreich. 1959. Releasing Understory Pine Increased Herbage Production (U.S. Forest Service Station Note No. 139, November) page 2.

[13]J. Alan Wagar. 1964. The Carrying Capacity of Wild Lands for Recreation (Forest Science Monograph 7) page 19.

[14]J. Alan Wagar. 1964. The Carrying Capacity of Wild Lands for Recreation (Forest Science Monograph 7) page 18.

[15]Sidney S. Frissell Jr. and Donald P. DUncan. 1965. Campsite Preference and Deterioration in the Quetico-Superior Canoe Country (Journal of Forestry 63(4)) page 258.

The total number of species represented in a ground cover association decreases as a result of trampling. Associations consisting largely of mosses are extremely susceptible to damage.[16] After severe damage to ground cover, Bates[17] and LaPage[18] found that bare spots become revegetated with the more resistant native species of grasses and forbs. deVos and Bailey[19] found that the invasion of hardy exotic species was characteristic of intensively used recreation sites. LaPage[20] attributed a general improvement in vegetation cover after the second year of campsite use to "the result of more resistant species taking over the barren ground previously occupied by the original plant community".

Shrubs - Shrubs contribute to the aesthetic appeal of outdoor recreation areas by adding variety and colour to the outdoor scene. In combination with tree boles and low branches, they provide screening cover. They often produce

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[16]Wilbur F. LaPage. 1967. Some Observations on Campground Trampling and Ground Cover Response (U.S. Forest Service Research Paper NE-68) page 4.

[17]Bates, loc. cit.

[18]LaPage, op. cit. page 7.

[19]A. deVos and R.H. Bailey. 1970. The Effect of Logging and Intensive Camping on Vegetation in Riding Mountain National Park (Forestry Chronicle 46:1 February) page 54.

[20]LaPage, loc. cit.

berries which are used as a source of food by animals and birds. The foliage of shrubs is often edible and used as a winter range by wildlife.

In intensively used areas shrub understory is usually lacking, but where it does exist as a shrub barrier it is very effective in protecting local areas and in reducing tree damage.[21] Shrub barriers increase vegetative low-growth cover damage by concentrating use into smaller areas.[22]

Of the 137 National Forest sites in California observed by Magill and Nord[23], half lacked a shrub understory. Of the remainder, thirty-five percent contained a medium density of shrubs and the rest were located on moist sites which supported the most abundant growth. The investigators concluded that species of shrubs that are tough, brittle, often thorny and grow in dense stands usually provide the most effective barriers to control visitor movements and protect tree reproduction.

The number of shrubs per acre on lightly used campsites in three California National Forests was reported by Magill[24]

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[21] Thomas H. Ripley. 1962. Recreation Impact on Southern Appalachian Campgrounds and Picnic Sites (U.S. Forest Service, S-E Forest Experimental Station Paper 153) page 19.

[22] Ibid, page 14.

[23] Magill and Nord. 1963. An Evaluation of Campground Conditions and Needs for Research (U.S. Forest Service Research Note PSW-4) page 5.

[24] Arthur W. Magill. 1963. Evaluating Ecological Trends on Campgrounds (U.S. Forest Service Research Note PSW-N 16) page 2.

to be almost three times greater than on heavily used sites. The reduction of shrubs from heavy use reduced screening effectiveness by fifty percent. Shrubby species in intensively used areas were reported to be displaced by grass-forb associations by Bates[25] in England, and by deVos and Bailey[26] in northern Canada.

Trees - Trees, being the dominant vegetation form, affect in several ways the recreational experience. Tree crowns provide shade and protection from wind and other elements of the weather and have considerable influence on ground cover and soil conditions. Tree boles often provide the only screening between sites, roadways and pathways. Recreational impact on the ecological quality of developed recreation areas may result in successional changes in forest associations which may have beneficial or detrimental effects on the value of the forest recreation resource.

An increase in the ratio of conifers to hardwoods due to recreation use was reported by Ripley[27]. He implied that this increase was probably related to the distribution of conifers

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[25] G.H. Bates. 1935. Vegetation of Foothills, Sidewalks, Carttracks and Gateways (Journal of Ecology, Volume 23) pages 470-487.

[26] deVos and Bailey, op. cit. page 55.

[27] Ripley, op. cit. page 13.

on thinner soils. Nevertheless, for the same areas he reported that "conifers were clearly more susceptible to disease and insect attack than were hardwoods... with the possible exception of short leaf pine and hemlock".[28] deVos and Bailey[29] in a study focusing on northern Canada found softwoods to be hardier and less affected by mutilation than hardwoods. They reported white spruce and jack pine withstood intensive use better than aspen and identified tree mutilations as a major factor in aspen mortality. Ripley[30] identified tree damage and root exposure as important consequences of recreational activity. Magill and Nord reported that:

> Most trees of poor vigor, and many vigorous ones, had been abused by campers... To support a multitude of camp conveniences, all sizes and kinds of nails, screws and wires -- objects that injure and disfigure woody plants, favour disease and insect attacks, and introduce toxic substances to the plants -- were attached to trees. Carving and chopping has destroyed some trees and girdled or scarred larger ones. Cars had damaged tree roots, boles, foliage and seedlings. Nearly all damaged trees were considered physically weakened and susceptible to pests or such other hazards as windstorms.[31]

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[28]Thomas H. Ripley. 1962. Tree and Shrub Response to Recreation Use (U.S. Forest Service, Southeastern Forest Experimental Station Research Note No. 172) page 2.

[29]deVos and Bailey, op. cit. page 54.

[30]Thomas H. Ripley. 1962. Recreation Impact on Southern Appalachian Campgrounds and Picnic Sites (U.S. Forest Service, S-E Forest Experimental Station Paper 153) page 5.

[31]Magill and Nord, op. cit. page 2.

Soils

Soil Compaction - Intensive recreation use has been reported by Dotzenko, Papamichos and Romine[32] and Lutz[33] to compact soil. The compaction interferes with the normal movement of air and water into the soil. The interrelationships between the soil and vegetation are numerous and complex. The changes in soil properties as a result of recreation indirectly affect the survival and propagation of plant species.

Soils formed from silt and clay are susceptible to puddling when wet. On drying, the upper layers of these soils become a powdery dust which is subject to wind and water erosion.[34] Soils formed of sand and gravel are less readily compacted but are usually deficient in nutrients and are least able to support good vegetative growth.

Changes in soil bulk density, infiltration rates, air capacity and permeability all indicate the degree and significance of compaction that has occurred in the upper layers of the soil. Compaction is dependent on intensity and duration of use

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[32] A.D. Dotzenko, N.T. Papamichos and D.S. Romine. 1967. Effect of Recreational Use on Soil and Moisture Conditions in Rocky Mountain National Park (Journal of Soil and Water Conservation, September-October) page 197.

[33] H.J. Lutz. 1945. Soil Conditions on Picnic Grounds in Public Forest Parks (Journal of Forestry, Volume 43) page 127.

[34] Magill and Nord. 1963. An Evaluation of Campground Conditions and Needs for Research (U.S. Forest Service Research Note PSW-4) page 6.

and is most severe in the A horizon[35]. By soil analysis, Lutz[36] found that treading may compact soils to a depth of 20cm., with the greatest increase of soil density occurring in the top 10 cm. Lutz defined air capacity as a measure of non-capillary pore space representing the amount of void space in a soil having a moisture content equal to its field capacity. He reported that the air capacity of soil to a depth of at least 20 cm. undergoes substantial reduction as a result of trampling; and that the permeability of sandy soils was six to twenty times greater for unused areas than for heavily trampled areas. In the trampled areas which exhibited changes in soil conditions, Lutz reported the absence of herbaceous vegetation, sedges and grasses. Steinbrenner[37] reported that compacted soils dry out faster than untrampled soils.

Organic Matter - Organic matter is an important factor in nutrient recycling, soil structure and soil permeability. Litter reduces the effect of trampling, aids the infiltration of water and retards evaporation. By interrupting the impact of precipitation and reducing runoff, organic matter reduces erosion.

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[35]Ripley, op cit. page 12.

[36]Lutz, op. cit. pages 123-126.

[37]E.C. Steinbrenner. 1951. Effects of Grazing on Floristic Composition and Soil Properties of Farm Woodland in Southern Wisconsin (Journal of Forestry, Volume 49) pages 906-910.

Recreational use reduces the thickness of the litter layer. Magill[38] reported a litter layer depth of 1.62 inches for lightly used sites and 0.58 for heavily used sites. A 65 percent reduction in litter and humus thickness was reported by Frissell and Duncan[39]. A dust-bed will often develop when vegetation and litter cover is absent.

Recreation Use Measurement

Recreation use and studies of the impacts of use on soils and vegetation have not been well defined quantitatively. Most investigators have employed an ordinal use measurement system usually consisting of two or three classes such as heavy, medium and light use. Investigators using this system have included Dotzenko, Papamichos and Romine[40], LaPage[41] and Magill[42]. Some researchers, including Frissell and Duncan[43],

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[38]Arthur W. Magill. 1963. Evaluating Ecological Trends on Campgrounds (U.S. Forest Service Research Note PSW-N16) page 2.

[39]Sidney S. Frissell, Jr. and Donald P. Duncan. 1965. Campsite Preference and Deterioration in the Quetico-Superior Canoe Country (Journal of Forestry 63 (4)) page 258.

[40]Dotzenko, Papamichos and Romine, op. cit. page 196.

[41]Wilbur F. LaPage. 1962. Recreation and the Forest Site (Journal of Forestry, Volume 60) page 320.

[42]Magill, loc. cit.

[43]Frissell and Duncan, op. cit. page 257.

have incorporated refinements by specifying limits for each class.

To fulfill the need for a reliable method of estimating man-hours of use and number of visits, James and Ripley[44] devised a double sampling technique based on previous findings which revealed a strong relationship between pneumatic traffic counts and the amount of use the areas received. The technique was to automatically count the vehicles entering the recreation area and to correlate this data with related information obtained from sample observations. Traffic movements were continuously tallied on pneumatic traffic counters and read daily. The number of visitors and activity participation were determined hourly during 12-hour observation periods on a few single random sample days. Camping, considered the sole activity during the remaining 12-hours, was adjusted to a 24-hour basis. Equations were then developed from the analysis of the observed data and traffic count. Future estimates of visits and use are based on 24-hour traffic counts only and the equations developed from the double sampling method. Traffic count data must be collected at the same location and during the same time of year as the original calibration data. The equations are applicable only as long as there are no major changes in the facilities and services of the recreation area.

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[44]George A. James and Thomas H. Ripley. 1963. Instruction for Using Traffic Counters to Estimate Recreation Visits and Use (U.S. Forest Service Research Paper SE-3. March) 11 pp.

The investigators stated that "The recommended sampling intensity of ten sampling days per site is expected to yield error terms no larger than plus or minus 25 percent of the estimated variable at the 67 percent level of probability... If error terms consistently less than 25 percent are desired, a sharp increase in the number of 12-hour sampling days will be necessary."[45]

Correlation regression and ratio analysis were employed by Bury and Margolies[46] to observed attendance records of 23 campgrounds to develop statistical models based on the relationships between attendance at each campground and total attendance. Equations were developed for key "indicator" campgrounds to estimate total daily attendance and total seasonal attendance. The precision of the estimated daily total attendance was reported to be 10 percent of true attendance from counts of daily attendance on only one of the campgrounds. This level of precision could be expected in two out of three estimates and could be improved by including additional indicator campgrounds in the calculations.

By combining the concept of key "indicator" campgrounds of Bury and Margolies[47] with the method of calibration of

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[45] Ibid, page 7.

[46] Richard Bury and Ruth Margolies. 1964. A Method of Estimating Current Attendance on Sets of Campgrounds... a Pilot Study (U.S. Forest Service Research Note PSW-42) 6 pp.

[47] Ibid.

traffic counts to use and activity observations developed by James and Ripley[48], James and Rich[49] reduced the cost of large-scale application of James and Ripley's method by reducing the number of single sample days and the intensity of observations at each site. Visits and activity estimates were generated for individual sites based on pneumatic traffic count records. Most estimates were within the acceptable limits specified by James and Ripley[50].

To determine a technique that can be used to predict recreation visitation at a campground before the facility is built, Dooling[51] modified the single sample day approach of James and Ripley[52], and James and Rich[53] by introducing the concept of two consecutive (back-to-back) sample days in order to enable more precise determination of the actual length of stay of site visitors.

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[48]James and Ripley loc. cit.

[49]George A. James and John L. Rich. 1966. Estimating Recreation Use on a Complex of Developed Sites (U.S. Forest Service Research Note SE-64) 8 pp.

[50]James and Ripley, loc. cit.

[51]Peter J. Dooling. 1973. Predicting Use of Recreational Sites: Model and User Analysis. (Ph.D. Colorado State University, Fort Collins, Colorado) p. 48.

[52]James and Ripley, loc. cit.

[53]James and Rich, loc. cit.

CHAPTER III

PROJECT PROCEDURE

The Study

Selection of the Study Area - The two westernmost provinces of Canada were examined to identify newly constructed campsites for the research project. Information obtained from the Provincial and National Parks branches indicated that few new campsites were to be placed in service in 1970. In 1969 three additional areas in Wapiti Campground had been opened to the public which increased the number of campsites from 120 to 325. From one of the new areas, five sample campsites were selected for the study.

Wapiti Campground is located in Jasper National Park three miles south of Jasper townsite at an elevation of 3470 feet (Figure I, page 24). The campground has a continental, boreal-like climate with extreme temperatures and low precipitation. The shallow soils support young stands of lodgepole pine (Pinus contorta) with an arid grassland understory consisting mostly of hairy wild rye grass (Elmyrus innovatus), buffalo-berry shrub (Shepherdia canadensis), Kinnikinnick (Arctostaphylos uvaursi) and wild strawberry (Fragaria vesca L.). Fire has had extensive influence on the environment and the development of plant associations. Largely because of fire, pure stands of lodgepole pine and aspen poplar (Populus tremuloides) are the dominant tree species.

The study area, a cluster of campsites oval in shape,

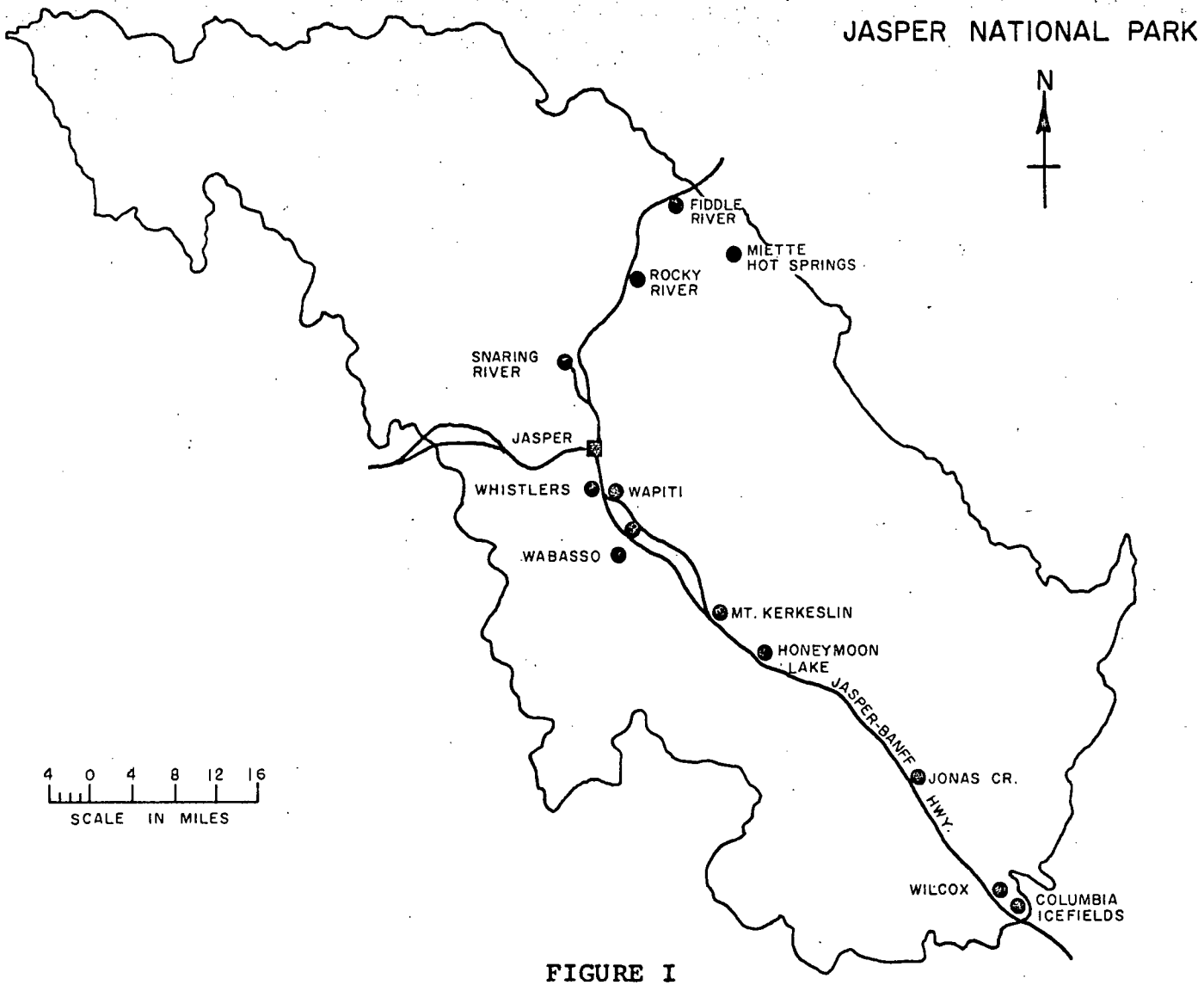

FIGURE I

WAPITI CAMPGROUND LOCATION

varied in elevation by approximately ten feet. The slope provided drainage towards the service area located at the centre of the oval. Because of the low precipitation and the porosity of the soil, drainage was not a problem.

Selection of Sample Periods - The study period was July 1 to September 1, 1970. Twelve sample days were selected to provide double backed days, evenly distributed between week-end and mid-week days. The Schedule for the sample periods of the user survey was:

Date	Period
July 4 and 5	Week-end
July 29 and 30	Mid-week
August 12 and 13	Mid-week
August 15 and 16	Week-end
August 19 and 20	Mid-week
August 22 and 23	Week-end

Vegetation Survey

Four experimental plots and one control plot were selected on each sample campsite to provide maximum impact on the experimental plots and minimum impact on the control plots. The area of each plot was one square meter. A square wooden frame (Figure 2, page 26) was employed to define each plot. The plot frame was divided into 25 - 20x20 cm. squares with wires which were used to locate and support a 1/8 inch thick clear plastic grid (Figure 3, page 27). The plot frame was adjusted so that the wires used to support the plastic grid were above the vegetation cover of the plot. The plastic grid, supported by the wires, was positioned 25 times during

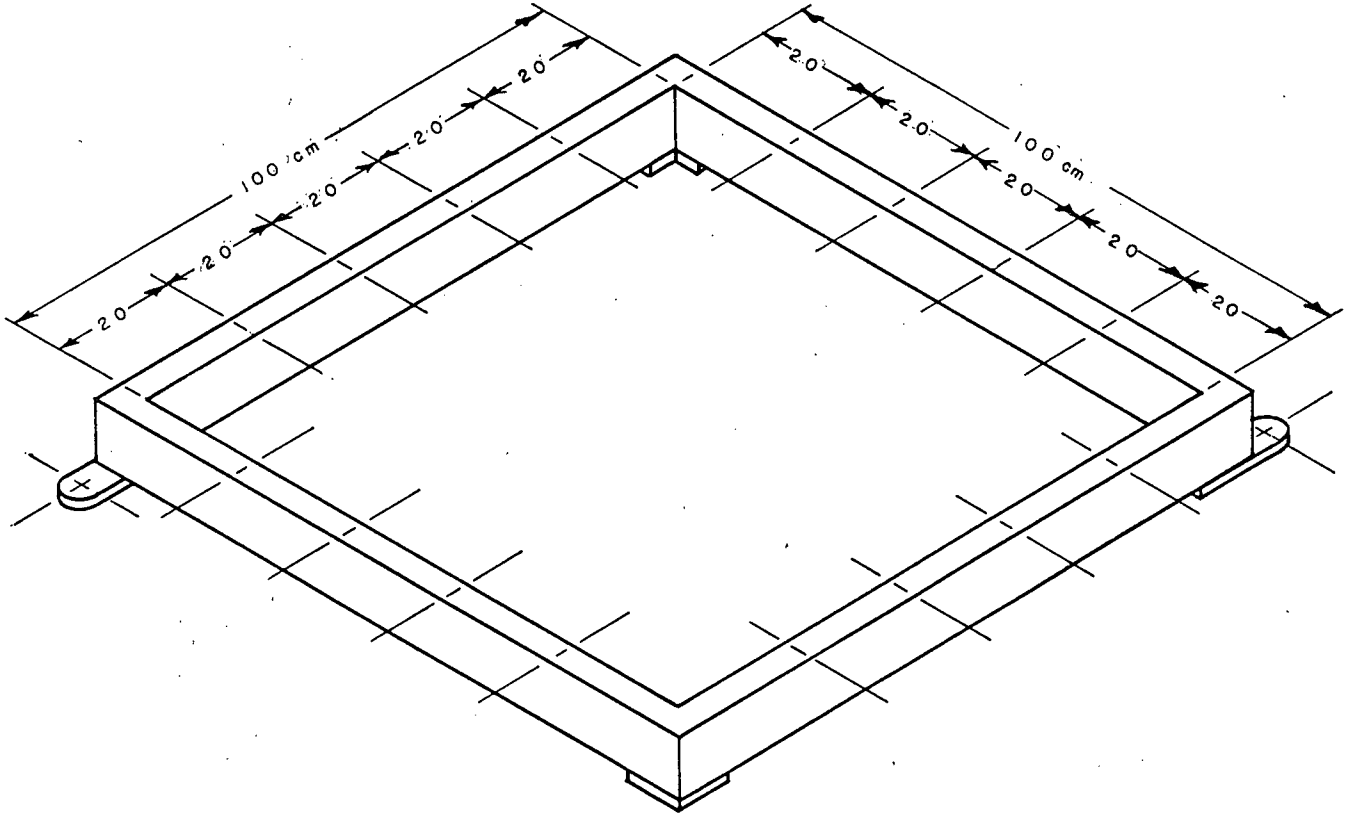

FIGURE 2
PORTABLE WOODEN PLOT FRAME

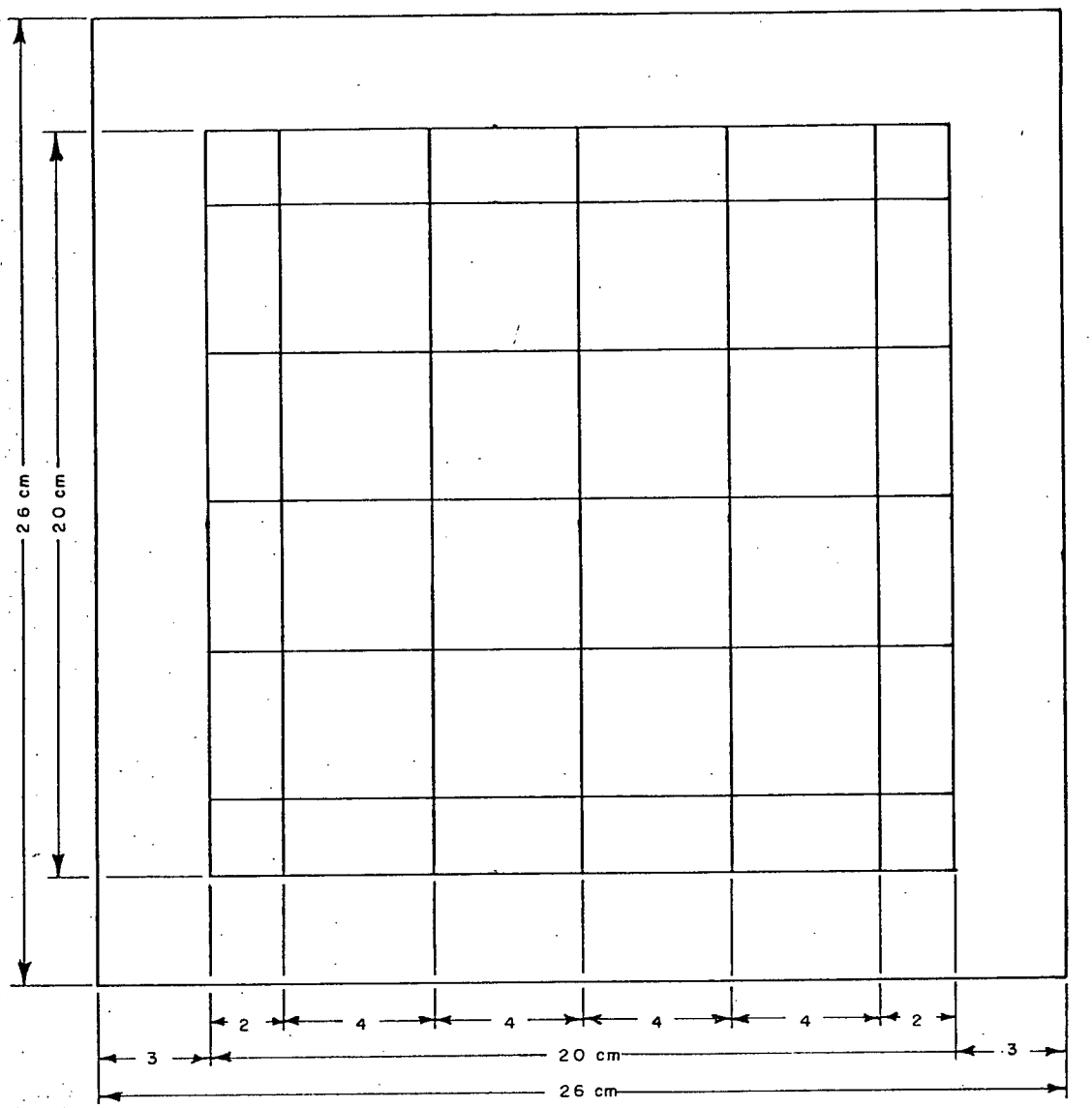

FIGURE 3

CLEAR PLASTIC GRID

vegetation cover readings. Observations were made by vertically sighting through the 25 inter sections of the lines on the plastic grid. The grid was scanned for forbs, graminoids, lichens and mosses, litter and bare ground. Photographs were taken from a fixed height with an Asahi 35 mm. Pentax Spotmatic camera.

The projecting steel lugs on the frame were used to locate steel marker pins which were left projecting about a half inch above the ground surface. The ends of the pins were painted orange to facilitate finding them at the end of the study period. Approximately 50 percent of the plot location pins were removed by visitors prior to the end of the study period. The pins were replaced with the aid of dimensional sketches drawn during the initial plot layout and shown in Appendix B.

Campsite screening was determined with a pantallometer constructed according to directions detailed by Nord and Magill[1].

Use Intensity Survey

Two methods of traffic data collection were employed. The first was the installation of Traffic Data Systems Model LD 353C traffic counters to tally incoming traffic at the Wapiti campground main entrance, and at the entrance to study

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[1]Eamor C. Nord and Arthur W. Magill. 1963. A Device for Gaging Campground Screening Cover (Journal of Forestry, Volume 61) pages 450-451.

area FF (Figure 4, page 30). The second method was the recording of two way traffic movements at a checkpoint located at the entrance to study area FF. The occupancy of the sample sites was visually observed hourly between 8:00 a.m. and 8:00 p.m. on the back-to-back sample days.

The number of campsite permits sold each day was obtained from campground records.

Field Adaptations

Sample campsites FF-3, FF-11, FF-41 presented difficulties in locating small protected areas for control plots due to the openness of the campsites. Only one control plot was located in each sample site instead of two as originally planned.

It was found that the observations became more difficult as the frame was raised to clear taller plants of the ground cover. Light wind made it necessary to judge whether or not a part of the plant would be directly under an observation point if the plant were stationary.

Separating moss from litter was a problem on those plots largely covered with lichens and mosses. The problem arose from the necessity of distinguishing live moss which was growing through a blanket of dead moss forming organic litter. At the end of the study period when vegetation cover readings were taken a second time, the graminoids had lost considerable green colour. Some difficulty was experienced in keeping discoloured grass separated from litter.

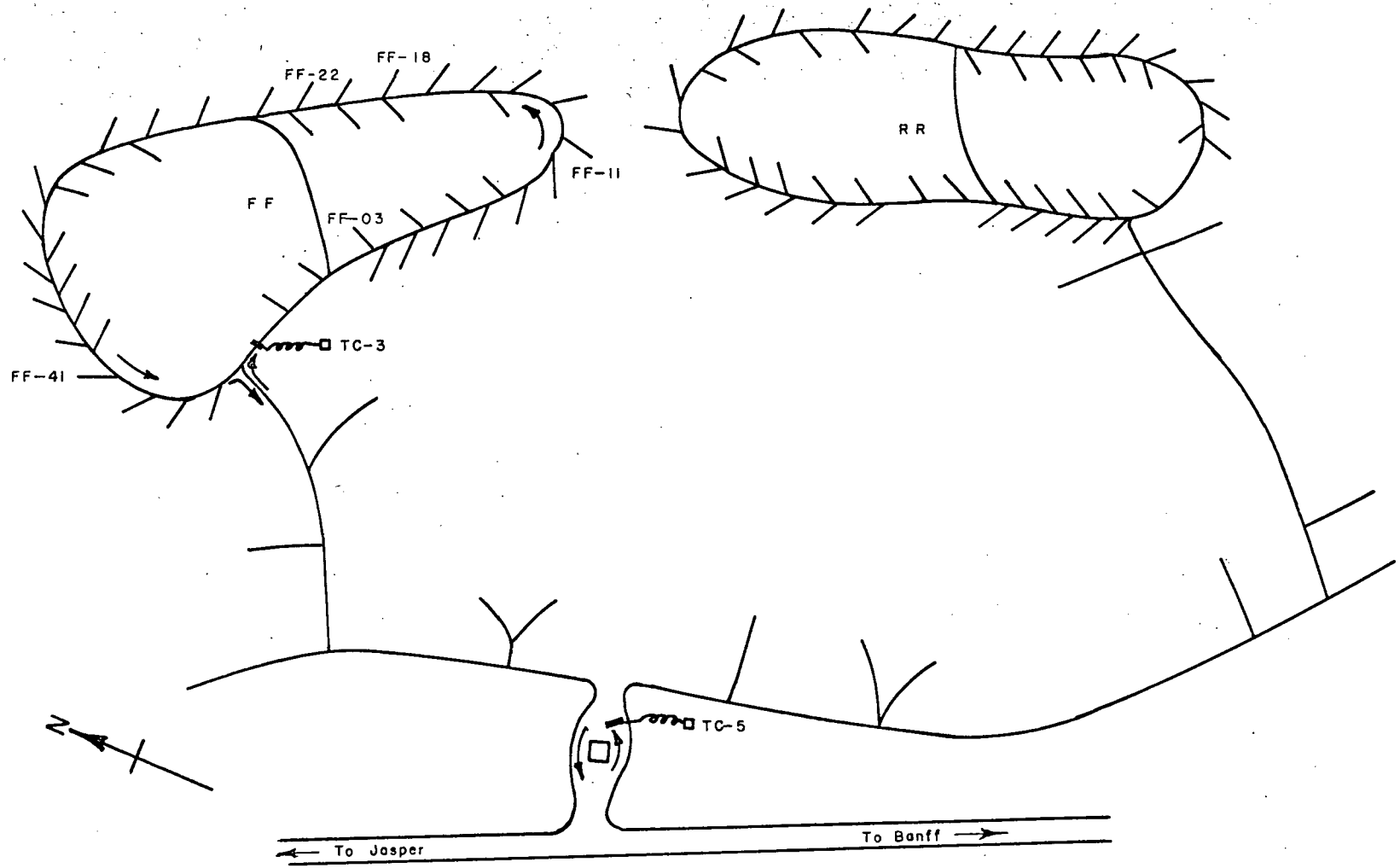

FIGURE 4
LOCATION OF TRAFFIC COUNTERS AND SAMPLE CAMPSITES IN WAPITI CAMPGROUND

In many of the plots Kinnikinnick was the dominant plant species and provided essentially all the ground cover. It has a spreading root system which makes counting the number of Kinnikinnick plants virtually impossible. For this reason counting and recording the number of plants in each plot was discontinued.

The pantallometer used for the determination of screening was not fully satisfactory. Rather than holding the pantallometer at eye level as illustrated by Nord and Magill[2], the apparatus was supported on the end of a staff at eye level. Although this minor modification improved the reliability of the readings, it was not possible to rotate the apparatus accurately through 360 degrees in twelve segments. Sloping trees, partially downed trees and the branches and leaves of trees all present problems in determining their contribution to campsite screening.

Difficulties were encountered in observing license numbers and place of origin of the moving vehicles. Observation of the number of occupants was only partially successful. Often an approximation was recorded, especially when six to eight passengers were involved.

Other traffic observation problems were related to vehicular entry and exit in the wrong direction and to vehicles

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[2]E.C. Nord and A.W. Magill. 1963. A Device for Gaging Campground Screening Cover (Journal of Forestry Volume 61) pages 450-451.

simultaneously entering or leaving the study area. These situations sometimes prevented adequate observation of individual vehicles.*

Modifications to the original concept of the project provided the opportunity to intensify the study on a limited area. The basic techniques and equipment employed proved to be adequate for determining vegetation cover, campground screening, traffic movements and campground occupancy. Visual observations contributed to data that otherwise would have been unattainable.

* A case was recorded where four vehicles entered, two exited - one in the wrong direction - simultaneously, making identification of individual vehicles impossible.

CHAPTER IV

DATA ANALYSIS

Screening

The sample campsites were located in an immature stand of lodgepole pine (Figures 5 and 6). The stems of the trees, which ranged up to a height of 60 feet, provided screening cover ranging from 25 to 49 percent (Table I, page 35). Litter on the ground surface was predominantly pine needles.

Sample campsite FF-18 supported the most dense growth of lodgepole pine of any of the sample sites (Figure 7, page 36). The average screening was approximately 49 percent. The screening of campsite FF-41 was approximately 25 percent, the most sparse screening of the sample campsites. However, nine seedlings were established which did not contribute significantly to the screening (Figure 8, page 37). Provided these young trees survive, screening effectiveness can be expected to improve in the future.

Vegetation Cover

Total vegetation cover for all experimental plots was reduced from a mean of 37 percent to 16 percent during the study period (Table II, page 38). Total vegetation cover for all control plots was reduced from a mean of 47 percent to 35 percent (Table III, page 39). Vegetation cover reduction as a percent of the vegetation cover at the beginning of the study period ranged from 40 to 68 percent on the experimental plots and 13 to 48 percent

FIGURE 5

ENTRANCE TO STUDY AREA

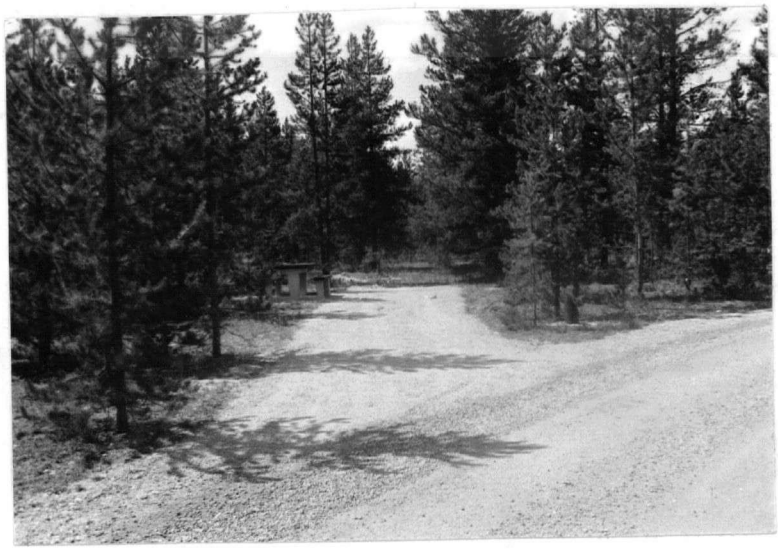


FIGURE 6

TYPICAL CAMPSITE IN STUDY AREA

TABLE I

SCREENING OBSERVATIONS AND SCREENING EFFECTIVENESS IN PERCENT

	FF-03		FF-11		FF-18		FF-22		FF-41	
Number	1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1	21	23	0	0	0	3	18	23	0	0
2	12	19	20	18	71	65	58	69	45	52
3	33	17	17	23	67	57	60	62	42	14
4	13	19	95	45	78	80	69	51	9	18
5	5	6	43	18	55	53	34	23	17	33
6	42	31	55	37	57	49	40	34	20	38
7	60	70	46	33	71	43	48	49	29	21
8	67	54	30	47	19	80	62	49	31	26
9	55	59	18	43	67	53	59	53	46	47
10	59	69	32	44	43	36	42	49	10	5
11	36	35	8	22	36	22	26	36	27	31
12	42	33	15	8	42	25	32	28	52	16
13	6	13	-	13	-	-	-	26	13	14
Total	899		750		1172		1099		656	
Percent Screening	35		30		49		44		25	

FIGURE 7

SAMPLE CAMPSITE FF-18 WITH CAMPSITE

FF-20 IN BACKGROUND PROVIDING

49 PERCENT SCREENING

FIGURE 8

SAMPLE CAMPSITE FF-41 LODGEPOLE

PINE SEEDLINGS

TABLE II

EXPERIMENTAL PLOT VEGETATION OBSERVATIONS

		Cover Readings							
		Total Vegetation		Graminoid Cover		Forbs Cover		Lichens & Mosses	
		July 1	Sept. 1	July 1	Sept. 1	July 1	Sept. 1	July 1	Sept. 1
FF-03	E-1	105	57	68	43	15	14	22	0
	E-2	77	6	40	6	2	0	35	0
	E-3	194	77	81	38	37	15	76	24
	E-4	157	81	48	48	33	21	76	12
FF-11	E-1	305	87	40	19	60	44	205	24
	E-2	203	11	84	9	10	0	109	2
	E-3	335	86	19	9	125	56	191	21
	E-4	354	255	1	0	104	103	249	152
FF-18	E-1	150	51	39	18	109	31	2	2
	E-2	309	221	36	19	224	181	49	21
	E-3	188	112	48	19	70	65	70	28
	E-4	226	141	58	34	102	84	66	23
FF-22	E-1	182	43	14	3	97	30	71	10
	E-2	234	164	32	28	200	136	2	0
	E-3	237	51	23	4	180	46	34	1
	E-4	313	139	30	8	86	41	197	90
FF-41	E-1	228	72	78	27	7	0	143	45
	E-2	-	-	-	-	-	-	-	-
	E-3	218	71	7	4	26	12	185	55
	E-4	397	128	48	18	49	27	300	83
Sum		4412	1853	794	354	1536	906	2082	593
Mean Percent Cover		37	16	7	3	13	8	18	5

TABLE III

CONTROL PLOT VEGETATION OBSERVATIONS

	Total Vegetation		Graminoid Cover		Forbs Cover		Lichens & Mosses	
	July 1	Aug. 31	July 1	Aug. 31	July 1	Aug. 31	July 1	Aug. 31
FF-03 C-1	228	117	106	49	63	36	59	32
FF-11 C-1	319	250	77	84	55	44	187	122
FF-18 C-1	316	274	29	17	258	232	29	25
FF-22 C-1	303	235	18	24	242	193	43	18
FF-41 C-1	286	209	38	34	93	90	155	85
Sum	1452	1085	268	208	711	595	473	282
Mean Percent Cover	47	35	9	7	23	19	15	9

on the control plots (Table IV, page 41).

A paired t-test at a confidence level of 90 percent was employed in the analysis of data tabulated in Tables II and III for each sample campsite. The significance of the changes in vegetation cover are shown in Table V, page 42. In all sample campsites there was a significant reduction in the total vegetation cover. There was also a significant reduction in the total vegetation cover of the control plots due to the difficulties encountered in locating small protected areas within the sample campsites.

Sample campsite FF-03 was located adjacent to the service roadway (Figure 9, page 43). The photograph was taken from the table at the approximate centre of the campsite looking towards the service road. This campsite had the least abundant initial and final vegetation cover of the sample sites studied (Table IV, page 41). The loss of vegetation cover is illustrated by Figures 10 to 14, pages 44 to 48. The reduction is most evident in Figure 11.

It was observed that the location of the campsite encouraged trespass by other campers from other sites on their way to and from the central service area. The impact on the vegetation cover in sample site FF-03 was due not only to the use of the campsite by the occupying parties but to the effects of other trampling as well.

Sample campsite FF-11 was more open than FF-03 and supported fewer but larger trees (Figure 15, page 49). This campsite had

TABLE IV

TOTAL VEGETATION COVER IN PERCENT

Site	Pct. Cover July 1	Pct. Cover Sept.1	Change in Pct. Cover	Change as Pct. of July 1 Value
Experimental Plots				
FF-03	21	9	-12	-59
FF-11	48	18	-30	-63
FF-18	35	21	-14	-40
FF-22	39	17	-22	-54
FF-41	45	14	-31	-68
Mean	37	16	-21	-58
Control Plots				
FF-03	37	19	-18	-49
FF-11	51	40	-11	-22
FF-18	51	44	- 7	-13
FF-22	49	38	-11	-22
FF-41	46	33	-13	-27
Mean	47	35	-12	-25

TABLE V

SUMMARY OF TEST OF SIGNIFICANCE OF CHANGES IN VEGETATION COVER EMPLOYING PAIRED T-TESTS AT NINETY PERCENT CONFIDENCE LEVEL

Experimental Plots

	Total Vegetation	Graminoids	Forbs	Lichens and Moss
FF-03	Yes	Yes	No	Yes
FF-11	Yes	No	No	Yes
FF-18	Yes	Yes	No	Yes
FF-22	Yes	Yes	Yes	Yes
FF-41	Yes	No	Yes	Yes

Control Plots

	Total Vegetation	Graminoids	Forbs	Lichens and Moss
FF-03	Yes	No	Yes	Yes
FF-11				
FF-18				
FF-22				
FF-41				

FIGURE 9

SAMPLE CAMPSITE FF-03 SHOWING SERVICE

ROAD WITH CAMPSITE FF-02

AND FF-01 IN BACKGROUND

JUNE 25, 1970

AUGUST 24, 1970

FIGURE 10

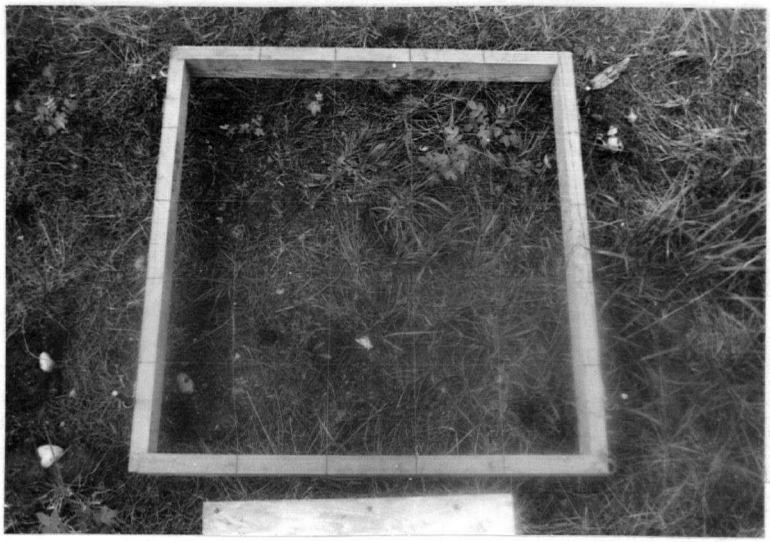
SAMPLE CAMPSITE FF-03, EXPERIMENTAL
PLOT E-1

JUNE 26, 1970

AUGUST 24, 1970

FIGURE 11

SAMPLE CAMPSITE FF-03, EXPERIMENTAL PLOT E-2



JUNE 27, 1970

AUGUST 24, 1970

FIGURE 12

SAMPLE CAMPSITE FF-03, EXPERIMENTAL PLOT E-3

JUNE 27, 1970

AUGUST 24, 1970

FIGURE 13

SAMPLE CAMPSITE FF-03, EXPERIMENTAL PLOT E-4

JUNE 27, 1970

AUGUST 24, 1970

FIGURE 14

SAMPLE CAMPSITE FF-03, CONTROL PLOT C-1

FIGURE 15

SAMPLE CAMPSITE FF-11 WITH CAMPSITES
FF-12 and FF-13 IN
BACKGROUND

been abused sometime during the study period. The steel plot markers were removed by excavating the soil and rock around them (Figure 16, page 51). The site showed evidence of damage to the lichens and moss ground cover, part of which is shown in the photograph of experimental plot E-3, Figure 17, page 52. This damage evidently was the result of children's play with toy vehicles and shows how severely an area can be damaged by innocent activity.

Difficulty was encountered in locating the control plot within campsite FF-11 due to the freedom of human movement. It was observed that the location of the campsite encouraged trespass by other campers on their way to and from activities in other areas of the campground; for example, attending the evening nature program. The impact from trampling by other than the occupying parties was not as severe as that on sample campsite FF-03.

The vegetation cover of the control plot at sample campsite FF-18 was the least affected of all control plots studied. The reduction represented only 13 percent of the initial total vegetation. Figure 18, page 53, shows little damage to the vegetation cover. The control plot is an excellent example of a Kinnikinnick association forming the vegetation ground cover.

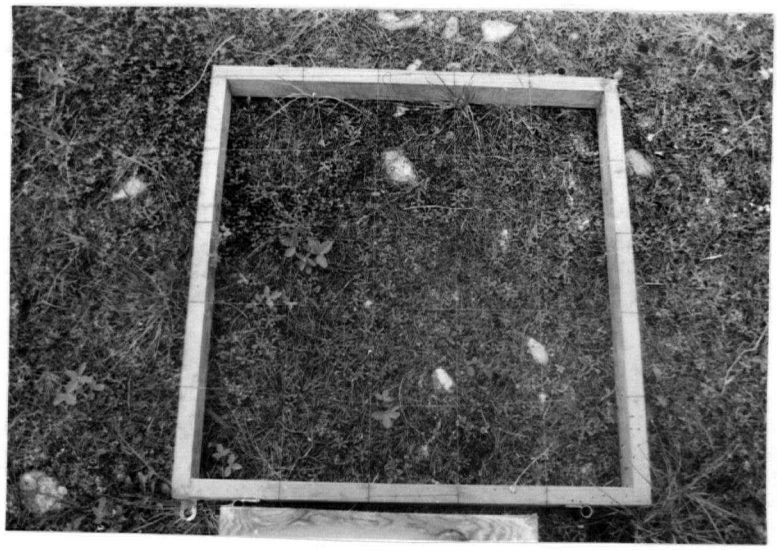
Sample campsite FF-22 underwent significant changes in all components of the ground cover vegetation. The changes are illustrated by Figure 19, page 54.

JUNE 27, 1970

AUGUST 24, 1970

FIGURE 16

SAMPLE CAMPSITE FF-11, EXPERIMENTAL PLOT E-2,
REMOVAL OF STEEL PLOT MARKERS



JUNE 27, 1970

AUGUST 24, 1970

FIGURE 17

SAMPLE CAMPSITE FF-11, EXPERIMENTAL PLOT E-3,
DAMAGED GROUND COVER VEGETATION

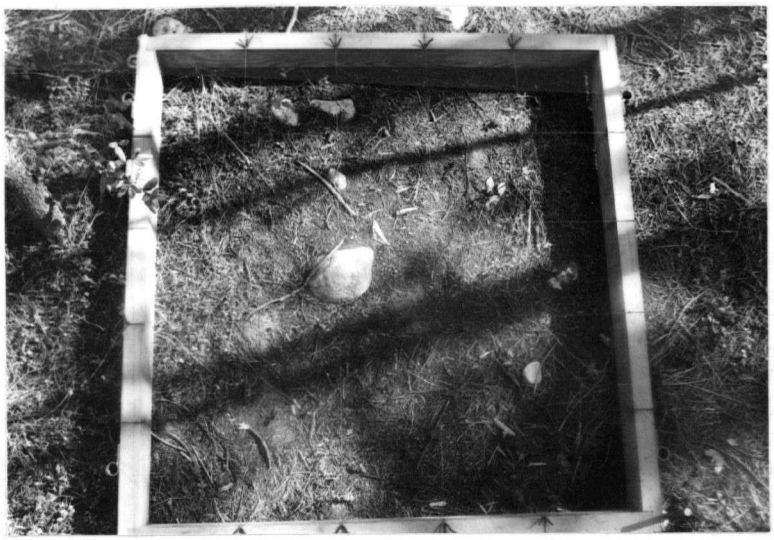
JUNE 28, 1970

AUGUST 25, 1970

FIGURE 18

SAMPLE CAMPSITE FF-18, CONTROL PLOT C-1

JUNE 29, 1970



AUGUST 25, 1970

FIGURE 19

SAMPLE CAMPSITE FF-22, EXPERIMENTAL PLOT E-1

Lichens and moss showed a significant reduction in the vegetation cover within all the experimental plots. There was also a significant reduction of this vegetation component within the control plots. This suggests that lichens and moss may be more sensitive to trampling than graminoids and forbs.

Photographs in Appendix C, Figures 20 to 34 provide additional examples of damage to vegetation cover.

Traffic Counter Calibration

The ratio of vehicles entering the campground to campground permit sales indicates that each vehicle enters the campground approximately twice daily as summarized in Table VI.

TABLE VI

CAMPGROUND TRAFFIC AND PERMIT SALES

Period	TC-5	Permit Sales	Ratio TC-5/permit sales
July	19685	9297	2.12:1.0
August	16760	7544	2.22:1.0
TOTAL	36445	16841	2.16:1.0

The ratio of the number of campsites in the study area to the number of campsites in Wapiti Campground was 0.14:1.0 (Table VII). The ratio of the number of vehicles entering the study area (TC-3) to the number of vehicles entering Wapiti campground (TC-5) for the month of August was 0.14:1.0. The close correlation reflects the full utilization of the campground throughout most of the month. During periods when large numbers of campsites throughout the campground are not occupied, the correlation provides a method of checking the allocation of sites by the campground attendants. The ratio for the month of July is greater than 0.14:1.0 indicating greater allocation of visitor parties to the study area than to other areas of the campground.

TABLE VII

STUDY AREA AND CAMPGROUND TRAFFIC

Period	Study Area TC-3	Campground TC-5	Ratio TC-3/TC-5
July	3349	19685	0.17:1.0
August	2311	16760	0.14:1.0
TOTAL	5660	36445	0.155:1.0
Campsites	46	325	0.14:1.0

Table VIII, page 58, shows that 573 vehicles entered the study area during the observation sample periods as recorded on traffic counter TC-3. At the checkpoint during the same periods 555 vehicles were observed to enter the study area. The difference between the two methods of counting vehicles was insignificant at the 95 percent confidence level employing a paired t-test. Traffic counter recordings were therefore accepted as a suitable method of determining the number of vehicles entering the study area.

Seven hundred fifty vehicles entered the study area during the observation sample periods (Appendix D, Table XII). Of these, four proceeded to sample campsite FF-03, five to FF-11, nineteen to FF-18, ten to FF-22 and nine to FF-41.

The traffic count use measurement technique would be improved by locating traffic counters across both lanes of traffic (entering and departing) and averaging the two traffic counts. This would account for traffic movements such as vehicles entering and leaving the study area in the wrong direction.

Occupancy Analysis

Appendix E, Table XIII and Table XIV show the number of hours during the sample weekdays and sample weekends each sample campsite was occupied and used and the total party hours of occupancy and use. Absence, the difference between occupancy and use, is shown in Table IX, page 59.

TABLE VIII

STUDY AREA TRAFFIC DURING

OBSERVATION PERIODS

Date	Time 8:00 a.m.	8:00 p.m.	Number of Vehicles Automatically Counted	Number of Vehicles Observed
July 4	451	546	95*	...[1]
July 5	575	657	82*	...
July 29	3331	3383	52	58
July 30	3399	3459	60	66
August 12	4900	4970	70	60
August 13	5001	5057	56	63
August 15	5174	5283	109	106
August 16	5305	5393	88	74
August 19	5557	5597	40	39
August 20	5610	5640	30	27
August 22	5699	5742	43	38
August 23	5762	5787	25	24
TOTAL VEHICLES			573	555

*Deleted from total.

[1]Observations on July 4 and July 5 were incomplete and have been deleted.

TABLE IX

ABSENCE AS PERCENT OF OCCUPANCY

	Occupancy	Use	Absence	
Sample Sites	Party Hours	Party Hours	Party Hours	Percent of Occupancy
FF-03	111.4	100.9	10.5	9.4
FF-11	105.1	90.4	14.7	14.0
FF-18	221.7	165.0	56.7	25.6
FF-22	219.2	180.6	38.6	17.6
FF-41	111.6	84.5	27.1	24.3
TOTAL	769.0	621.4	147.6	19.2

The occupancy level of sample sites FF-18 and FF-22 was considerably higher than that for the other three sample sites. Sample sites FF-18 and FF-22 were located nearest to the river, were more ideally located from the service areas, and were located in more dense young lodgepole pine and therefore were better screened from adjacent campsites. The assignment of campsites to campground visitors is arbitrarily carried out by the kiosk attendants. The attendants generally assigned the more attractive sites first. This also is the probable reason why the sample sites were occupied only 62 percent of the nights available compared to the campground occupancy rate of 82 percent during the study period (Appendix E, Table XV). Occupants of the sample campsites spent approximately a fifth of their stay off the campsite (Table X). Except for inactive types of recreation such as resting or reading, the periods of absence represents most of the active participation in recreation excluding the camping activity itself. The sample sites in general were occupied more during weekends than during weekdays. The sample campsites were subjected to recreational impact only 43.2 percent of the potential time or 10.4 hours out of each 24.0 hours. This includes the time that parties were asleep. The net daily impact time would appear to average about three hours per day for each campsite.

Recreation Impact

Examination of the sample campsite data in Table IV, page 41, and Table IX, page 59, failed to reveal the expected

TABLE X

SAMPLE PERIOD OCCUPANCY, USE AND ABSENCE AS PERCENT OF AVAILABLE HOURS

Sample Period	Occupancy Party Hours	Use Party Hours	Absence Party Hours	Available Campsite Hours	Percent of Available Campsite Hours		
					Occupancy	Use	Absence
Weekdays	277.7	222.2	55.5	720	38.6	30.9	7.7
Weekends	491.3	399.2	92.1	720	62.2	55.4	12.8
TOTAL	769.0	621.4	147.6	1440	53.4	43.2	10.2

relationship of reduced vegetation cover with increased levels of occupancy or between reduction in vegetation cover and level of use. The two most heavily used sample campsites FF-18 and FF-22 suffered the least reduction in vegetation cover.

More than half the visiting parties accommodated in the study area used vehicles registered in Alberta. (Appendix F, Table XVI). A quarter of the visitors came from the United States. Less than twenty-one percent came from the rest of Canada. The mean size of the parties occupying the sample sites during the sample periods was 3.3 persons (Appendix F, Table XVII).

Trailers were the most popular type of camping equipment and represented 43.7 percent of the units observed (Appendix F, Table XVIII). The next largest group, most of whom it can be assumed used tents for sleeping accommodation, represented 36.2 percent. Self contained units provided transportation and accommodation to 20 percent of the parties occupying the study area.

Eighty-seven and onehalf percent of the vehicles which entered the study area during the observation periods were recreation vehicles (Table XI). The non-recreation vehicles were used by park personnel to provide services to the campground occupants including campground supervision, washroom cleaning, service area clean-up, cartage of firewood and garbage collection.

TABLE XI

RECREATION AND NON-RECREATION VEHICLES

ENTERING THE STUDY AREA

	Weekdays	Weekends	Total	Percent
Recreation Vehicles	271	216	487	87.7
Non-Recreation Vehicles	44	24	68	12.3
TOTAL	315	240	555	100.0

Twenty-eight percent of the recreation vehicles which entered the study area did so prior to 2:00 p.m. Seventy-two percent entered after 2:00 p.m. (Appendix F, Table XIX).

The analysis revealed that at ninety percent confidence level there was a significant reduction of total vegetation ground cover on both the experimental plots and the control plots during the study period. These changes were clearly evident in the photographs. No correlation was found between reductions in vegetation cover and levels of use of the sample campsites; expected relationships appear to be masked in this study due to uncontrolled variable effects and measurement problems.

CHAPTER V

SUMMARY AND CONCLUSIONS

The analysis of vegetation cover proved conclusively that the ground cover adjacent to the prepared surface of the sample campsites deteriorated during the second season of occupancy. In at least two of the sample campsites a portion of the trampling was unrelated to occupancy. Sample sites FF-03 and FF-11 were observed to receive trampling by trespassers due to their location in the study area. The effects of this trampling in excess of that due to occupancy offers support to the concept that arbitrary selection of sample campsites based on prior knowledge of visitor movements would provide a superior method of sample selection to that of random selection employed in this study. Arbitrary selection would have the advantage of eliminating those sites subjected to obvious transient trampling. It would also have the advantage of providing a more equitable distribution of sample sites throughout the study area.

The control plots underwent a significant change in vegetation cover during the study period. Problems of locating and protecting the control plots prevented the removal of human use impacts from other more natural causes of vegetation change. As it was not possible to consider relationships of user impact alone on changes of vegetation cover, the first objective of developing use-intensity relationships to changes

in vegetation cover was unattainable. No significant relationship between total site occupancy and changes in vegetation ground cover was found.

The vegetation analysis of the plots indicated that lichens and moss may be the least tolerant of the three plant components studied. Vegetation analysis of the control plots indicated that the graminoid component may be the most tolerant.

The pantallometer used for the determination of screening as illustrated by Nord and Magill[1] was considered suitable for qualitative comparisons between campsites. It is best suited to areas where tree boles provide most of the vegetative screening.

One of the objectives of the project was to assess the reliability of battery operated electromagnetic digital traffic counters. These traffic counters offered the advantage of a buried wire sensing grid much less subject to vandalism than pneumatic type counters. There was no significant difference in the number of vehicles which entered the study area as recorded by the traffic counter or visually observed. Although the installation was more involved than the installation of pneumatic counters, they proved to be completely free of maintenance during the study period. Based on experience, it is concluded that electromagnetic digital traffic counters are capable of providing satisfactory vehicle sensing over a

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[1] E.C. Nord and A.W. Magill. 1963. A Device for Gaging Campground Screening Cover (Journal of Forestry Volume 61) page 450-451.

considerable period of time. The traffic counters employed in the project offered the advantage of counting vehicle units rather than axles, thereby recording a vehicle plus trailer as one unit. The traffic counters were sufficiently sensitive to record a metallic mass as small as that of a bicycle. If a fault was to be found with the traffic counters, it was the inherent oversensitivity of the equipment. It was necessary to open the hinged lid of the metal container in order to observe the count. Occasionally this disturbance caused the digital counter to function as though a vehicle had traversed the grid.

Occupancy of Wapiti Campground based on the sale of campsite permits was 82.0 percent. Occupancy of the sample sites was only 62 percent during the sample periods. It can be concluded that a disproportionate number of parties were assigned to the campsites outside the study area during the study period. Demand for campsites at Wapiti Campground often exceeded supply. One hundred percent occupancy was a recurring phenomenom. Average party size was found to be 3.3 persons. More than a third of the parties occupying campsites used tents or less sophisticated equipment.

A large percentage of visitors to the study area came from the Province of Alberta and from the United States. It appears that the study area caters to the recreational needs primarily of one province and to the citizens of the United States more than to the rest of the Canadian population.

The methodology employed in the research project must be improved to separate the effects of non controllable variables on vegetation cover from the effects attributable to occupancy of the sample campsites. In particular, sample sites must be selected to minimize trespass and protection of control plots from trampling must be considered.

Future Research

Another study of the sample sites is required to determine the change in vegetation cover during another camping season and during the period since the original study in 1970. A comparative assessment would indicate the rate of change of vegetation cover. Based on the premise that degradation of vegetation cover leads to a reduction in the aesthetic attraction of the site, the study would provide the data required to estimate the probable useful life of the campground before the cessation of plant propagation. This information would be useful to determine the desirability of resting groups of campsites within the campground or periodic closure of the campground.

The popularity of the types of mobile accommodation appears to be changing from the less sophisticated equipment to elaborate, self-contained units. Each type of accommodation imposes its own level of space and service requirements on a campground. The rates of change in popularity of the various types of accommodation should be investigated so that design requirements and provision of services can be incorporated in

the planning processes to meet future expected types of use.

Periodic overcrowding of Wapiti Campground in excess of rated capacity, and the establishment of improperly serviced overflow areas nearby to accommodate excess visitation requires that methods of controlling the numbers and concentrations of visitors should be investigated.

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BIBLIOGRAPHY

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Sample sites were located in England. Trampling by itself had little influence on vegetation change but when combined with high moisture conditions to develop puddling the changes to the vegetation were severe with almost complete species replacement on pathways. Grasses and woody vines were more resistant to trampling than broad-leaved herbs.

Bailey, Reed W. 1962. Recreation: Opportunities and Problems in the National Forests of the Northern and Intermountain Regions. (U.S. Dept. Agr. Intermountain Forest and Range Experiment Station. Forest Research Paper 66) 33 pp.

The report demonstrates the management problems arising from increased use of the National Forests for outdoor recreation and recognizes unintentional site deterioration resulting from excessive concentrations of people as the major management problem.

Brockman, C. Frank. 1959. Recreational Use of Wildlands (McGraw-Hill Book Company Incorporated. New York) 346 pp.

This is a broad basic outline of the background, important values and fundamental requirements of recreation management. The reader is provided with a perspective for the preservation, management and recreational use of wildlands, along with a history of outdoor recreation development.

Bury, R., and R. Margolies. 1964. A Method of Estimating Current Attendance on Sets of Campgrounds... a Pilot Study (U.S. Forest Service Res. Note PSW-42) 6 pp.

Statistical models were devised for estimating attendance at campgrounds through correlation regression and ratio analysis. Equations were developed to estimate total daily attendance at 23 campgrounds by measuring attendance at one of them.

Dana, S.T. 1957. Problem Analysis: Research in Forest Recreation (U.S. Forest Service, U.S. Dept. Agr. Washington) pages 22-23.

The determination of the carrying capacity of different sites for different recreation uses is recognized as a basic problem in recreation management. The definition of carrying capacity is implied in the posing of the questions, "How much use can a given area stand without physical deterioration of the site and without impairment of aesthetic and spiritual values?" and "How heavily can a campground ... be used without destroying the very values which the recreationist seeks?"

de Vos, A., and R.H. Bailey. 1970. The Effect of Logging and Intensive Camping on Vegetation in Riding Mountain National Park (Forestry Chronicle 46(1)) pages 49-55.

Heavy recreational use in two campground areas of Riding Mountain National Park in Northern Canada encouraged invasion by exotic plant species in intensively used areas. Shrubby species were displaced with grass-forb associations. Softwoods were able to withstand more mutilation than hardwoods.

Dooling, P.J. 1973. Predicting Use of Recreational Sites: Model and User Analysis (Ph.D. Colorado State University, Fort Collins, Colorado) 262 pp.

Dotzenko, A.D., Popamichos, N.T., Romine, D.S. 1967. Effect of Recreational Use on Soil and Moisture Conditions in Rocky Mountain National Parks (Journal of Soil and Water Conservation. Sept. - Oct.) pages 196-197.

Recreational use of three long-established campgrounds in Colorado increased soil density and decreased organic matter and moisture content of the soil surfaces.

Douglass, Robert W. 1969. Forest Recreation (Pergamon Press, Toronto) 336 pp.

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Ehrenreich, J.H. 1959. Releasing Understory Pine Increased Herbage Production (U.S. Forest Service Central States Experimental Station Note 139) 2 pp.

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Frissell, Sidney S. Jr. and D.P. Duncan. 1965. Campsite Preference and Deterioration in the Quetico-Superior Canoe Country (Journal of Forestry 63(4)) pages 256-260.

Vegetation understory on the canoe route campsites has undergone major changes with recreational use. Over 80 percent in ground cover loss was incurred with light use. Average loss was 85 percent. Litter and humus was reduced by 65 percent. Reduced infiltration rates, exposed tree roots, loss of sapplings and absence of tree generation all decreased the attractiveness of the campsites.

Hills, G.A. 1961. Ecological Basis for Land-Use Planning (Ontario Department of Lands and Forests. Research Report No. 46) 204 pp.

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James, G.A., and T.H. Ripley. 1963. Instructions for Using Traffic Counters to Estimate Recreation Visits and Use (U.S. Forest Service Research Paper SE-3) 12 pp.

Double sampling and analytical procedures for estimating recreation visits and use are described. The recommended sampling intensity of ten days per site was expected to yield a sampling error of ±25 percent at 67 percent level of probability. Computations can be used to estimate future recreation visits and use only during the same season as that of the calibration.

James, G.A., and J.L. Rich. 1966. Estimating Recreation Use on a Complex of Developed Sites (U.S. Forest Service Res. Note SE-64) 8 pp.

Traffic count records from the "indicator" locations were employed to generate estimates of visitations to several sites in a recreation area.

LaPage, Wilbur F. 1962. Recreation and the Forest Site (Journal of Forestry, 60) pages 319-321.

Data was collected at three long established New Hampshire State Parks. Soil density was increased in the top six inches of soil due to recreational use.

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Plant density and species composition were studied in a Pennsylvania campground before and after a camping season. A marked reduction in vegetation cover and number of plant species occurred. An increase in use from one to two camper days produced an increase in loss of vegetation cover from 10 percent to 60 percent.

_____. 1967. Some Observations on Campground Trampling and Ground Cover Response (U.S. Forest Service Research Paper NE-68) 11 pp.

The findings of the first three years of a continuing study of new campsites located in the Allegheny National Forest of Pennsylvania indicated that total plant species and average number of species declined due to the trampling effects of recreational use. During the same period barren ground became revegetated with more resistant cover.

Lutz, H.J. 1945. Soil Conditions on Picnic Grounds in Public Forest Parks (Journal of Forestry, 43) pages 121-127.

Soil conditions were investigated in the picnic sites of two Connecticut State Parks. Trampling resulted in significant changes in soil properties, particularly in the upper 10 cm. layer. Density increased, pore volume and air capacity and rate of infiltration decreased. Field capacity in fine textured sandy loams increased.

Magill, Arthur W. 1963. Evaluating Ecological Trends on Campgrounds (U.S. Dept. Agr. U.S. Forest Service Research Note PSW-N 16) 3 pp.

Heavily used and unused sites on three campgrounds in California National Forests were investigated. Preliminary data indicated recreational use restricts the growth of young trees, reduces the number of trees and foliage screening and the number of shrubs.

Magill, Arthur W and Nord, Eamor C. 1963. An Evaluation of Campground Conditions and Needs for Research (U.S. Forest Service Research Note PSW-4) 8 pp.

Heavy recreational use in 137 California National Forest Campgrounds and picnic areas caused site deterioration of vegetation and soil conditions. Reproduction, vigour and numbers of plants were reduced. Screening and litter were reduced and the soil compacted.

Meinecki, E.P. 1929. The Effect of Excessive Tourist Travel on the California Redwood Parks (California Department of Natural Resources, Division of Parks, California State Printing Office, Sacramento, California) 20 pp.

Trampling compacted the soil into an impervious layer that interfered with the normal movement of air and water into the soil. The dying out of plants was due not only to bruising and trampling but packing of the soil.

National Parks Act. 1956. Part 1 Canada Department of Northern Affairs and Natural Resources. Ottawa. Consolidated for office purposes. 8 pp.

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Odum, Eugene P. 1959. Fundamentals of Ecology (W.B. Saunders Company) 546 pp.

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Ripley, Thomas H. 1962. Recreation Impact on Southern Appalachian Campgrounds and Picnic Sites. (Southeastern Forest Experimental Station, Ashville, North Carolina: Station Paper 153) 20 pp.

Forty-two recreation sites over ten years old located in three National Forests were analysed by multiple regression statistical techniques on 18 independent and eight dependent variables. It was found that breaks in high canopy benefitted ground cover. The ratio of conifers to hardwoods increased with increased ground cover damage and root exposure. Shrub barrier decreased tree injury but increased ground cover damage.

Ripley, Thomas H. 1962. Tree and Shrub Response to Recreation Use (Southeastern Forest Experimental Station, Ashville, North Carolina: Research Note No. 171) 2 pp.

A convenient ranking of species of hardwoods and conifers in order of decreasing recreation impact tolerance is tabulated. Hardwoods generally withstood disease infection and insect infection better than conifers. The author observed that the dense shade produced by conifers apparently induced greater site degradation from recreation use.

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A report of a comparative study which showed that compacted soils held lower spring moisture and dried out faster. Water and air permeability decreased significantly with grazing.

Wagar, J. Alan. 1964. The Carrying Capacity of Wild Lands for Recreation (Forest Science Monograph 7. Published by the Society of American Foresters) 24 pp.

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Coleman, John R.B. 1967. The Visitor Impact on the National Parks in Canada (International Union for Conservation of Nature and Natural Resources. Publ. No. 7, Part 1) pages 112 - 115.

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Czarnowski, K.J. 1967. An Analysis of the Recreation Land Use Problems of the Mount Lemmon Area. Coronada National Forest (Masters Thesis. Michigan State University) 91 pp.

The study analysed recreation land use problems and identified causes by examining past and present policy decisions of the United States Forest Service.

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A consideration of the effects of human activities on natural vegetation and the dynamic powers of plant communities to reconstitute themselves in response to human impact.

Gregarson, Hans M. 1965. Campurbia (American Forests 71 (7)) pages 18-20.

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James, G.A. and R.K. Henley. 1968. Sampling Procedures for Estimating Mass and Dispersed Types of Recreation Use on Large Areas (U.S. Dept. Agr. Forest Service Research Paper SE-31) 15 pp.

The Research Paper details a stratified random sampling technique for calibrating traffic data obtained with mechanical counters and activity data obtained by check-point interviews. The method is useful for estimating future total visits to and use of dispersed recreation areas based on traffic counts recorded at the same locations as that of the calibration and during the same season.

Jemison, George M. 1967. Impacts of Recreation on the Ecology of Temperate North American Forests (International Union for Conservation of Nature and Natural Resources. Publ. No. 7. Part 1) pages 173-185.

A general discussion of the amenity values of the forest environment as resources of inspiration and enjoyment to man down through history. Due to ever-increasing visitor density inconsequential problems of site damage have become major problems.

King, David A. 1966. Activity Patterns of Campers (U.S. Dept. Agr. Forest Service Research Note, NC-18) 3 pp.

Families camping in auto campgrounds on Huron-Manishee National Forest spend most of their time in and around their campsite. Diversity of interests and preferences should be considered in the provision of campground facilities.

Leopold, Aldo. 1970. A Sand County Almanac with Essays on Conservation from Round River (Ballantine Books, Incorporated, New York) 295 pp.

The book is a collection of short articles which describes the seasonal changes in nature. The author supports a plea for the development of a new land ethic of conservation by citing many examples of the destruction of the natural environment.

Marcus, L.F., E.M. Gould, and R.L. Bury. 1961. Measuring the Recreation Use of National Forests (U.S. Forest Service Technical Paper, PSW-59) 26 pp.

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Neff, Paul E. 1965. Applied Silviculture in Managing Outdoor Recreation Sites. (Paper to the National Meeting of the Society of American Foresters at Detroit, Michigan, October 26, 1965.) 2 pp.

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Paine, L.A. 1966. Butt Rot Defect and Potential Hazard in Lodgepole Pine on Selected California Recreation Areas. (U.S. Forest Service Research Note PSW-106) 7 pp.

The research note is based on data obtained from five plots each containing 100 trees over 10 in. dbh. at elevations between 7400 and 9500 feet in California. Old growth lodgepole pine stands with high hazard ratings are extensively used for recreation.

Seffergren, C.D. and D.M. Cole. 1970. Recreation Effects on Soil and Vegetation in the Missouri Ozarks (Journal of Forestry. 68 (4)) pages 231-233.

A study of three campgrounds having similar soil, physiographic and vegetation characteristics to determine the effects of past recreation on forest vegetation and soils. Surface compaction, sheet erosion, surface rock accumulation and soil moisture depletion indicated the level of deterioration of the sites.

Snyder, A.P. 1960. Wilderness Area Management: an Administrative Study of a Portion of the High Sierra Wilderness Area (U.S. Dept. Agr. Forest Service Region 5) 63 pp.

The article discusses the damage to vegetation and the initiation of erosion caused by the impact of the horses used by groups of recreationists.

Stevens, M.E. 1966. Soil Surveys as Applied to Recreation Site Planning (Journal of Forestry, 64 (5)) pages 314-316.

Article demonstrates the application of soil surveys to recreation site location and outlines the aesthetic and economic advantages of site designs which consider soil properties.

Stone, Edward C. 1965. Preserving Vegetation in Parks and Wilderness (Science Vol. 150, No. 3701) pages 1261-1267.

The article outlines the desirability of defining the objectives of management related to vegetation preservation. The objectives of keeping park lands green, preservation of favoured dominant species, preservation of particular successional stages and slowing succession are discussed. Universities with land management courses can best provide training to meet these objectives.

Tocher, S. Ross, Wagar, J. Alan, and Hunt, John D. 1965. Sound Management Prevents Worn Out Recreation Sites. (Parks and Recreation. 48 (3)) pages 151-153.

Article outlines methods by which indiscriminate trampling and damage can be avoided and includes dead and dying vegetation, compacted and eroding soils in a list of indicators of poor management.

Wagar, J. Alan. 1965. Cultural Treatment of Vegetation on Recreation Sites (Paper to National Meeting of Society of American Foresters at Detroit, Michigan. October 26, 1965.) 3 pp.

Recommends use of cultural treatments to reestablish and maintain overstory and vegetative covering. Application of fertilizer and water were very effective.

Wagar, J.V.K. 1946. Services and Facilities for Forest Recreationists. (Journal of Forestry, 44) pages 883-887.

Protection of trees and scenic areas is included in the detailed list of objectives in the provision of facilities.

Westhoff, V. 1967. The Ecological Impact on Pedestrian, Equestrian and Vehicular Traffic on Vegetation (International Union for Conservation of Nature and Natural Resources. Publ. No. 7, Part 1) pages 218-223.

The capacity and vulnerability of ecosystems to recreation impact vary with soil types and soil properties. Flat, stable, compact soils are very resistant to recreation impact. Slopes with loose sandy soils are extremely vulnerable.

APPENDIX A

GLOSSARY OF TERMS

Absence - the period of time in hours that the vehicle of a party is not located at a campsite. It is equal to the difference between occupancy and use.

Available Hours - the period of time in hours a campsite could be occupied.

Campground - a developed area located in a wildland setting for the purpose of camping and related intensive use activities.

Campsite - a single unit within a developed campground.

Forest Recreation - that outdoor form of recreation that is dependent on forest or other wildlands.

Impact - that proportion of the change in vegetation cover attributable to occupancy of a campsite.

Observation Period - a twelve hour interval of time from 8:00 a.m. to 8:00 p.m. during back to back sample days.

Occupancy - the length of stay in a campsite to which a party is entitled by the purchase of a campsite permit.

Party Hours - the measurement unit of length of stay or occupancy.

Party Size - the number of people travelling together who occupy a campsite.

Percent Absence - the ratio of absence to occupancy in party hours multiplied by 100.

Plant Community - a combination of competing plants which is relatively uniform in its structure and floristic composition.

Recreation - refers to creative leisure-time activities based on self choice, initiative and spontaneity.

Recreational Quality - is the degree to which a recreation area normally contributes to the physical and psychic well-being of the user.

Sample Period - the 48 hour time interval of two back to back days from 8:00 a.m. the first day to 8:00 a.m. the third day.

Sample Weekdays - back to back Wednesdays and Thursdays randomly selected from the study period.

Study Period - the interval of time between the initial and final observations (8:00 a.m. July 1 to 8:00 a.m. September 1, 1970).

Study Area - the campsites in Wapiti campground identified as cluster FF.

Total Sample Period - the total of the back to back sample days.

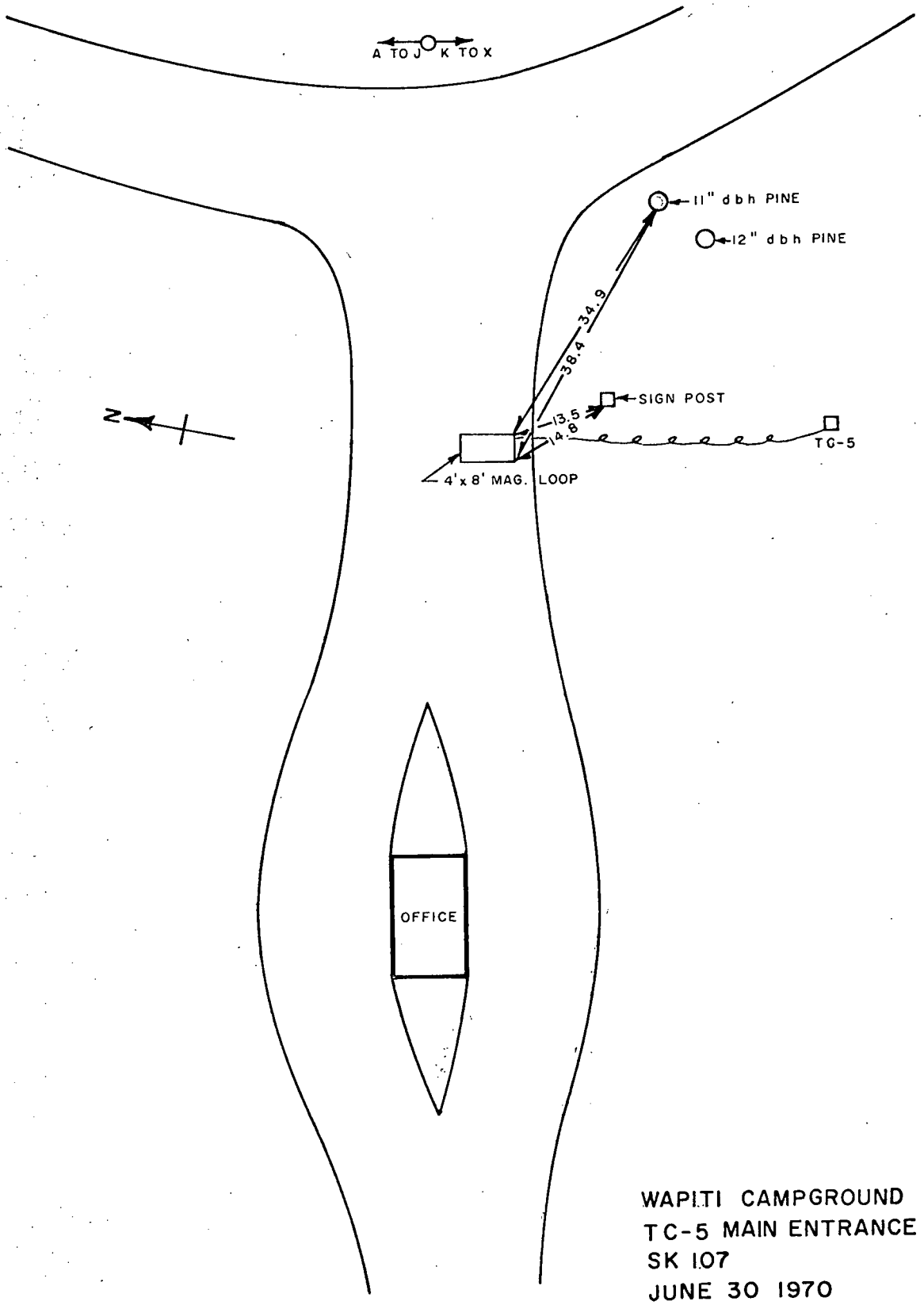
Use - the period of time in hours that the vehicle of a party is located on a campsite.

Vegetation cover - the vertical projection of low growing plant life forms consisting of graminoids, forbs, lichens and mosses.

Vehicle Origin - the political unit issuing a vehicle licence.

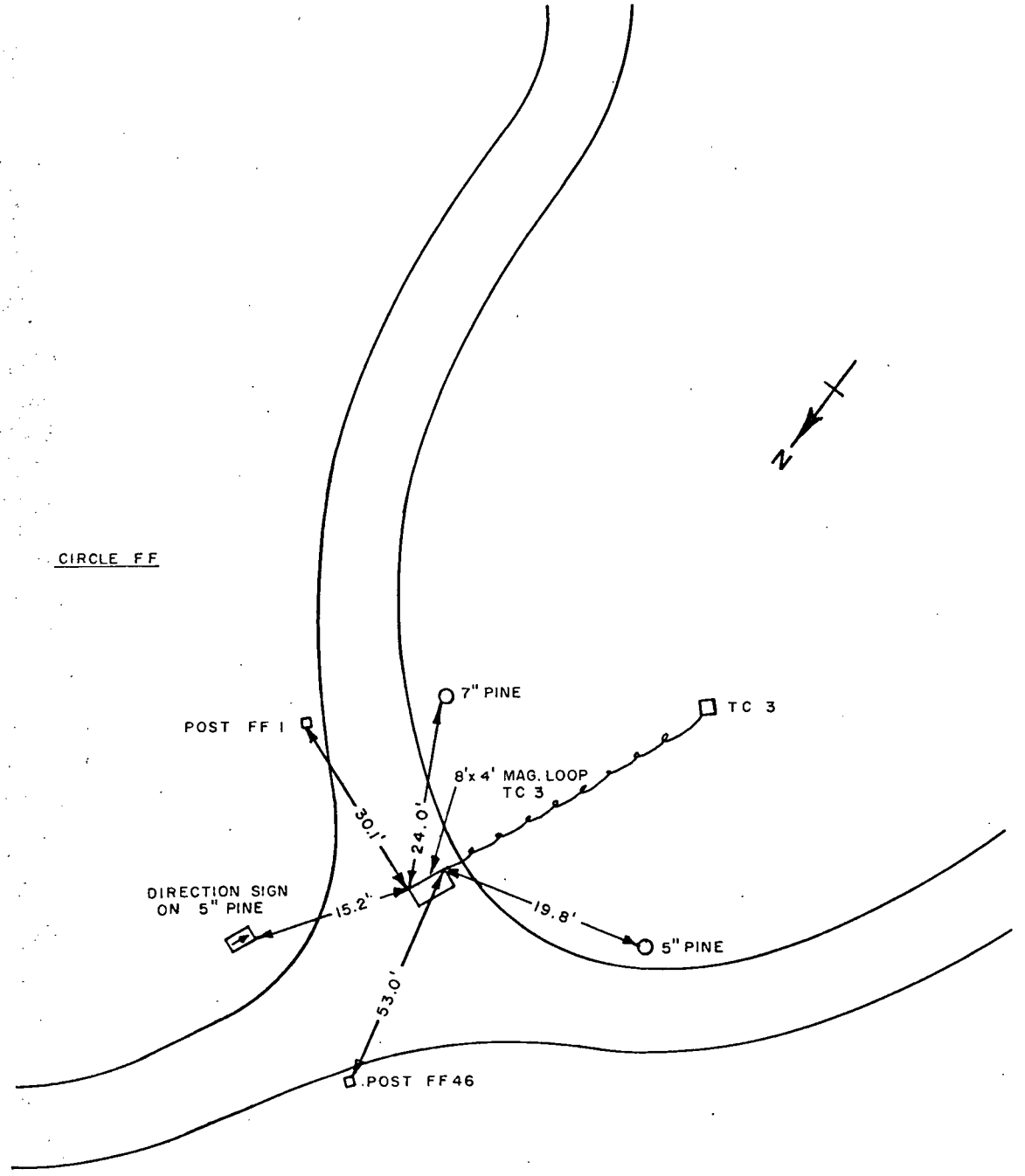
Visitor Hours - party size x occupancy.

APPENDIX B



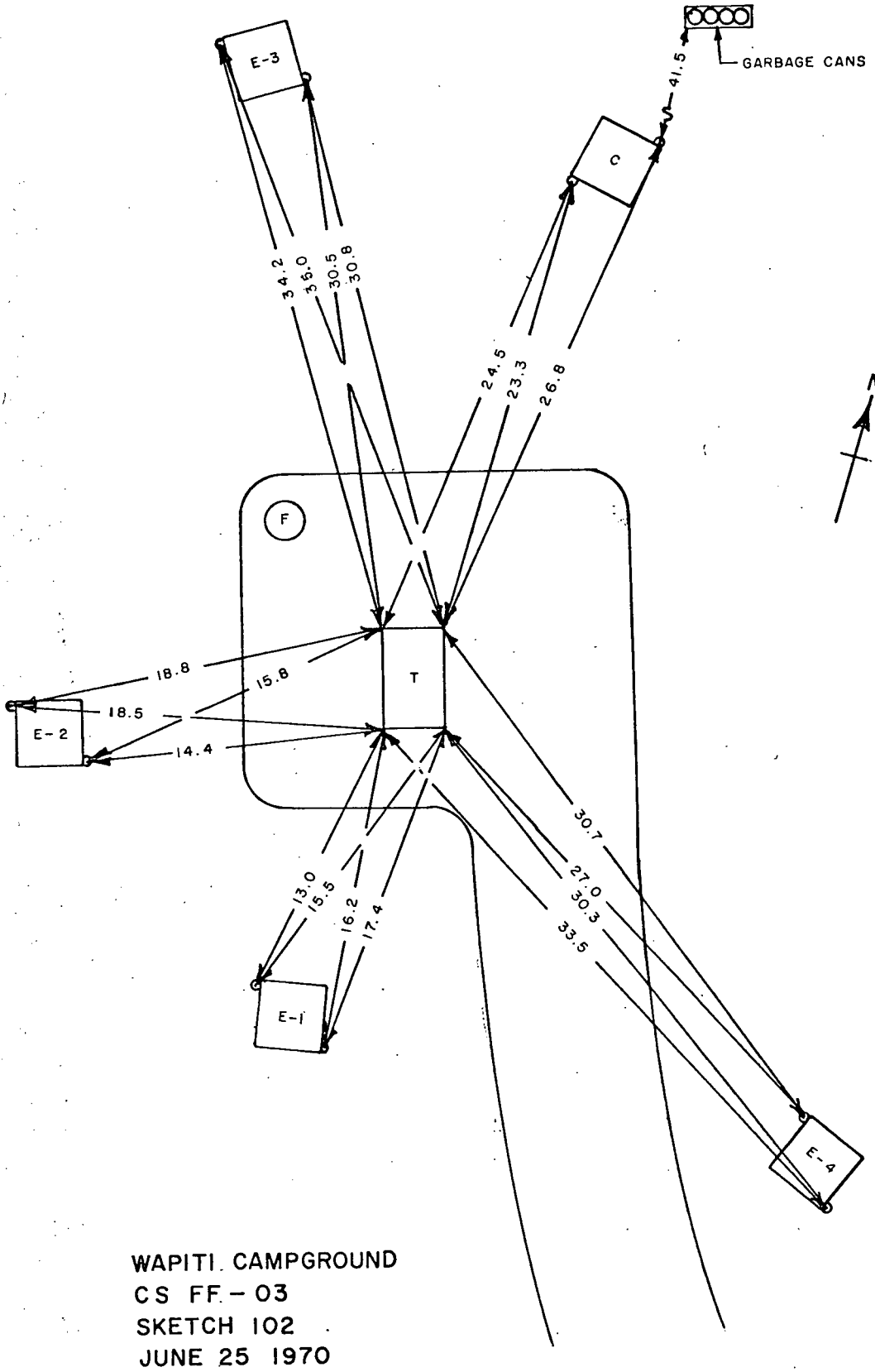
WAPITI CAMPGROUND
TC-5 MAIN ENTRANCE
SK 107
JUNE 30 1970

APPENDIX B



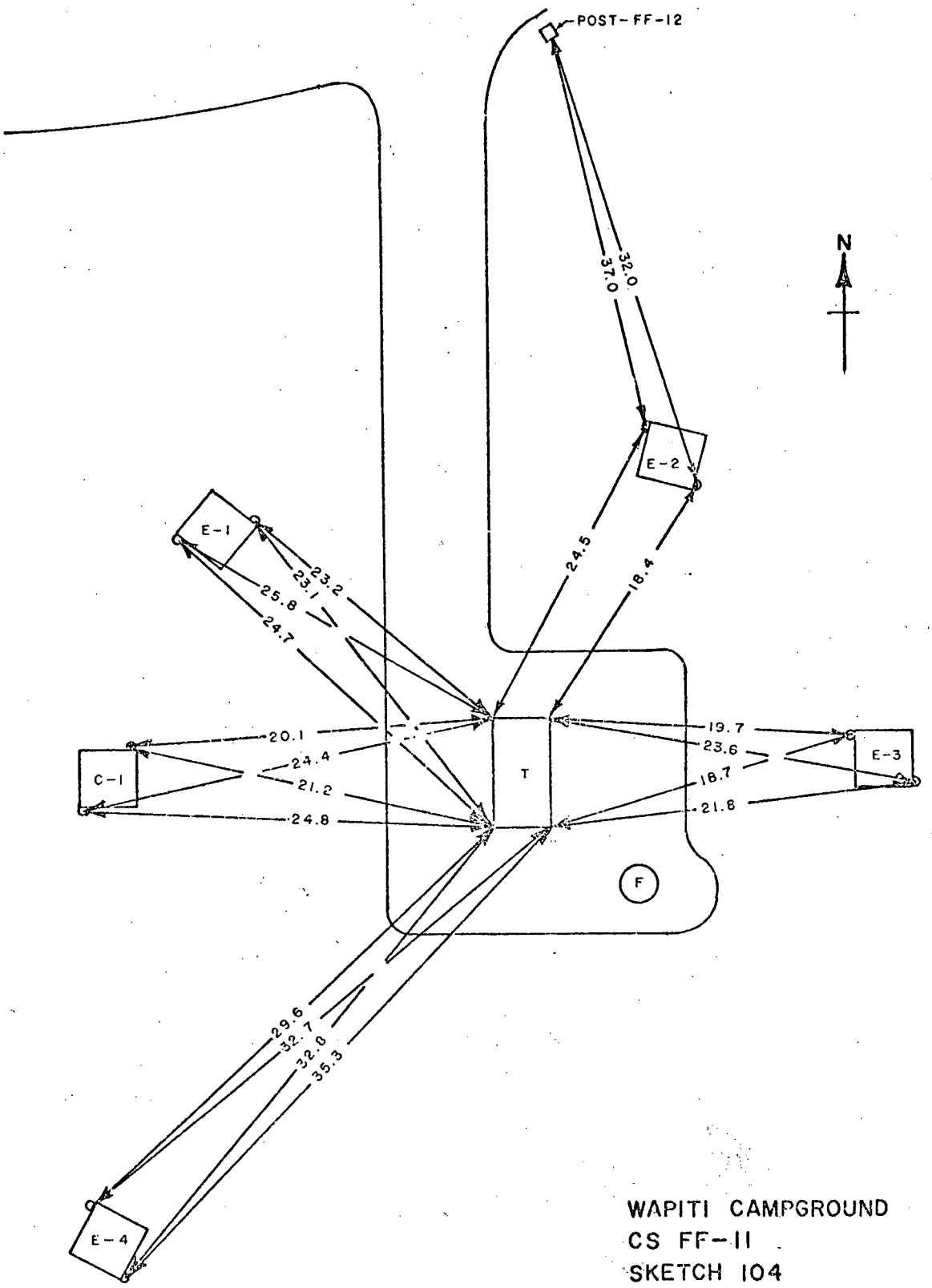
LOCATION SKETCH – TC 3
WAPITI C.G. CIRCLE FF
JUNE 25 1970

APPENDIX B



WAPITI CAMPGROUND
CS FF-03
SKETCH 102
JUNE 25 1970

APPENDIX B



WAPITI CAMPGROUND
CS FF-11
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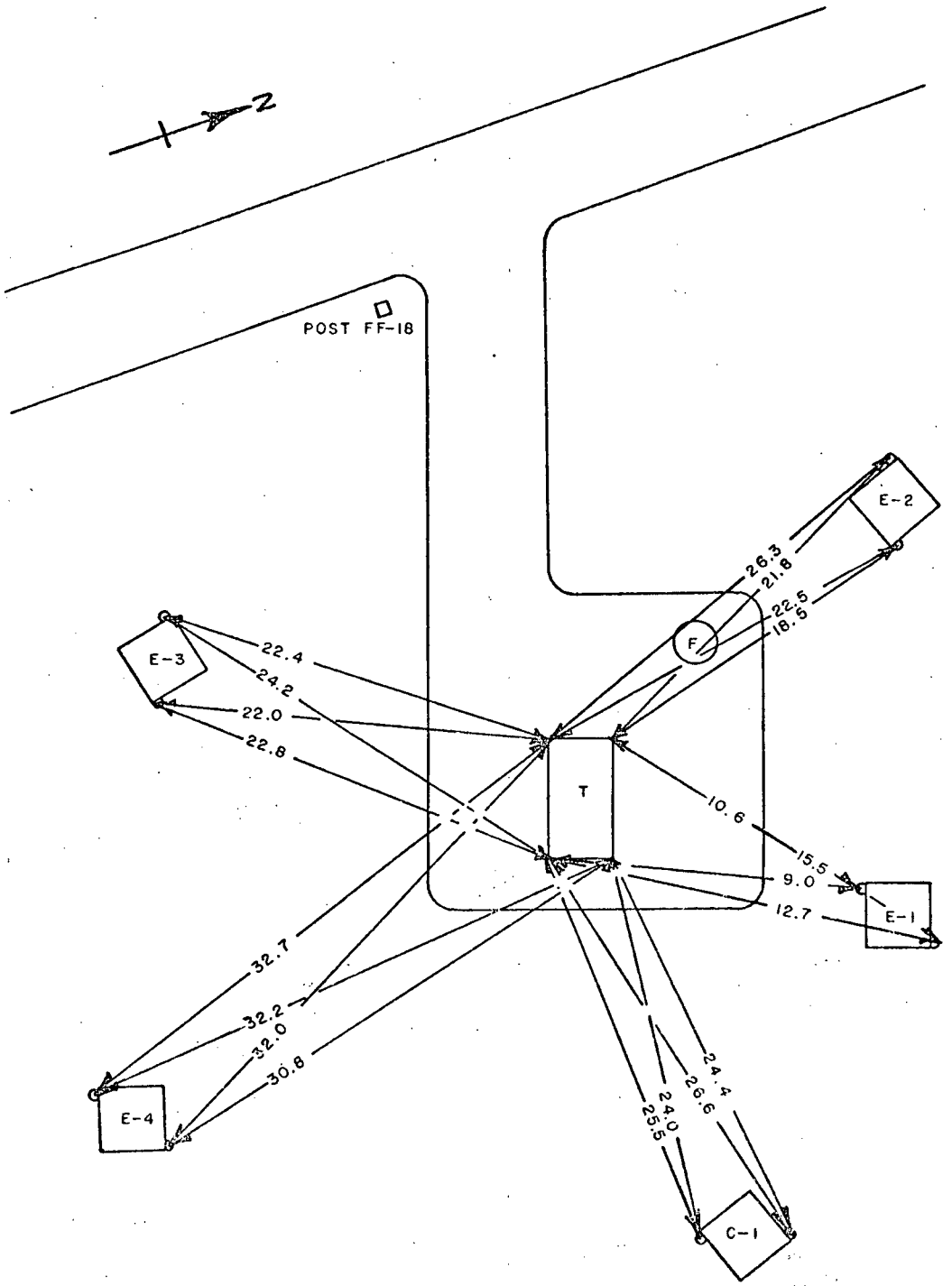
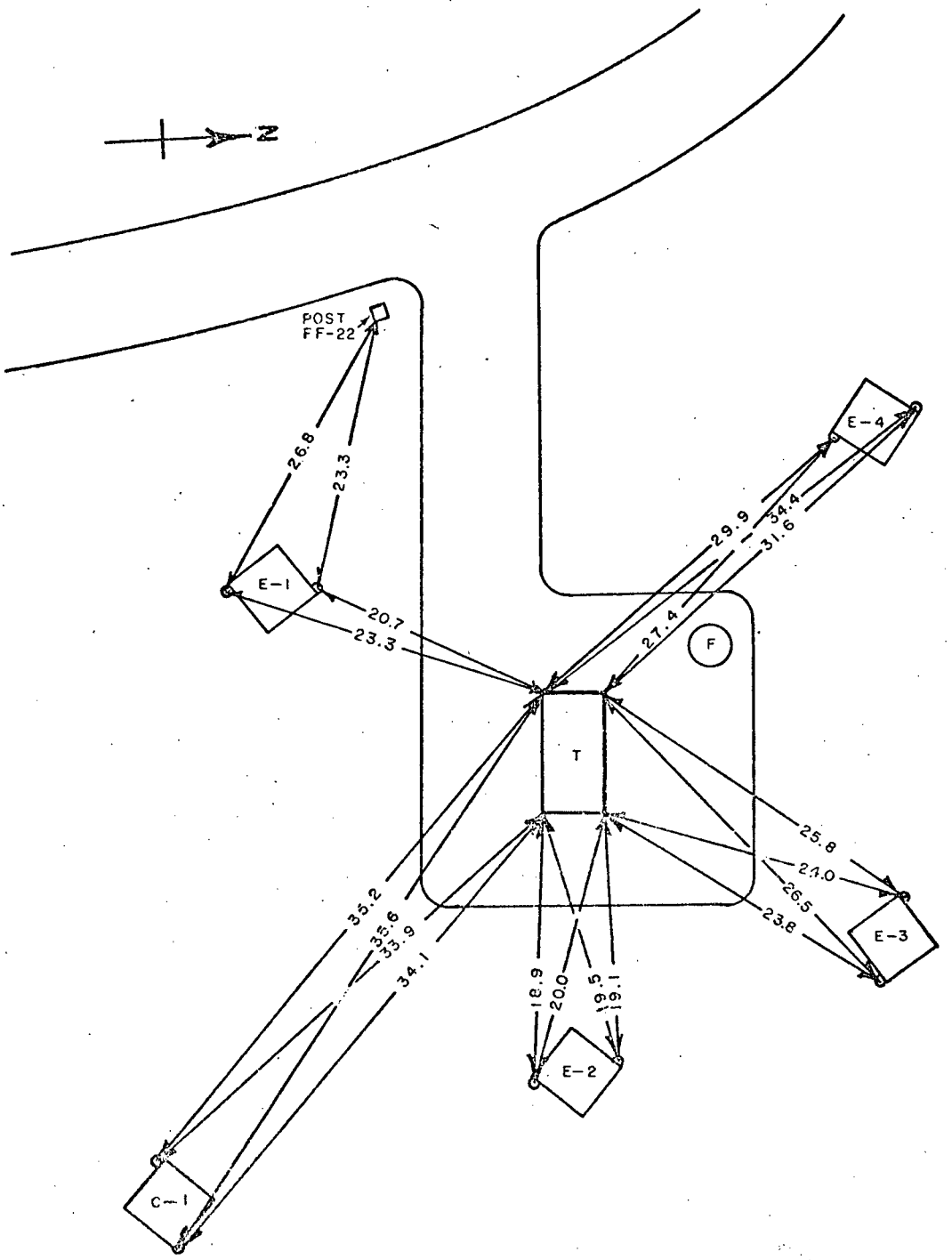
APPENDIX B



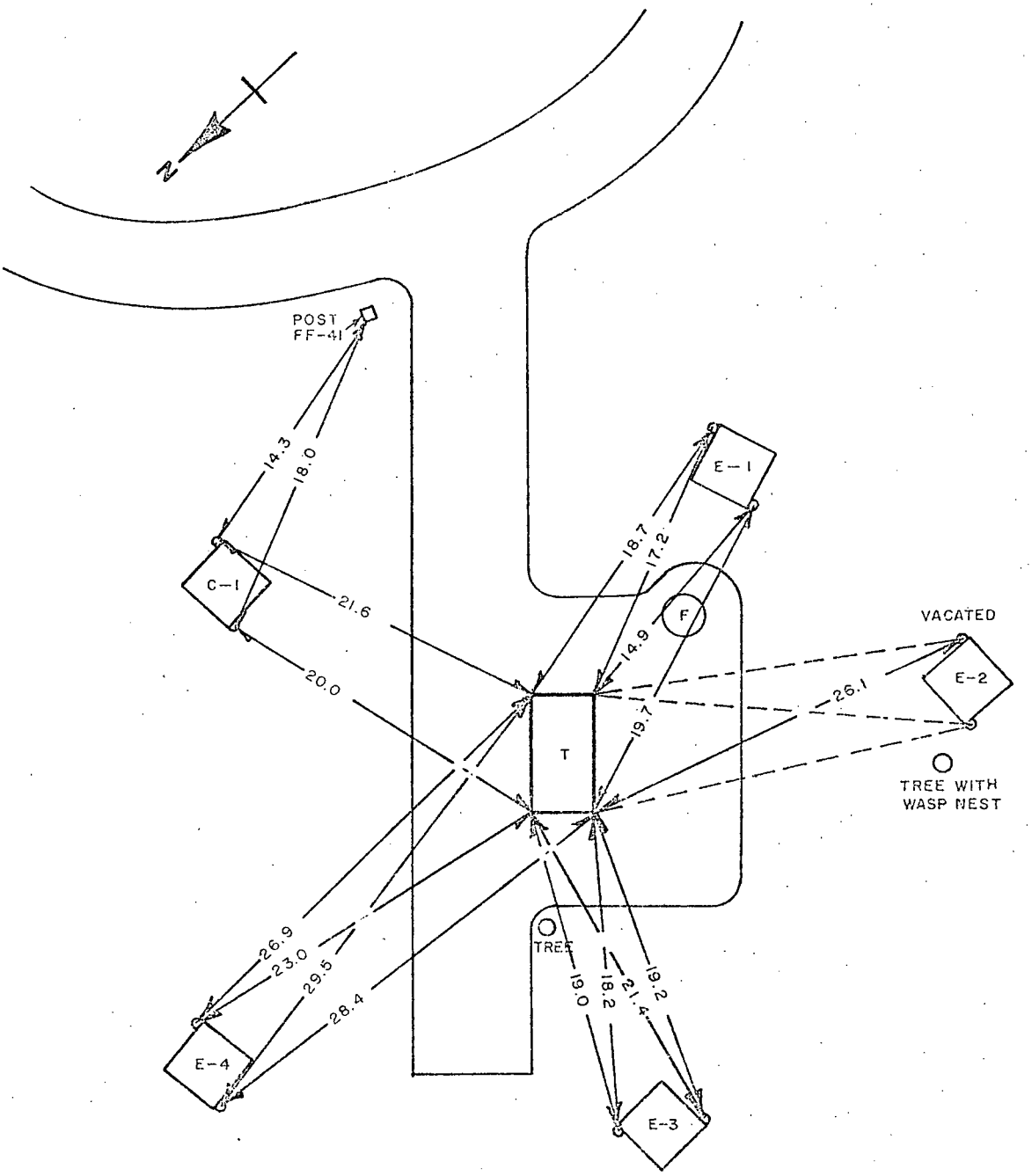
WAPITI CAMPGROUND
CS FF-18
SKETCH 105
JUNE 28 1970

APPENDIX B



WAPITI CAMPGROUND
CS FF-22
SKETCH 106
JUNE 29 1970

APPENDIX B



WAPITI CAMPGROUND
CS FF-41
SKETCH 108
JULY 3 1970

APPENDIX C

JUNE 27, 1970

AUGUST 24, 1970

FIGURE 20

SAMPLE CAMPSITE FF-11, PLOT E-1

APPENDIX C

JUNE 27, 1970

AUGUST 24, 1970

FIGURE 21

SAMPLE CAMPSITE FF-11, PLOT E-4

APPENDIX C

JUNE 27, 1970

AUGUST 25, 1970

FIGURE 22

SAMPLE CAMPSITE FF-11, PLOT C-1

APPENDIX C

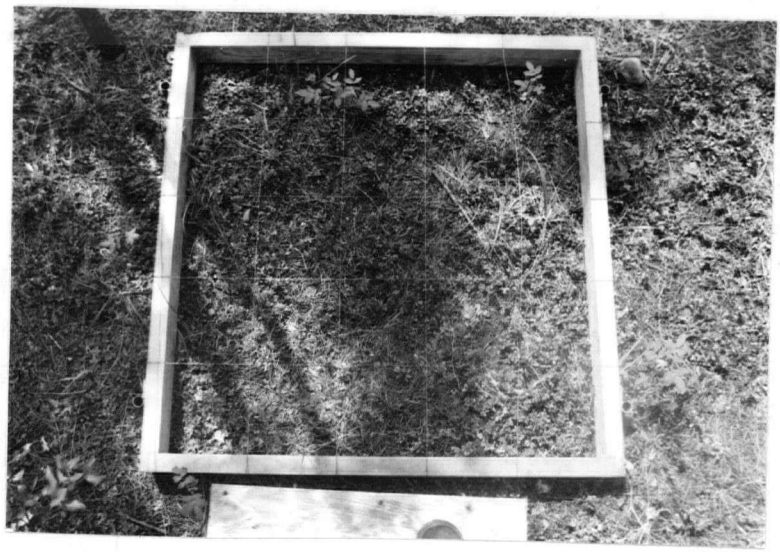
JUNE 28, 1970

AUGUST 25, 1970

FIGURE 23

SAMPLE CAMPSITE FF-18, PLOT E-1

APPENDIX C



JUNE 28, 1970

AUGUST 25, 1970

FIGURE 24

SAMPLE CAMPSITE FF-18, PLOT E-2

APPENDIX C

June 28, 1970

AUGUST 25, 1970

FIGURE 25

SAMPLE CAMPSITE FF-18, PLOT E-3

APPENDIX C

JUNE 28, 1970

AUGUST 25, 1970

FIGURE 26

SAMPLE CAMPSITE FF-18, PLOT E-4

APPENDIX C

JUNE 29, 1970

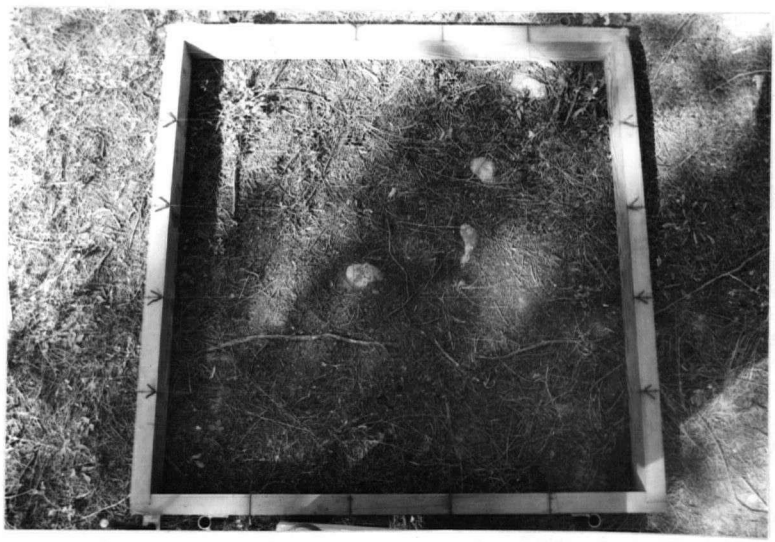
AUGUST 25, 1970

FIGURE 27

SAMPLE CAMPSITE FF-22, PLOT E-2

APPENDIX C

JUNE 29, 1970

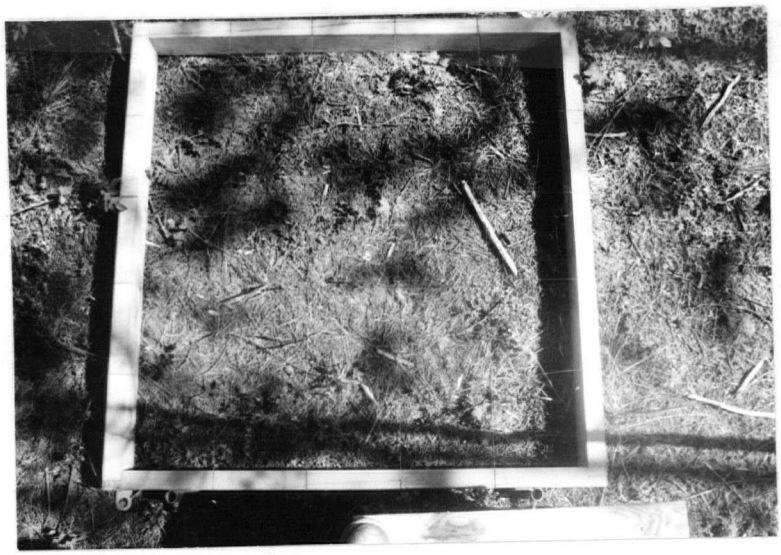


AUGUST 25, 1970

FIGURE 28

SAMPLE CAMPSITE FF-22, PLOT E-3

APPENDIX C



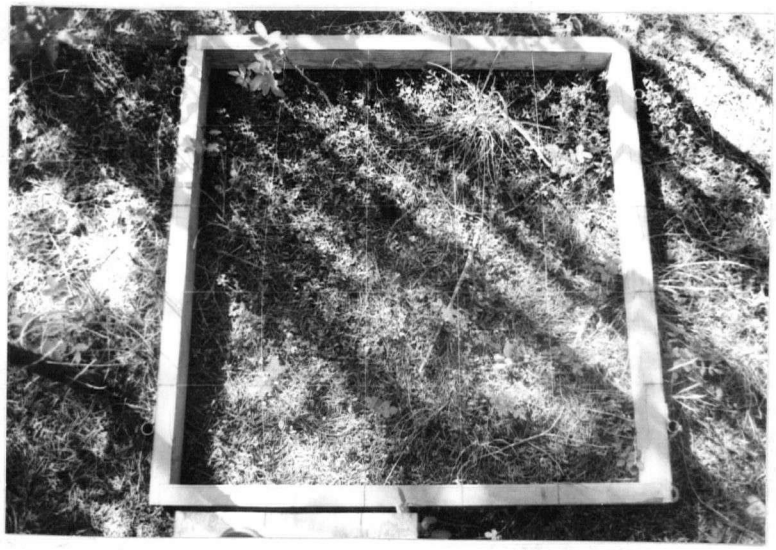
JUNE 29, 1970

AUGUST 25, 1970

FIGURE 29

SAMPLE CAMPSITE FF-22, PLOT E-4

APPENDIX C



JUNE 29, 1970

AUGUST 25, 1970

FIGURE 30

SAMPLE CAMPSITE FF-22, PLOT C-1

APPENDIX C

JULY 3, 1970

AUGUST 25, 1970

FIGURE 31

SAMPLE CAMPSITE FF-41, PLOT C-1

APPENDIX D

TABLE XII

SAMPLE CAMPSITE TRAFFIC AND STUDY AREA TRAFFIC

DURING OBSERVATION PERIODS

Date	Vehicles Entering Sample Campsites						Vehicles Entering Study Area
	FF-03	FF-11	FF-18	FF-22	FF-41	Total	
July 4	1	0	2	1	2	6	95
July 5	0	1	1	3	0	5	82
July 29	0	2	1	0	0	3	52
July 30	0	1	2	0	0	3	60
August 12	1	0	2	0	2	5	70
August 13	0	0	1	2	0	3	56
August 15	1	1	2	2	3	9	109
August 16	1	0	2	0	2	5	88
August 19	0	0	2	1	0	3	40
August 20	0	0	0	0	0	0	30
August 22	0	0	3	0	0	3	43
August 23	0	0	1	1	0	2	25
TOTAL	4	5	19	10	9	47	750

APPENDIX E

TABLE XIII

OCCUPANCY DURING WEEKDAYS AND WEEKENDS

	Sample Site Occupancy					
Sample Period	FF-03 Party Hours	FF-11 Party Hours	FF-18 Party Hours	FF-22 Party Hours	FF-41 Party Hours	Total Party Hours
Weekdays	2.0	31.4	44.4	36.5	3.3	
	16.7	-	44.2	24.9	23.4	
	-	-	22.8	28.1	-	
	18.7	31.4	111.4	89.5	26.7	277.7
Weekends	34.2	47.2	33.8	47.3	42.2	
	41.7	26.5	48.0	40.5	42.7	
	16.8	-	28.5	41.9	-	
	92.7	73.7	110.3	129.7	84.9	491.3
TOTAL OCCUPANCY	111.4	105.1	221.7	219.2	111.6	769.0

APPENDIX E

TABLE XIV

USE DURING WEEKDAYS AND WEEKENDS

Sample Site Use						
Sample Period	FF-03 Party Hours	FF-11 Party Hours	FF-18 Party Hours	FF-22 Party Hours	FF-41 Party Hours	Total Party Hours
Weekdays	2.0	30.9	35.9	26.9	3.3	
	16.7	-	29.6	14.3	19.3	
	-	-	15.2	28.1	-	
	18.7	30.9	80.7	69.3	22.6	222.2
Weekends	30.7	39.5	32.8	41.3	29.3	
	34.7	18.8	31.9	40.0	32.6	
	16.8	-	19.6	30.0	-	
	82.2	58.3	84.3	111.3	61.9	398.0
TOTAL						620.2

APPENDIX E

TABLE XV

OCCUPANCY OF SAMPLE SITES AND WAPITI CAMPGROUND BY NIGHTS AVAILABLE

Sample Site Occupancy

Date	FF-03	FF-11	FF-18	FF-22	FF-41	Total
July 4-5	2	2	2	2	2	10
July 29-30	-	2	2	2	-	6
August 12-13	1	-	2	1	1	5
August 15-16	2	1	2	2	2	9
August 19-20	-	-	1	2	-	3
August 22-23	1	-	1	2	-	4
TOTAL	6	5	10	11	5	37
Total nights Available	-	-	-	-	-	60
Occupancy in Percent						62

WAPITI CAMPGROUND OCCUPANCY

	July	August	Total
Permits Issued[1]	9282	7542	16824
Number of Nights	31	31	62
Available Campsites	10075	10075	20150
Occupancy in Percent	92.1	74.9	82.0

[1]Overflow deducted from total permits issued.

APPENDIX F

TABLE XVI

ORIGIN OF VEHICLES OCCUPYING THE STUDY AREA DURING SAMPLE PERIODS

Origin	Number	Percent	Percent
Alberta	149	53.7	53.7
British Columbia	24	8.7	
Saskatchewan	13	4.7	
Manitoba	1	0.4	20.7
Ontario	18	6.5	
Quebec	1	0.4	
Maritime Provinces	-	-	
United States	71	25.6	25.6
TOTAL	277	100.0	100.0

APPENDIX F

TABLE XVII

MEAN PARTY SIZE OCCUPYING SAMPLE SITES

Sample Campsite	Number of Visitors	Sample Size	Mean Party Size
FF-03	16	6	3.7
FF-11	12	4	3.0
FF-18	32	9	3.6
FF-22	35	10	3.5
FF-41	10	3	3.3
TOTAL	105	32	3.3

APPENDIX F

TABLE XVIII

DISTRIBUTION OF TYPES OF EQUIPMENT USED IN THE STUDY AREA DURING SAMPLE PERIODS

	Number of Units		Percent	
Trailer Equipment				
Tent Trailers	78		28.2	
House Trailers	40		14.4	
Campers and House Trailers	3	121	1.1	43.7
Self-contained units				
Campers	45		16.2	
Vans	9		3.2	
Mobile Home Units	2	56	0.7	20.1
Tents and Other				
Autos	80		26.8	
Station Wagons	17		6.0	
Trucks	2		0.7	
Motor Cycles	2	101	0.7	36.2
TOTAL Number of Units		278		100.0

APPENDIX F

TABLE XIX

HOURLY DISTRIBUTION OF RECREATION AND NON-RECREATION VEHICLES ENTERING THE STUDY AREA DURING OBSERVATION PERIODS[1]

Time	July 29-30		August 12-13		August 19-20		August 15-16		August 22-23		TOTAL	
	RV	NRV	RV	NRV	RV	NRV	RV	NRV	RV	NRV	RV	NRV
8:00-9:00 a.m.		2	5	2	1	2		2	1	3	7	11
9:00-10:00 a.m.	8		4	2	4		4		3		23	2
10:00-11:00 a.m.	2	2	5		3	1	9		4		23	3
11:00-12:00 a.m.			2		2	2	12	2	1	3	17	7
12:00-1:00 p.m.	2		6		4		10		3		25	
1:00-2:00 p.m.	8	4	11	3		1	21	1	2	2	42	11
2:00-3:00 p.m.	8	2	7	3	2	4	14	2	4	1	35	12
3:00-4:00 p.m.	22	4	9	2	4	3	7	3	6		48	12
4:00-5:00 p.m.	18		11	1	6	1	24		7	1	66	3
5:00-6:00 p.m.	20		16		2		30		4		72	
6:00-7:00 p.m.	16		20		8		18		6		68	
7:00-8:00 p.m.	10		12	1	13	2	17	2	9	2	61	7
TOTAL	104	14	108	14	49	16	166	12	50	12	487	68

[1]From original Field Observations.